Private consumption expenditure in the macro-econometric model of the Reserve Bank

by C.J. Pretorius and S. Knox

Introduction

Consumption expenditure by private households absorbs by far the largest part of South Africa's gross domestic product. As a percentage of gross domestic product in the post-1960 era, private consumption expenditure ranged from a low of 50 per cent in 1980 to a high of 61 per cent in 1992. Any attempt to explain the dynamics of the South African economy by means of an econometric model must therefore focus closely on aggregate consumer behaviour. Great care should be taken in formulating and estimating the consumption function to ensure that it captures consumer behaviour as accurately as possible.

This article describes the set of equations in the Reserve Bank's macro-economic model which attempts to explain aggregate consumer behaviour. The first section deals with some theoretical considerations which underpin the estimated consumption equations contained in the model. The second section presents an overview of medium-term trends in private consumption expenditure as it is recorded in the national accounts of South Africa. Subsequent sections deal with the explanatory variables appearing in the behavioural equations and the specification and econometric estimation of these equations. The interest rate sensitivity of private consumption expenditure is then discussed briefly before some concluding comments are made in the final section.

Private consumption theories

Keynes' formulation of the consumption function can be regarded as an important milestone in the development of macro-economics. Various alternative theories were subsequently proposed, among which Milton Friedman's permanent-income hypothesis, the life-cycle hypothesis of Modigliani, Ando and Brumberg and Duesenberry's relative-income hypothesis. These hypotheses were debated extensively by prominent economists. Although they differ in some respects, modern theory and empirical analyses are usually a combination of the life-cycle and the permanent-income theories.

Keynes' consumption hypothesis

The determination of consumption expenditure is central to Keynesian macro-economic theory[1]. Keynes based his theory of consumer behaviour on the observation that consumption increases when income increases, but not

to the same extent. His theory of consumption is also referred to as the absolute-income hypothesis, in order to emphasise that consumption decisions are based on the absolute amount of current income of individuals. The theory can be stated in three explicit propositions:

- aggregate consumption is a stable function of aggregate disposable income, which implies that the propensity to consume is a fairly stable function;

- the marginal propensity to consume (MPC) is positive and less than one (that is, consumption will increase as income increases, but not by as much as income); and

- as income increases, the average propensity to consume (APC) declines.

The Keynesian theory also postulates that certain types of income may be associated with different marginal propensities to consume. For example, transfer receipts would produce higher marginal consumption responses than income earned.

The Keynesian propositions can be illustrated by the following linear consumption function:

$$C_t = C_0 + bY_t, \text{ with } 0<b<1$$

where
- C = real private consumption expenditure;
- C_0 = constant term representing autonomous consumption that is the proportion of consumption that does not vary with income;
- Y = real disposable income; and
- b = the marginal propensity to consume.

Because the consumption function is linear, the marginal propensity to consume ($\Delta C/\Delta Y$) is constant over time. The marginal propensity to consume is lower than the average propensity to consume (C/Y), causing the APC to decline as income rises and to approach the MPC at very high levels of income. This can be shown with the following algebraic manipulation:

$$APC = \frac{C}{Y} = \frac{C_0 + bY}{Y},$$

which can be simplified as

$$APC = \frac{C}{Y} = \frac{C_0}{Y} + b$$

As disposable income increases, the first term becomes smaller, causing the APC to decline.

[1] Keynes, J.M.: *The general theory of employment, interest, and money*, Harcourt, Brace and World, New York, 1936.

Attempts to forecast aggregate consumer behaviour in the United States of America with the Keynesian consumption function after the Second-World War were characterised by unacceptably high forecast errors. This gave rise to serious doubts about the validity of the proposition of a stable aggregate consumption function.

The constant term was mathematically responsible for the fact that the Keynesian consumption function did not fit time series data. If autonomous consumption is zero, the marginal propensity to consume equals the average propensity to consume and both will be constant for all levels of income. A zero intercept does not, however, help to explain the short-run cyclical fluctuations of the APC. Most subsequent theoretical formulations use a consumption function with a zero intercept to allow for the long-run stability of the APC.

The permanent-income hypothesis
Another important contribution to aggregate consumption theory is the permanent-income hypothesis developed by Milton Friedman in the mid-1950s[2]. The basic notion underlying the concept of the permanent-income hypothesis is the proportionality between permanent consumption and permanent income. Permanent income is defined as the income generated by an individual's total wealth. Total wealth includes human capital which is the stock of inborn physical and mental capabilities, knowledge and training that enables an individual to earn labour income. Permanent income takes into account a longer time horizon than the current period, i.e. the level of income that can be expected to persist in the long run.

Friedman argues that consumption has two components: a permanent or planned component based on budget planning, habits and current needs; and a transitory erratic component based on caprice, chance occurrence and random phenomena. The transitory component fluctuates around zero, while the permanent component of consumption is a constant fraction of the household's permanent income. The relationship between permanent consumption and permanent income can be expressed as follows:

$$C(P) = gY(P)$$

where C(P) represents permanent consumption and Y(P) permanent income.

The fraction g can be regarded as the long-run MPC. Seeing that there is no intercept, it is also the APC and is constant as income grows over time. The actual fraction of permanent income that is consumed depends, among other things, on:

- the preference for future consumption as opposed to current consumption;

- the opportunity costs of current consumption; and

- the uncertainty about future needs and wants.

Readily available data for the empirical verification of the permanent-income hypothesis do not distinguish between a permanent and a transitory component. Estimated consumption data are the product of optimising decisions and unplanned occurrences of the past and do not correspond to the theoretical concepts of permanent and transitory income. The observed data on consumption and income are of an *ex post* nature and are not *ex ante* concepts as are the theoretical concepts.

In the absence of observed totals on permanent and transitory income, the empirical estimation of consumer behavioural equations requires that realistic assumptions be made on the evolution of these two concepts over time. Permanent income is usually approximated as a weighted average of current and past income levels. Current income will normally have the highest weight and lower weights will be assigned to historical levels of income. This approach assumes that households' expectations are heavily influenced by their recent experience. This can be illustrated in the following way:

$$y_t(P) = \sum_{i=0}^{N} w_i y_{t-i}$$

where N indicates the length of the time horizon and w_i the weights attached to the current and past income levels.

The equation can be estimated once the length of the income lag has been specified. The estimation can be simplified by specifying a weighting scheme, e.g. the weights w_i can be assumed to follow an exponentially declining path:

$$w_i = (1-\lambda)\lambda^i, \text{ with } 0<\lambda<1 \text{ and } \sum w_i = 1$$

If the weights are specified in this manner, the consumption function is reduced to:

$$C_t = (1-\lambda)Y_t + \lambda C_{t-1}$$

Some caveats must be added to the permanent-income hypothesis. The hypothesis stipulates that consumption is proportional to permanent income. This implies that positive transitory income is not spent, but saved. The permanent-income hypothesis, by not taking transitory income into account when spending decisions are taken, may therefore suggest a slower reaction to exogenous changes than might actually be the case.

Currently, some research work on consumption theory involves alternative methods of estimating permanent income.

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2   Friedman, M.: *A Theory of the Consumption Function*, Cambridge, MA.: National Bureau of Economic Research, 1957.

Life-cycle hypothesis

A theory of consumer behaviour which has had a strong influence on economic thinking over the past three decades was developed by Modigliani and Ando (1963)[3]. Like Friedman and Duesenberry they used the analysis of individual consumer behaviour as a basis for their aggregate consumption function. Contrary to Friedman, who argued that the horizon over which economic agents make their decisions can be determined empirically from available statistical data, they assumed that the horizon over which consumers make their spending choices stretches over the expected lifetime of the consumer. The consumption theories that were based on this assumption are generally referred to as the life-cycle hypotheses of consumer behaviour. The constraint on consumption according to the life-cycle theory is wealth rather than income.

The basic premise of life-cycle theory is that utility is maximised by smoothing consumption over time. Assumptions on lifetime income are used to make rational consumption choices. Labour income normally increases during the early part of the life cycle, levels off during the worker's mature working years, and then drops at retirement. The life-cycle hypothesis states that earnings will be allocated in such a manner that an even flow of consumption can be sustained over the course of the consumer's life. Savings in the middle years must be sufficient to pay back any borrowing for consumption early in the life-cycle and to provide income for consumption during retirement. The MPC for the economy as a whole will depend inter alia on the preferences and age of consumers and on interest rates. Interest rates determine the growth of wealth and the allocation of income between current and future consumption. Consumption is expected to vary inversely with interest rates; current consumption will be reduced when interest rates are high in order to save for future consumption.

Total wealth (Wo) can be defined as the sum of current asset holdings (Ao) plus current labour income (Yo) plus the present value of expected future labour income (Y^e). This can be written as:

$$Wo \ = \ Ao + Yo + \sum_{i=1}^{N} \frac{Y_i^e}{(1+r)^i} \ ,$$

where N is the expected lifetime and r is the discount rate, which is assumed to be constant.

The expected future income cannot be measured and some simplifying assumptions must be made before the equation can be estimated. If Y^e is defined as the average discounted expected income level and it is further assumed that expected income is related to current income in the following manner:

$$\overline{Y^e} \ = \ \alpha Yo \ ,$$

then wealth can be written as:

$$Wo \ = \ Ao + Yo + N\alpha Yo$$

If wealth is substituted in the consumption function (Co = kWo), the life-cycle consumption equation can be rewritten as:

$$Co \ = \ kAo + k(1 + N\alpha)Yo$$

If an assumption is made on the average duration of working life (N), then the other two parameters in the equation, k and α, can be estimated.

In contrast to the Keynesian consumption function where the ratio of consumption to income declines as income increases, this ratio will be stable in the life-cycle consumption function as long as the ratio of labour income to national income remains fairly stable. Empirical evidence shows that this ratio has been relatively constant over time.

Fluctuations in income will have little impact on current consumption or expected lifetime income, because consumption decisions depend on lifetime income. The long-run APC should be relatively constant since the aggregate APC depends on the demographic profile of society, which changes only gradually over time.

Criticism against the life-cycle hypothesis is that in real life a vast number of people do not base their consumption decisions on lifetime income, but rather use current income as an indicator of their capacity to consume. Especially younger people find it hard to base current decisions on lifetime income because they may find it difficult to borrow. The gap between measured consumption and desired consumption is expected to be greater among younger people. The fact that lifetime income cannot be measured and has to be estimated from data on current income, can also be regarded as a major shortcoming of this hypothesis.

Duesenberry's relative-income hypothesis

Duesenberry postulated his relative-income hypothesis[4] on two observations, namely that:

- household consumption behaviour is influenced by the spending habits and spending levels of other families; and

- consumption behaviour tends to be habitual (that is, once people become used to a certain standard of living they try to maintain that standard, despite a decline in income).

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[3] Ando, A. and Modigliani, F.: "The life-cycle hypothesis of saving: Aggregate implications and tests", *American Economic Review*, Volume 53, March 1963.

[4] Duesenberry, J.S.: *Income, saving and the theory of consumer behaviour*, Cambridge, MA.: Harvard University Press, 1949.

The theory formed on these notions states that consumption depends on both current income and the highest income attained by the consumer in the past. It is argued that the Keynesian consumption function is stable only in the short run. In the long run other factors on which consumption depends may change, thus violating the stable relationship between consumption and income.

Duesenberry believes that consumers respond differently to income increases than to income decreases; families find it difficult to lower their standards of living and may experience difficulties to adjust to a decrease in income. If household income exceeds its previous peak, consumption will adjust to the higher level of income according to a proportional relationship. On the other hand, if household income falls below its previous peak, consumption will react more gradually to the change in income and will fall less than proportionately to the reduction in income. Duesenberry assumed that the highest previous peak-income would be revised upwards after every cyclical expansion in a growing economy, but that it would not be revised downwards – the so-called ratchet effect.

People in lower-income brackets are assumed to spend most of their income in an effort to demonstrate that they are better off than they really are; this will result in high APCs. People in the upper-income brackets will tend to have lower APCs; they are likely to save a large proportion of their income and still maintain a high standard of living. Duesenberry referred to this kind of behaviour as the demonstration effect.

Duesenberry's relative-income hypothesis did not have the same lasting impact on the analysis of consumer behaviour as some of the other theories, partly because it only explains non-proportional consumption when income is below past peaks, and also because aggregate income has seldom fallen below past peak income for any length of time. However, Duesenberry's theory demonstrates that economic behaviour can be asymmetrical and intertemporally dependent.

Medium-term trends in private consumption expenditure in South Africa

Growth trends
When analysing growth trends from the national-accounts data, it is important to note that consumption, as defined in an economic sense, differs from consumption expenditure as measured in the national accounts. Consumption refers to benefits derived from expenditure on goods and services, whereas consumption expenditure is defined as the actual expenditure on goods and services, irrespective of whether such goods are really consumed in the accounting period. This distinction is particularly relevant in the case of the purchases of durable consumer goods where consumption expenditure is measured in the period in which the goods are acquired, but consumption

Graph 1: The growth in real private consumption expenditure

1960 63 65 67 69 71 73 75 77 79 81 83 85 87 89 91 93
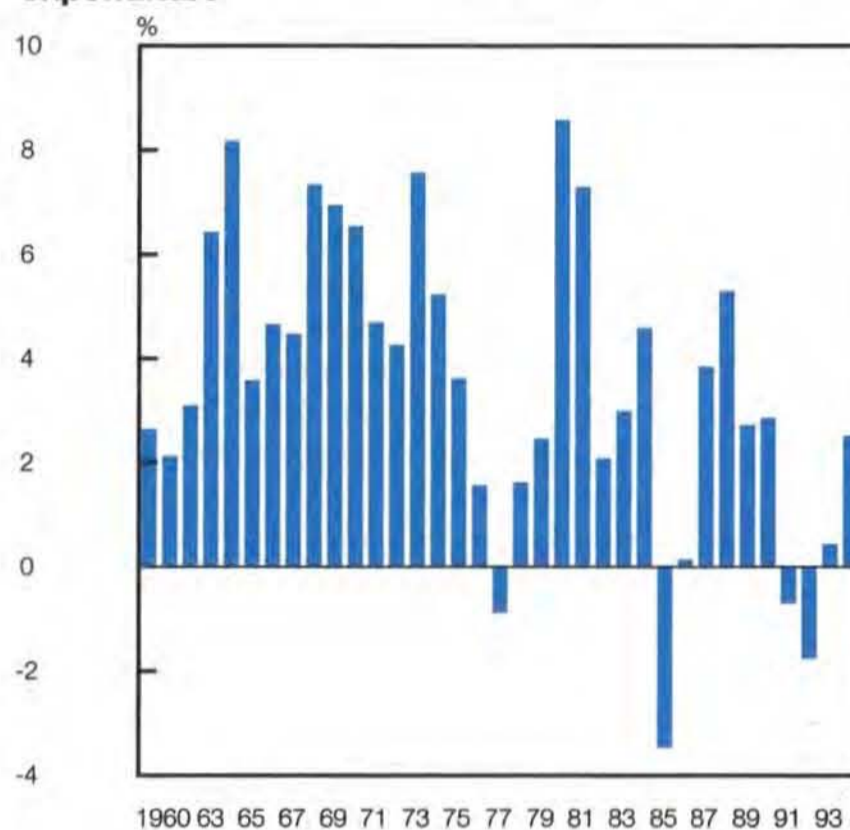
takes place over the entire economic life-span of the goods in question.

Total real private consumption expenditure, as measured in the national accounts, has increased at an average annual growth rate of 3,6 per cent since 1960. However, during this fairly long period the average growth rate in households' real outlays on consumer goods and services decelerated considerably from an average of 5,0 per cent in the 1960s to an average of less than 1 per cent in the early 1990s.

Table 1 shows the changes in the growth rates of the components of real private consumption expenditure over the last few decades. Apart from expenditure on services, the deceleration in aggregate private consumption expenditure occurred in all the components of consumption expenditure. Cutbacks in households' real outlays on consumer goods did not only take place in the case of durables, which normally reflect expenditure of a more discretionary nature, but also in the case of expenditure of a more essential nature. The growth in real spending on non-durable goods actually turned negative in the period from 1990 to 1994.

Cyclical changes
Real private consumption expenditure exhibits clearly defined short-term cyclical movements. Graph 2 indicates that changes in real consumption expenditure on durable and semi-durable goods is more subject to cyclical variation, whereas real

Table 1. Growth rates in the components of real private consumption expenditure
Per cent

	Durables	Semi-durables	Non-durables	Services	Total
1961-1969......................	8,0	7,9	5,4	2,9	5,0
1970-1979......................	4,5	3,8	3,8	3,3	3,7
1980-1989......................	1,5	3,9	3,2	4,6	3,4
1990-1994......................	0,4	1,3	-0,3	2,0	0,7
1960-1994......................	3,9	4,5	3,4	3,6	3,6

consumption expenditure on non-durable goods and services tends to change more smoothly. As emphasised by Duesenberry, once people have grown accustomed to a certain standard of living, they will try to maintain their consumption levels despite fluctuations in their income. Cutbacks in private consumption expenditure are more likely to occur on discretionary items such as durable and semi-durable goods during periods of recession.

Graph 2: Real private consumption expenditure

Shaded areas indicate periods of recession.

1961 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94
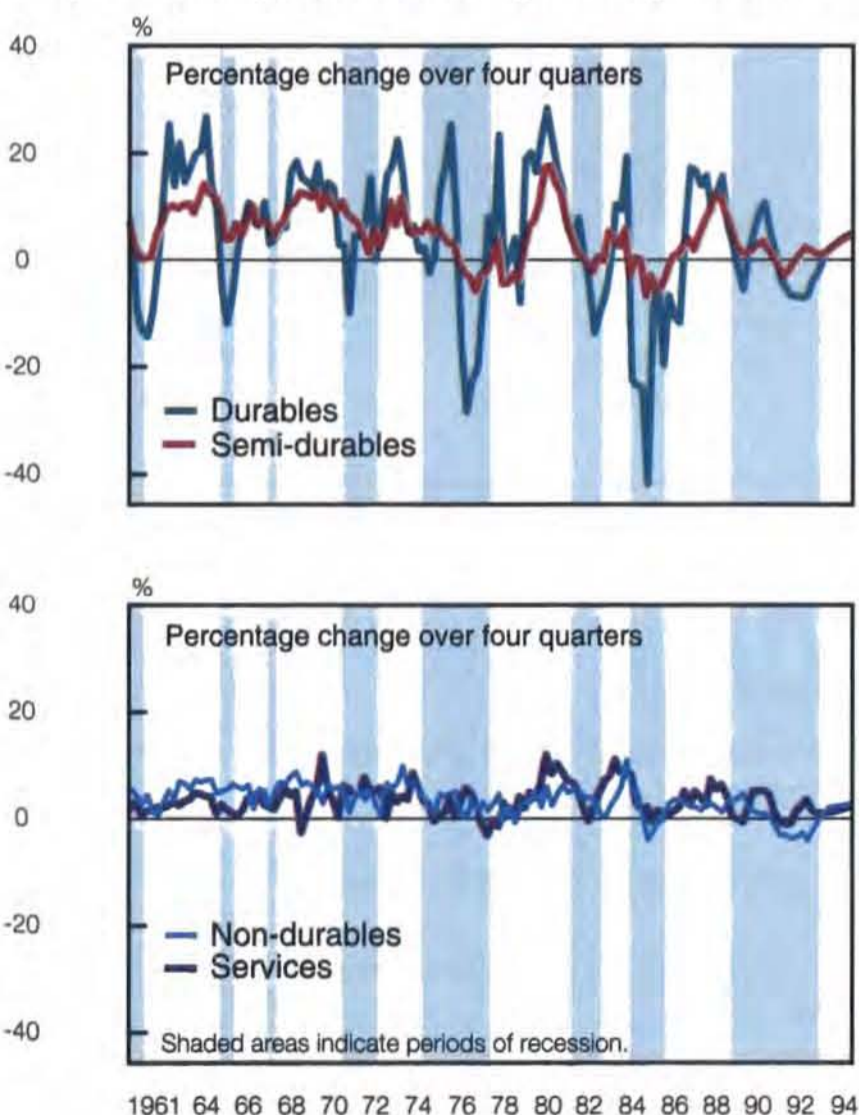
The average propensity to consume

The South African economy has been characterised by a sharply rising trend in households' average propensity to consume (nominal private consumption expenditure relative to nominal personal disposable income). The average propensity to consume is, of course, not the same for all households and may change over time for any specific household. The value of the average propensity to consume of an individual household depends, inter alia, on the average age and composition of the household, fluctuations of income around its mean and the availability and cost of credit. Although the average propensity to consume is usually assumed to be constant over long periods of time, its actual measurement more often exhibits short-term cyclical and other movements. Consumption falls much less than household income during minor recessions and at times even rises when income decreases.

The average propensity to consume rose moderately from 90 per cent in the 1960s to 91 per cent in the 1970s. It then rose sharply to 95,5 per cent in the 1980s and to 97 per cent in the early 1990s. Graph 3 clearly indicates that the changes in the average propensity to consume cannot be regarded as a temporary or cyclical phenomenon but instead reflects a structurally rising ratio.

This persistent rise in the propensity to consume can be attributed to the following factors:

- the persistently high rate of inflation in the 1970s and 1980s, which encouraged households to purchase durable and semi-durable goods in anticipation of future price increases;

- the redistribution of income to population groups with a higher propensity to consume and a lower propensity to save;

- the attempt of households to maintain living standards while real income per capita continues to decrease;

- the relatively easy availability of consumer credit during most of the 1970s and 1980s; and

Graph 3: Average propensity to consume

Graph 4: Proportionate consumption expenditure
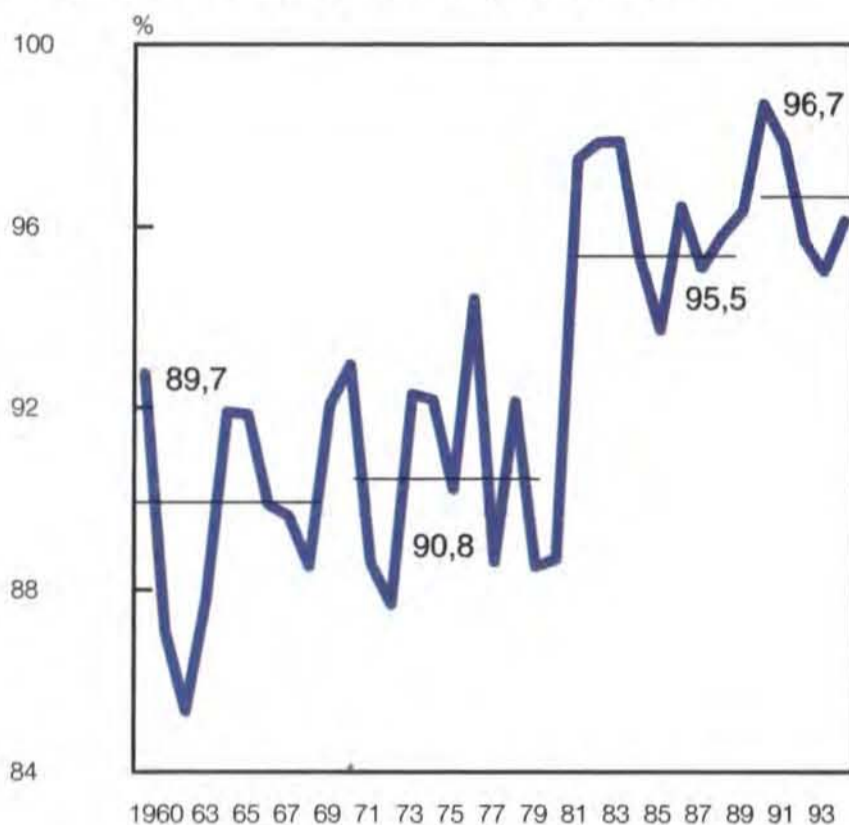
- the rapid growth in the population and the increasing proportion of younger people.

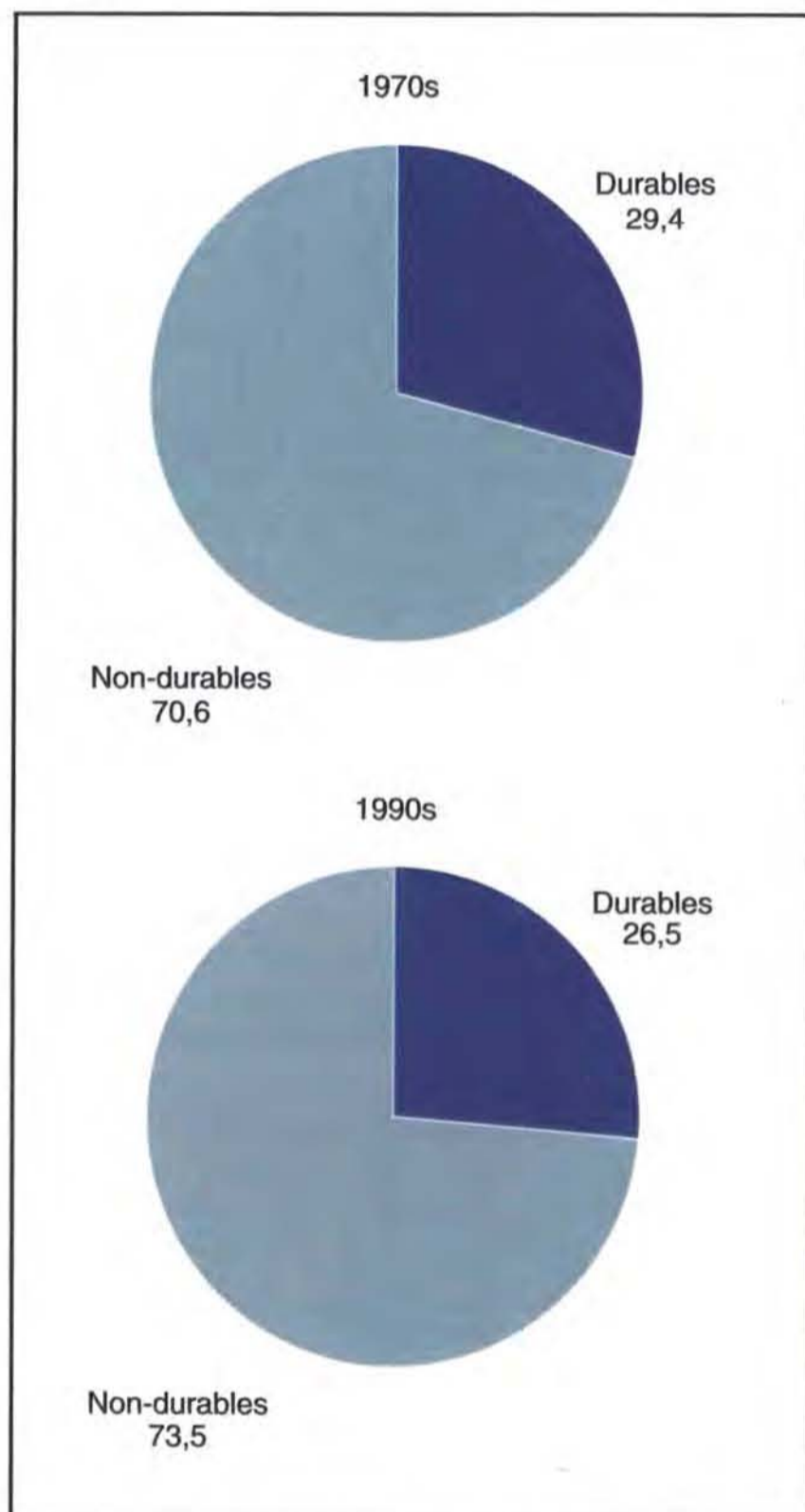### Composition of private consumption expenditure

The proportionate expenditure by households on non-durable goods and services rose sharply from the early 1980s. The ratio of this kind of expenditure to total real private consumption expenditure has increased steadily from about 70 per cent in the 1970s to 72 per cent in the 1980s and further to 73,5 per cent in the early 1990s. The change in the proportionate expenditure by households is illustrated in Graph 4[5].

The declining proportion of consumer spending that has recently been allocated to consumer durables would appear to indicate that spending has been taking place against a backdrop of relatively slow growing and perhaps even declining household income.

Several factors were probably responsible for the shift in consumer spending patterns. These include:

- the redistribution of income in favour of households with low incomes and who spent a larger proportion of income on essential goods and services;

- the relatively high interest rate levels combined with rising levels of outstanding consumer debt, which made consumers less willing to avail themselves of credit for the purchases of durable goods;   •

- the declining per capita income;

- rising unemployment and the lack of job security; and

- the sharp increase in the average personal tax rates which tend to reduce households' disposable income.

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5   "Durables" refer to consumption expenditure on durable and semi-durable goods, while "non-durables" refer to consumption expenditure on non-durable goods and services.

Explanatory variables of the consumption function

The theoretical overview in Section 2 provides a number of possible explanatory variables that can be investigated in the determination of a behavioural equation for describing consumer behaviour. The evolution of household income over the past more than three decades, along with movements in other explanatory variables that can possibly be introduced into the consumption function, is briefly described in this section.

Current income of households

As indicated by Friedman, households' income can be divided into a permanent component and a transitory component which fluctuates more freely. In a national-accounts context, remuneration of employees can be regarded as a more permanent source of income, while income from property reflects more closely the characteristics of temporary or transitory income. Graph 5 illustrates that real income from property is more volatile and fluctuates more than real remuneration of employees[6]. The volatility of income from agricultural activity is perhaps the single most important reason for the variability of household property income.

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6 Nominal income from property and remuneration of employees are deflated by the implicit deflator for private consumption expenditure.

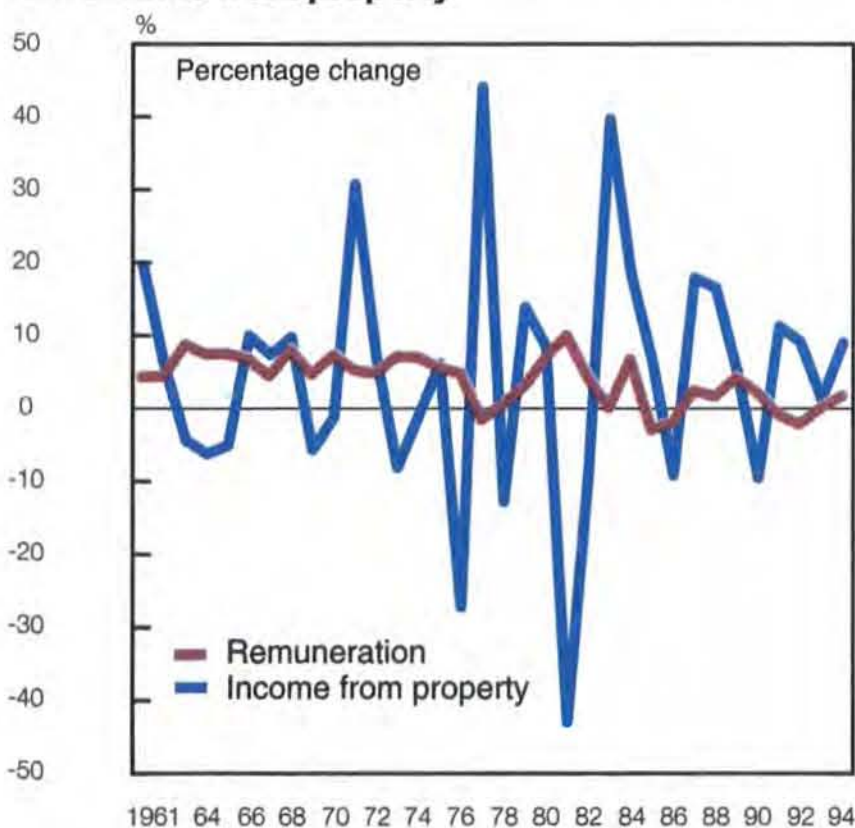### Graph 5: Real remuneration of employees and real income from property

Table 2 shows that the average annual percentage change in real household income has decelerated substantially since the 1960s. This trend was primarily caused by the changes in the remuneration of employees – the biggest component of households' current income. It is noteworthy that the average annual percentage change in income from property did not decrease to the same extent as the growth of real employee remuneration.

Table 3 indicates that the contribution of income from property to current income declined from an annual average of 24,4 per cent in the 1960s to 15,1 per cent in the 1980s. This ratio rose again to 18,9 per cent in the first half of the 1990s, when the growth in employee remuneration slowed down considerably.
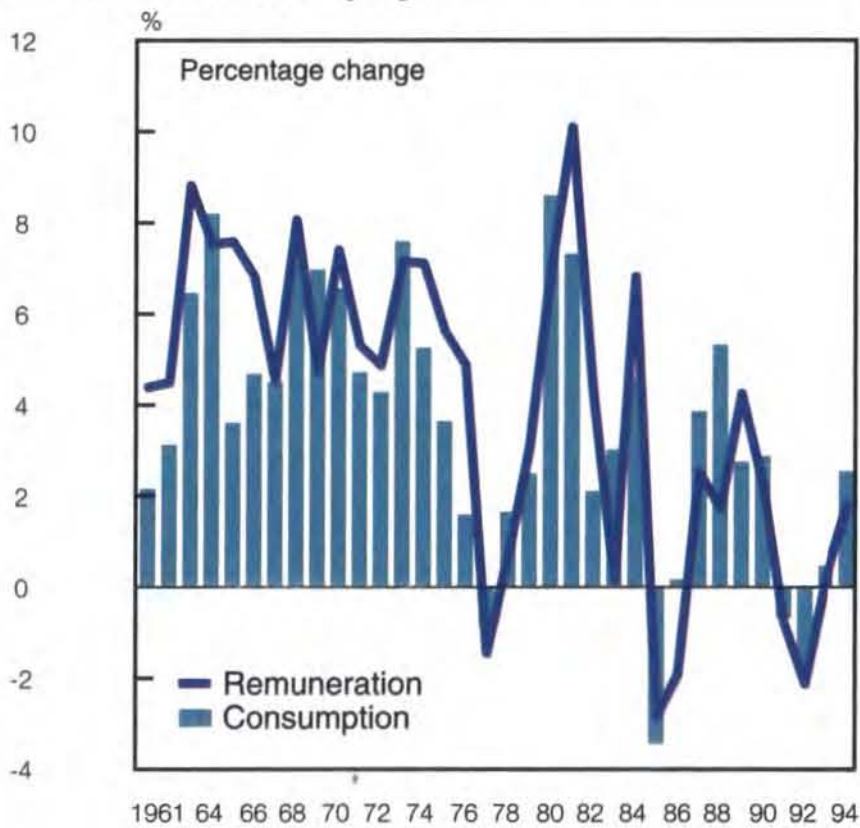
Graph 6 confirms that changes in real private consumption expenditure are more closely related to changes in the remuneration of employees than to changes in the property income of households. The slowdown in real consumption expenditure corresponds fairly closely with the low and negative growth rates of labour income in the early 1990s.
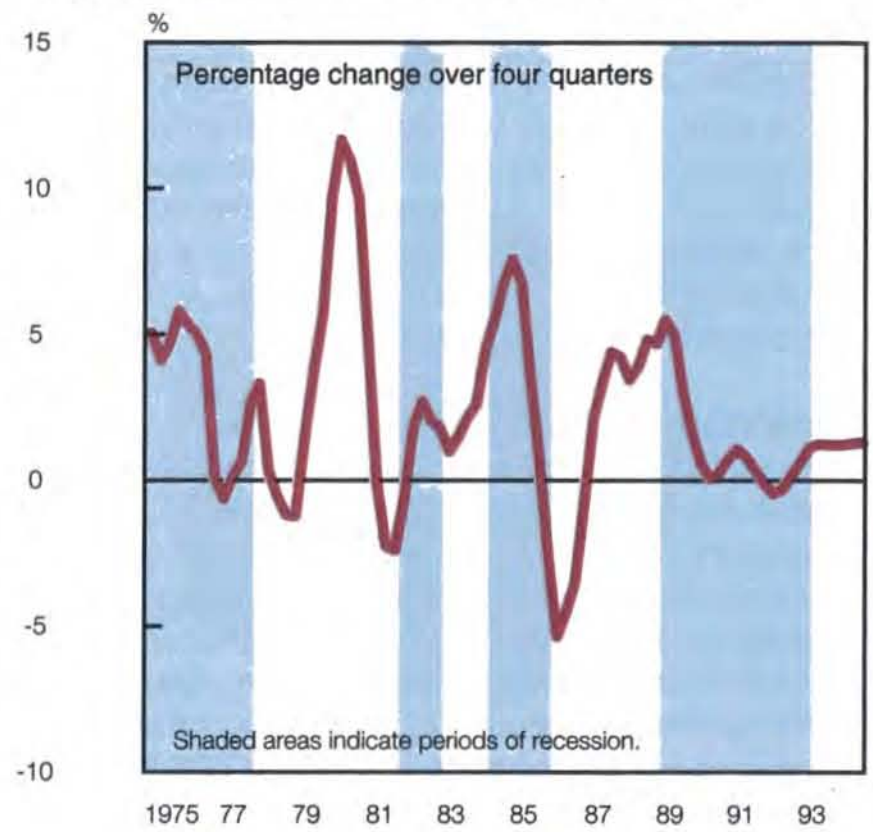
Table 2. Growth rates in the components of real current income

Per cent per year

	Remune-ration of employees	Income from property	Current income
1961-1969	6,3	3,3	5,5
1970-1979	4,5	5,0	4,2
1980-1989	3,2	5,1	3,1
1990-1994	0,3	4,0	1,1
1960-1994	4,0	4,4	3,8

Table 3. Composition of current income

Per cent

	Remune-ration of employees	Income from property	Transfer receipts	Total
1960-1969	71,4	24,4	4,2	100,0
1970-1979	75,8	19,8	4,4	100,0
1980-1989	80,4	15,1	4,5	100,0
1990-1994	75,5	18,9	5,6	100,0
1960-1994	75,9	19,5	4,6	100,0

Graph 6: Real consumption expenditure and remuneration of employees

%

Percentage change

- Remuneration
- Consumption

12 10 8 6 4 2 0 -2 -4

1961 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94

Graph 7: Real personal disposable income

%

Percentage change over four quarters

Shaded areas indicate periods of recession.

15 10 5 0 -5 -10

1975 77 79 81 83 85 87 89 91 93

Growth rates in real personal disposable income decelerated notably from an annual average of almost 5 per cent in the 1960s to less than 1 per cent in the early 1990s. Graph 7 illustrates further that personal disposable income varied with changes in the business cycle, which can be ascribed mainly to the cyclical changes in income from household property. The share of wages in personal disposable income usually increased during recessions and decreased during periods of strong economic activity, tending to add stability to the cycle.

Labour's share of income

The decline in the growth rate of real personal disposal income in the 1990s was partly countered by an upward movement in labour's share of nominal factor income. The average share of labour in nominal factor income increased to 60 per cent in the 1990s after having averaged 57 per cent in the preceding thirty years. The increase in the share of labour remuneration in total income supported real consumption expenditure by households in the early stages of a protracted cyclical downturn which lasted from 1989 tot 1993.

### Direct taxes on households

The ratio of direct taxation to the current income of households increased significantly since the early 1960s and is portrayed in Graph 9. The ratio averaged only 6 per cent per year in the 1960s but then increased to about 10,5 per cent in the 1980s and continued to rise to 14 per cent in 1994. This sharp increase in the direct tax

burden on individuals reduced the disposable income of households and thereby also private consumption expenditure.

Graph 8: The share of labour in nominal factor income

%

65 60 55 50 45

1960 63 65 67 69 71 73 75 77 79 81 83 85 87 89 91 93
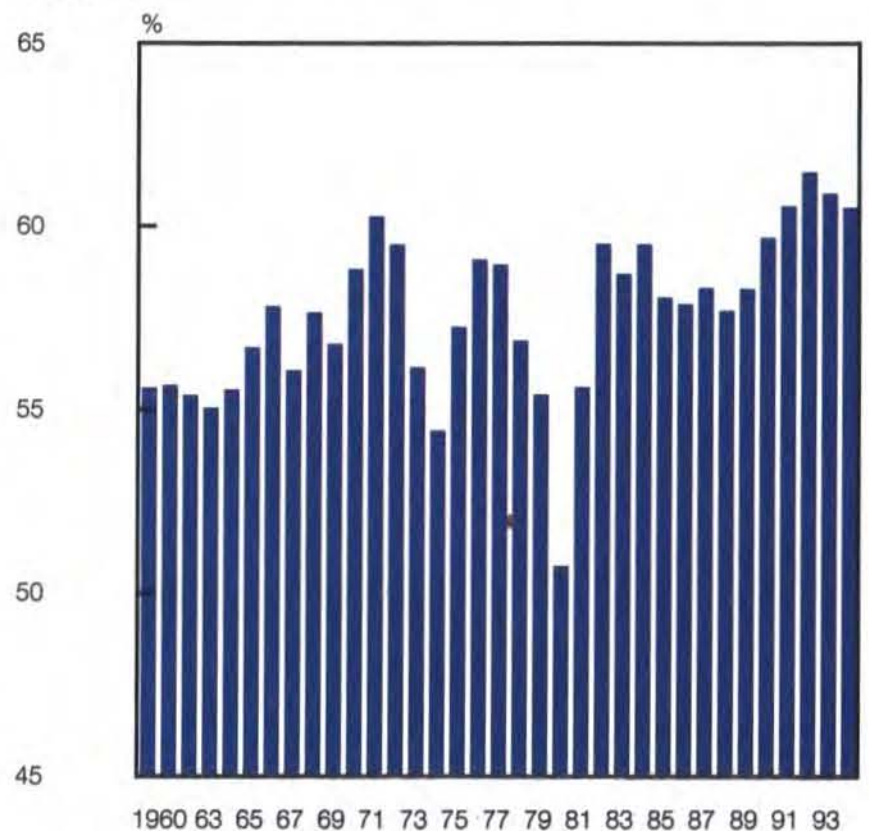
Graph 9: Direct taxation as a percentage of current income
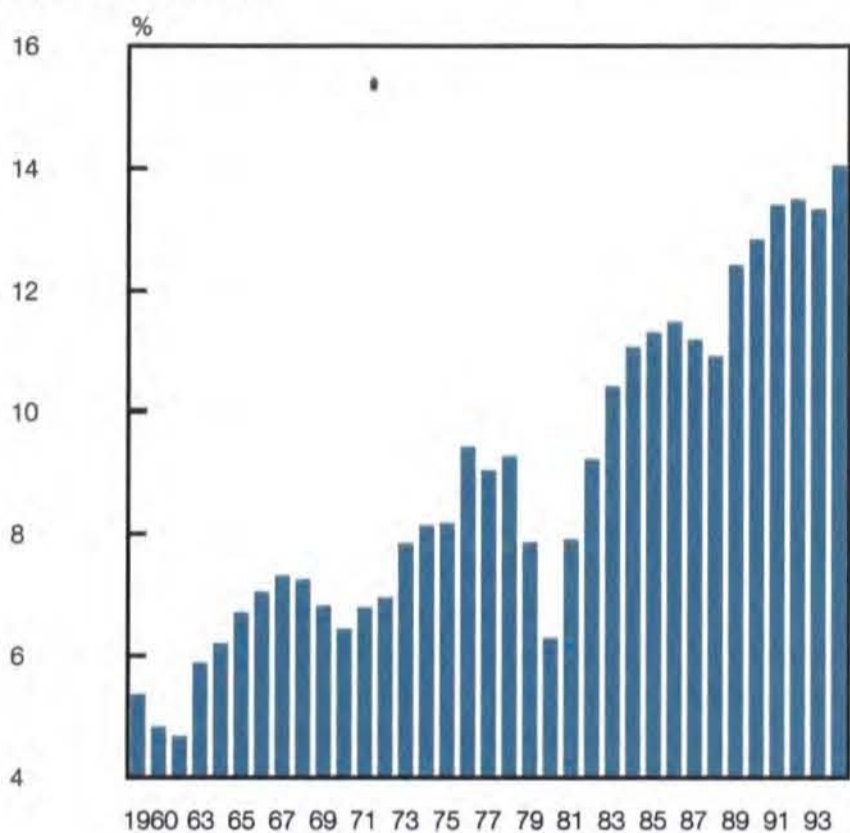
Consumer credit

After having risen sharply in the early 1980s, the growth in consumer credit slowed down in 1985 and 1986 when the supply of credit was affected by the application of strict

monetary policy measures. The use of credit by households started to accelerate again in 1987 and by 1991 it had returned to the high levels of the mid-1980s. Since then consumer credit growth has declined and seems to have stabilised at a lower level. The slower growth in consumer credit in recent years can be ascribed to the already high debt burden of individuals, relatively high interest rates and greater job insecurity. Graph 10 confirms the consistent relationship between changes in outstanding consumer credit and changes in real private consumption expenditure on durable goods. The slower growth in borrowing by households in the early 1990s was reflected in a decrease in durable consumption expenditure.
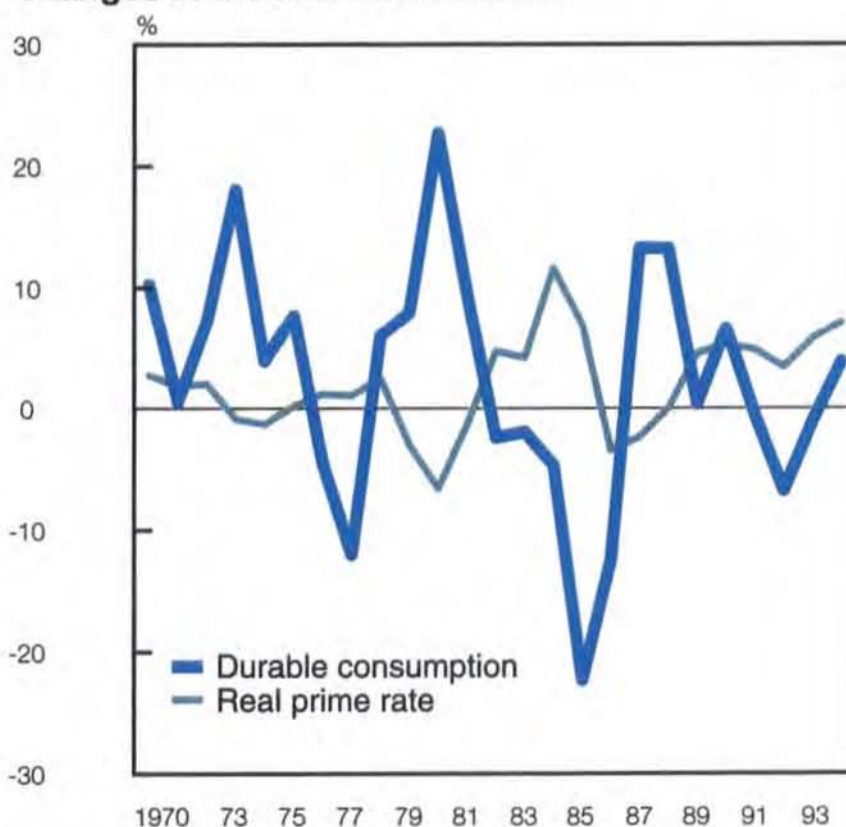
Interest rates

Interest rates indicate the terms of the trade-off between current and future consumption. A rise in the rate of return on accumulated savings increases the opportunity cost associated with current consumption and should raise the savings rate – the substitution effect. On the other hand, the future income stream expected from the higher rate of return on saving may encourage current consumption – the income effect. It is therefore not easy to determine the net effect of a change in interest rates. Graph 11 nevertheless shows that a fairly strong lagged inverse relationship exists between changes in the real interest rate[7] and changes in

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[7] The real interest rate was calculated by subtracting the contemporaneous consumer price inflation rate (as derived from changes in the price deflator for private consumption expenditure) from the nominal prime lending rate of banks.

Graph 10: Outstanding consumer credit and real private consumption expenditure on durable goods
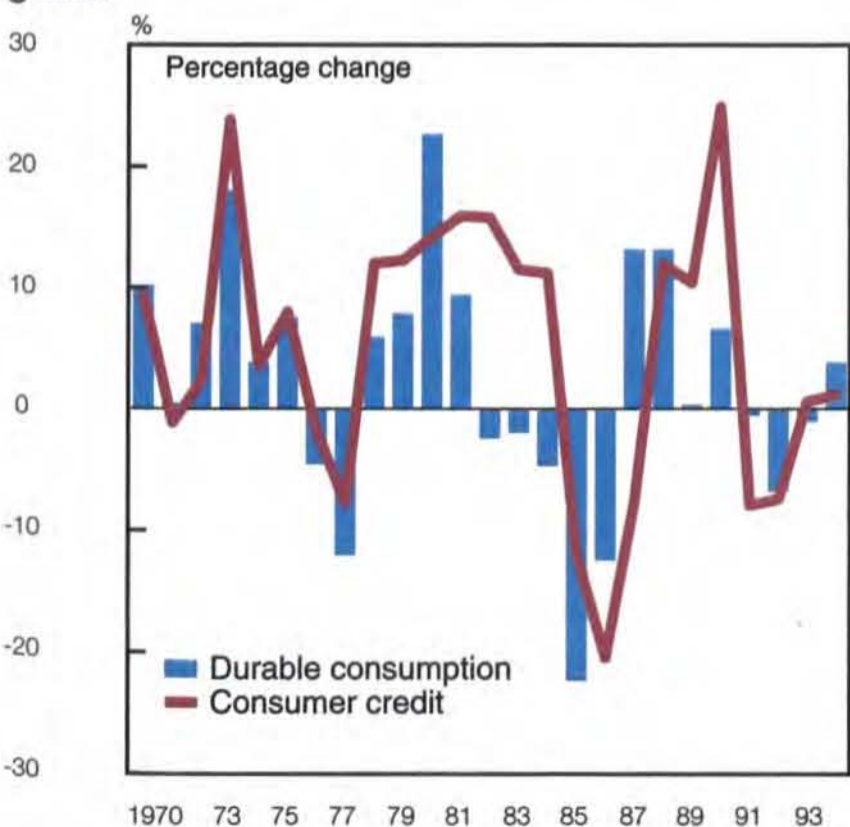
Graph 11: Percentage change in real private consumption expenditure on durable goods and changes in the real interest rate

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 interest rates.

Investment in private residential buildings

Graph 12 shows that changes in real investment in private residential buildings are closely correlated with changes in real consumption expenditure on semi-durable goods. Households' real expenditure on semi-durable consumer goods includes outlays on household equipment such as textiles, furnishings and glassware that usually coincides with the construction of new private residential buildings.

Statistical estimation of the private consumption expenditure equations

The empirical results of the estimated equations are described in this section. All the econometric calculations were carried out with quarterly seasonally adjusted data. T-values of the estimated coefficients as well as the following summary statistics are tabulated:

$\bar{R}^2$ =   adjusted coefficient of determination; and

D-W   =   Durbin-Watson d-statistic.

Graph 12: Real investment in private residential buildings and real consumption expenditure on semi-durable goods

1961 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94
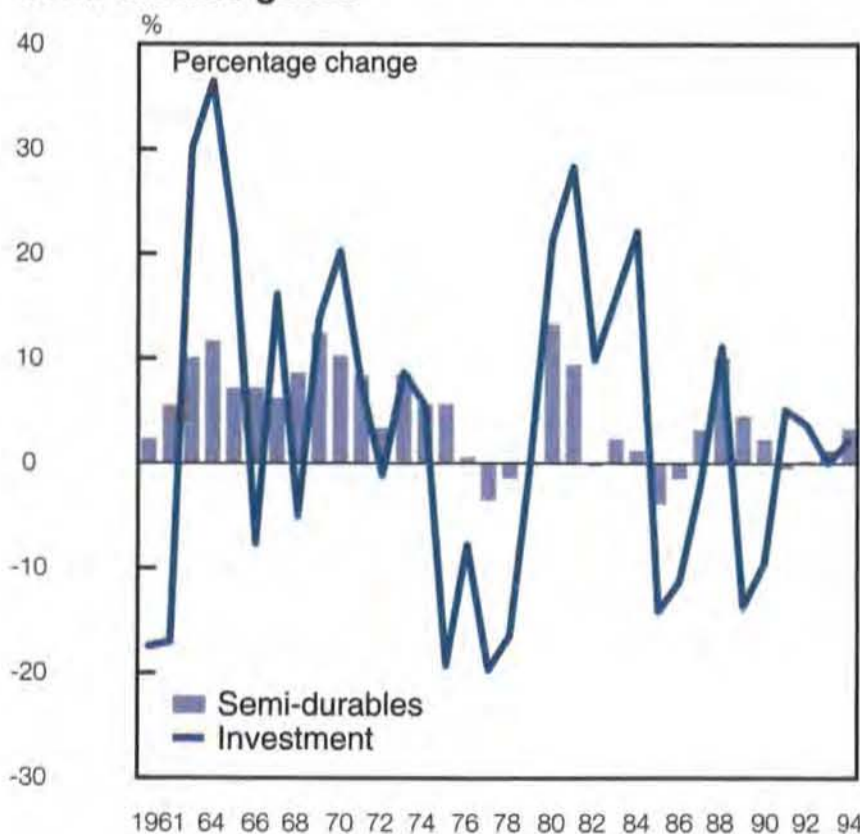
The period of estimation is stated below the summary statistics for each equation.

The equations were specified in logarithmic form in order to ensure that the parameter estimates reflect elasticities. In the case where an explanatory variable contains negative values in the sample period, the transformation to logarithmic form can not be performed. The time series of real interest rates has negative values and the equation for durable consumption expenditure that includes this variable could therefore not be estimated in logarithmic form. All variables used in the estimation of the equations were measured in constant 1990 prices.

The equations were estimated with cointegration techniques consisting of the two-step Engle-Granger procedure[8]. The first step involved the estimation of a long-run equation, supported by relevant economic theory. The order of integration of the variables included in the equation was then determined. In practice few macro-economic time series are stationary in level terms, but most are stationary in first or second differences. The Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) test statistics were used to determine stationarity. The order of integration of the residuals from the long-term equations of all four categories of private consumption expenditure was determined by means of the Phillips Z_t test.

The second step in the estimation process involved the estimation of a short-term equation (error correction model). In many cases the same variables used in the long-term equation were also used as explanatory variables in the error correction model (ECM). Additional dummies and other variables were also included to explain short-run influences, provided they were stationary. The ECM equations were estimated in differences over four quarters and the coefficients of determination ($\bar{R}^2$) were lower than in the case of the long-term equations as a result of large fluctuations in these time series.

The following general notation is used in the specification of the equations:

Δ   =   the percentage change over four quarters in a variable;

L   =   the subscript indicating the long-term equation;

S   =   the subscript indicating the short-term equation; and

ln   =   the natural logarithm of a variable.

Private consumption expenditure on durable goods (CD)

The following explanatory variables are included in the equation for private consumption expenditure on durable goods:

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8   Engle, R.F. and Granger, C.W.J.: "Cointegration and error correction: Representation, estimation, and testing", *Econometrica*, Volume 55, 1987.

- the real interest rate, defined as the prime lending rate minus the inflation rate (RI);

- a dummy for the introduction of general sales tax in 1978 and the increase in the sales tax rate in 1984 from 7 to 10 per cent (GSTD)[9]; and

- real tax-adjusted remuneration of employees together with transfer payments received from the general government, as a measure of permanent income (YP).

Various measures of wealth such as liquid assets, personal savings and the capital stock of private residential buildings were used in the specification of the function for private consumption expenditure on durable goods. However, none of these were found to be statistically significant.

Long-term equation

$$CD_L = B1 \cdot YP + B2 \cdot RI + B3 \cdot CD(-1) + B4 \cdot GSTD$$

COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,026	4,23
B2	-22,895	4,21
B3	0,891	23,35
B4	827,938	8,87

$\bar{R}^2$ = 0,913
D-W = 1,76
Sample period = 70:q1 - 94:q4
Phillips Z_t statistic = -7,60
[Critical value = -4,67 (1% level)]

Short-term equation

The dependent variable in the short-term equation is the change over four quarters in private consumption expenditure on durable goods (ΔCD). All the explanatory variables in the equation represent the change over four quarters in the variables. In addition to the variables used in the long-term equation, real tax-adjusted household income from property (ΔYT) is included in the equation as an approximation for transitory income.

$$\Delta CD_S = B1 \cdot \Delta YP + B2 \cdot \Delta YT + B3 \cdot \Delta RI + B4 \cdot \Delta CD(-1)$$
$$+ B5 \cdot GSTD + B6 \cdot [CD_L - CD(-4)]$$

COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,096	3,25
B2	0,033	1,72

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[9] In order to account for the effect of pre-emptive buying, a value of 1 is assigned to the dummy in the quarter before the change in the tax rate becomes effective. A value of -1 is assigned to the dummy in the quarter in which the change takes effect. The algebraic sign of this variable is expected to be positive.

B3	-21,727	2,52
B4	0,754	11,17
B5	833,951	6,11
B6	0,904	5,61

$\bar{R}^2$ = 0,72
D-W = 2,16
Sample period = 71:q1 - 94:q4

The actual and fitted values of the equation for private consumption expenditure on durable goods are compared in Graph 13.

Private consumption expenditure on semi-durable goods (CS)

The following explanatory variables are included in the equation for private consumption expenditure on semi-durable goods:

- real tax-adjusted remuneration of employees together with transfer payments received from the general government, as a measure of permanent income (YP);

- real tax-adjusted household income from property as a measure of transitory income (ΔYT);

- the real interest rate, defined as the prime lending rate deflated by the implicit deflator for private consumption expenditure (RID); and

- a dummy variable: 1984Q3 = 1 (D843) accounting

Graph 13: Actual and fitted values of consumption expenditure on durable goods

R millions
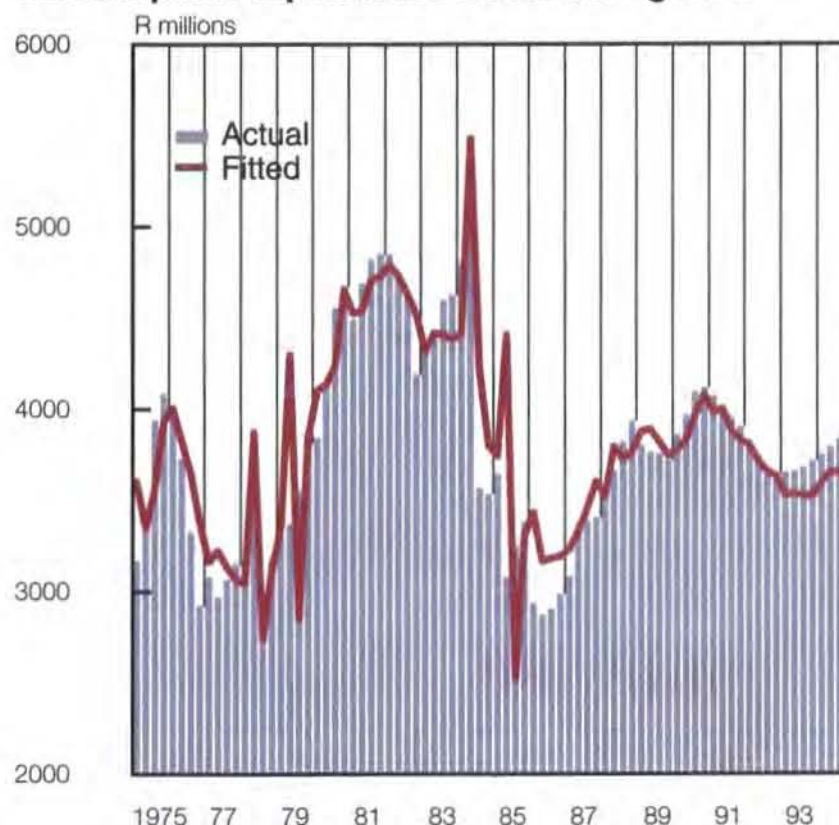
for the increase in general-sales tax on 1 July 1984 from 7 to 10 per cent.

Long-term equation

$$\ln(CS_L) = B1*\ln(YP) + B2*[(\ln(YT) + \ln(YT(-1))$$
$$+ \ln(YT(-2)))/3] + B3*\ln(RID) + B4*D843$$
$$+ B5*\ln(CS(-1))$$

COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,105	4,01
B2	0,016	1,89
B3	-0,016	3,91
B4	-0,042	2,57
B5	0,867	28,86

$\overline{R}^2$ = 0,988
D-W = 1,59
Sample period = 75:q1 - 94:q4
Phillips Z_t statistic = -7,22
        [Critical value = -4,99 (1% level)]

Short-term equation
The dependent variable in the short-term equation is the change over four quarters in private consumption on semi-durable goods (ΔCS). All the explanatory variables in the equation reflect the change over four quarters in the variables. In addition to the variables used in the long-term equation, real fixed investment in private-sector residential buildings (IPB) was added to the equation as an additional explanatory variable.

$$\Delta\ln(CS_S) = B1*\Delta\ln(YP) + B2\cdot[(\Delta\ln(YT) + \Delta\ln(YT(-1)))/2]$$
$$+ B3*\Delta\ln(RID) + B4*[(\Delta\ln(IPB)$$
$$+ \Delta\ln(IPB(-1)))/2] + B5*\Delta\ln(CS(-1))$$
$$+ B6*[\ln(CS_L) - \ln(CS(-4))] + B7*DGST$$

COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,101	2,10
B2	0,013	1,94
B3	-0,013	1,71
B4	0,038	2,59
B5	0,896	21,36
B6	1,102	8,65
B7	0,038	5,05

$\overline{R}^2$ = 0,92
D-W = 2,18
Sample period = 76:q1 - 94:q4

The actual and fitted values of the equation for expenditure on semi-durables goods are compared in Graph 14.

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Private consumption expenditure on non-durable goods (CN)
The following explanatory variables are included in the equation for private consumption expenditure on non-durable goods:

- real personal disposable income (YD); and

- total employment in the non-agricultural sectors (EMP). Formal-sector employment is included as an explanatory variable because it is argued that real-income growth accompanied by employment growth is likely to impact differently on non-durable consumer spending than real-income growth originating from a rise in income per capita of those engaged in formal-sector employment.

Long-term equation

$$\ln(CN_L) = B1*\ln(YD) + B2*\ln(EMP) + B3*\ln(CN(-1))$$

COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,130	3,39
B2	0,106	2,24
B3	0,841	17,82

$\overline{R}^2$ = 0,991
D-W = 2,13
Sample period = 75:q1 - 94:q4
Phillips Z_t statistic = -9,73
        [Critical value = -4,30 (1% level)]

Graph 14: Actual and fitted values of consumption expenditure on semi-durable goods
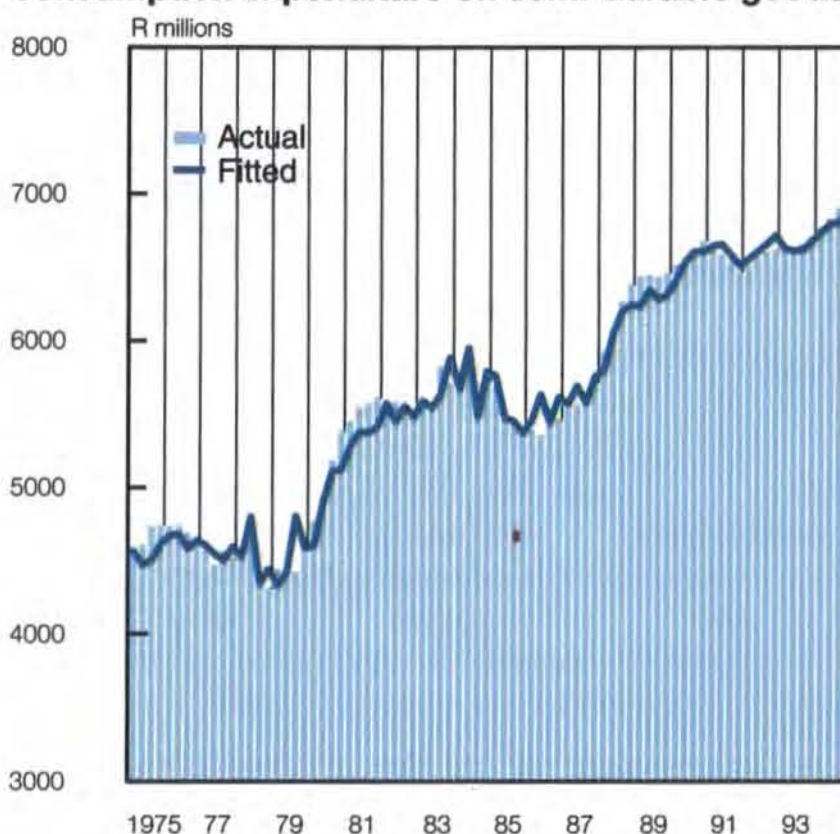
Short-term equation

The dependent variable in the short-term equation is the change over four quarters in private consumption expenditure on non-durable goods (ΔCN). All the explanatory variables in the equation are measured in terms of changes over four quarters. In addition to the variables used in the long-term equation, the inflation rate (INFL) was added as an additional explanatory variable to accentuate the impact of declining real incomes on account of rising prices.

$$\Delta\ln(CN_S) = B1*\Delta\ln(YD) + B2*\Delta\ln(EMP) + B3*\Delta\ln(INFL)$$

$$+ B4*DGST + B5*\Delta\ln(CN(-1))$$

$$+ B6*[\ln(CN_L) - \ln(CN(-4))]$$

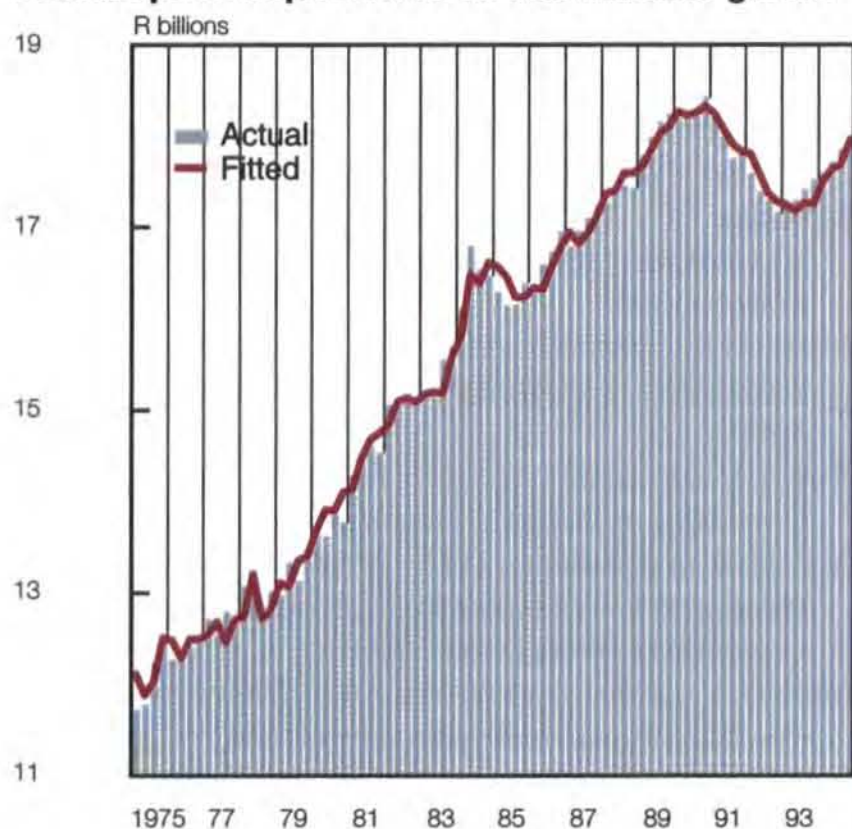| COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,078	2,96
B2	0,347	3,98
B3	-0,020	2,74
B4	0,023	4,00
B5	0,752	13,06
B6	0,794	7,33

$\bar{R}^2$ = 0,833
D-W = 2,22
Sample period = 76:q1 - 94:q4

The actual and fitted values of the equation for consumption expenditure on non-durable goods are compared in Graph 15.

Graph 15: Actual and fitted values of consumption expenditure on non-durable goods

Private consumption expenditure on services (CV)

The following explanatory variables are included in the equation for private consumption expenditure on services:

-   real personal disposable income (YD);

-   the real interest rate, defined as the real prime lending rate deflated by the implicit deflator for private consumption expenditure (RID); and

-   real fixed investment in private sector residential buildings (IPB).

Long-term equation

$$\ln(CV_L) = B1*\ln(YD) + B2*\ln(RID) + B3*\ln(IPB)$$

$$+ B4*\ln(CV(-1))$$

COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,107	3,38
B2	-0,020	3,09
B3	0,036	2,87
B4	0,857	21,33

$\bar{R}^2$ = 0,994
D-W = 2,50
Sample period = 75:q1 - 94:q4
Phillips Z_t statistic = -11,68
[Critical value = -4,67 (1% level)]

Short-term equation

The dependent variable in the short-term equation is the change over four quarters in private consumption expenditure on services (ΔCV). All the explanatory variables in the equation are measured as changes over four quarters. Real personal disposable income was replaced by real tax-adjusted remuneration of employees in the estimation of the short-term equation.

$$\Delta\ln(CV_S) = B1*\Delta\ln(YP) + B2*\Delta\ln(RID) + B3*\Delta\ln(IPB)$$

$$+ B4*\Delta\ln(CV(-1)) + B5*[\ln(CV_L) - \ln(CV(-4))]$$

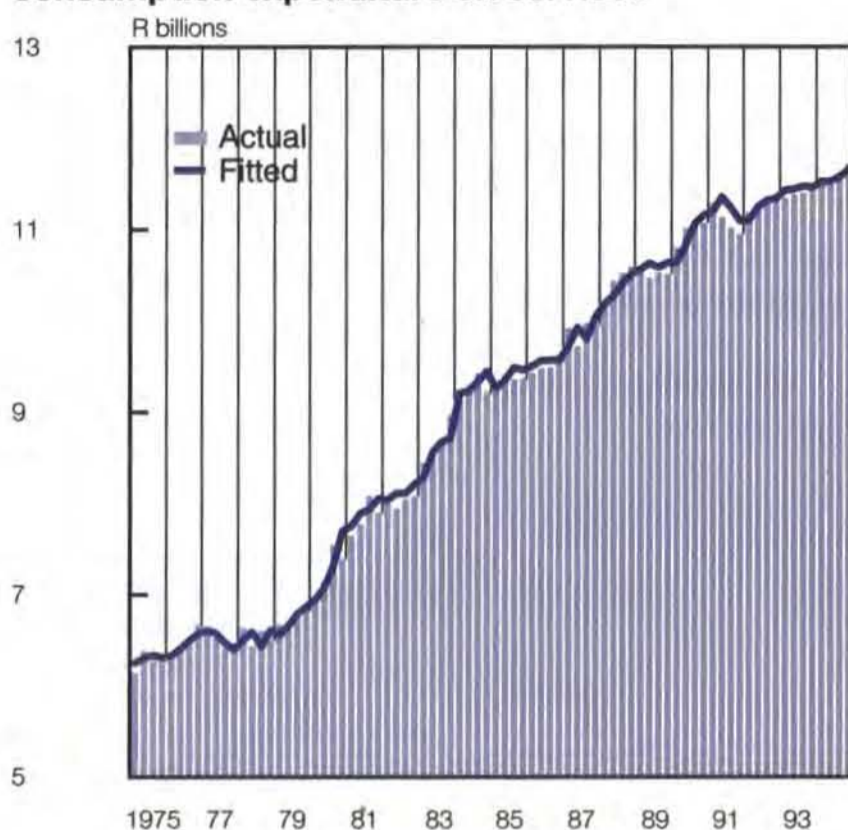| COEFFICIENT	ESTIMATE	T-STATISTIC
B1	0,107	2,23
B2	-0,027	3,71
B3	0,050	3,48
B4	0,812	16,87
B5	0,821	7,62

$\bar{R}^2$ = 0,794
D-W = 2,46
Sample period = 76:q1 - 94:q4

The actual and fitted values of the expenditure on services are compared in Graph 16.

Graph 16: Actual and fitted values of consumption expenditure on services

R billions

Interest rate sensitivity of private consumption expenditure

A number of the estimated expenditure equations contain a measure of the real interest rate as an explanatory variable. In order to ascertain the sensitivity of aggregate consumption expenditure with respect to changes in the real interest rate, a multi-period simulation exercise was performed with the full set of private consumption expenditure equations.

In the baseline simulation interest rates were assumed to remain unchanged at their historical levels. In the alternative simulation interest rates were assumed to increase by one percentage point for a full year. A comparison of the time paths of the two simulations indicates that private consumption expenditure can be expected to decline by R500 million (at current prices), or by 0,2 per cent with an increase of one percentage point in interest rates. It should be emphasised that this response only represents the direct impact of a change in interest rates, and that the indirect effects working their way through changes in other variables, such as capital formation and income from property, were not taken into consideration.

Concluding remarks

Although the absolute-income hypothesis proposed by Keynes can be regarded as an important milestone in the development of the aggregate consumption function, it was to a certain extent refuted by empirical analyses.

Various alternative theories were subsequently proposed and they offer clearer insight into explaining consumer behaviour. Recent consumption theories and empirical analyses are usually a combination of the life-cycle and permanent-income theories. The major features of these theories are that consumption expenditure tends to be less subject to change than income and that changes in policies must be perceived as being permanent before they can be expected to have any lasting impact on consumer behaviour.

The private consumption expenditure equations in the macro-econometric model of the Reserve Bank are predominantly based on the permanent-income hypothesis. All the equations include a permanent-income component, usually represented by a weighted average of past employee incomes, and of a more volatile transitory component represented by income from property of households.

Consumption expenditure is the most stable and largest component of domestic expenditure and tends to act as a stabilising force in the economy. Great care should accordingly be taken with the modelling of private consumer behaviour. Biased or misrepresentative estimates may give radically different results when these functions are used for purposes of forecasting and policy simulation.

Multi-period dynamic single-equation simulations with the estimated consumption-expenditure equations point to a somewhat modest direct response by real private consumption expenditure to a change in the real interest rate.

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