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Long-Term Determinants of the Personal Savings Rate: Literature Review and Some Empirical Results for Canada

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Abstract

This paper examines the structural determinants of the personal savings rate in Canada over the last 30 years, using cointegration techniques. The main finding is that the real interest rate, expected inflation, the ratio of the all-government fiscal balances to nominal GDP, and the ratio of household net worth to personal disposable income are the most important determinants of the trend in the personal savings rate, as measured in the National Income and Expenditure Accounts (NIEA). The results also suggest that the rapid decline in the NIEA personal savings rate in recent years largely reflects a change in the trend component of the savings rate, rather than a transitory departure from the trend. In the current environment of low inflation and government fiscal balances moving into surpluses, the trend NIEA savings rate could remain low. When using a measure of the personal savings rate based on the change in the net worth position of the personal sector (as estimated in the National Balance Sheet Accounts [NBSA]), the trend is determined by the real interest rate, expected inflation, and the ratio of household net worth to personal disposable income. However, the statistical evidence supporting this long-run relationship is not as conclusive as that for the NIEA savings rate.

JEL classifications: C22, E21
Bank classifications: Domestic demand and components

Résumé

Au moyen de techniques de cointégration, les auteurs étudient les déterminants structurels de l’évolution du taux d’épargne des particuliers au Canada au cours des trente dernières années. Leur principale conclusion est que le taux d’intérêt réel, l’inflation attendue, le ratio du solde budgétaire de l’ensemble du secteur public au PIB nominal et le ratio de l’avoir net des ménages à leur revenu disponible constituent les principaux déterminants de l’évolution à long terme du taux d’épargne des particuliers mesuré dans les comptes nationaux des revenus et des dépenses. Selon les résultats obtenus par les auteurs, la baisse rapide que ce taux d’épargne connaît depuis quelques années refléterait essentiellement une modification de la composante tendancielle du taux d’épargne plutôt qu’un écart transitoire par rapport à la tendance. Dans le contexte actuel, caractérisé par un bas taux d’inflation et l’apparition d’excédents budgétaires, il se pourrait que cette mesure du taux d’épargne tendanciel demeure faible. Si les auteurs utilisent plutôt une mesure fondée sur la variation de l’avoir net du secteur des particuliers (estimée à l’aide des comptes du bilan national), les déterminants de l’évolution tendancielle du taux d’épargne sont

alors le taux d'intérêt réel, l'inflation attendue et le ratio de l'avoir net des ménages à leur revenu disponible. Toutefois, les résultats statistiques obtenus à l'appui de cette relation à long terme ne sont pas aussi concluants que dans le cas du taux d'épargne mesuré dans les comptes nationaux des revenus et des dépenses.

Classifications JEL : C22, E21
Classification de la Banque : Demande intérieure et composantes

1. Introduction

Savings play a central role in income determination, both in the short run through aggregate demand and in the long run through capital formation and wealth accumulation. Personal savings is an important source of national savings (see Table 1 and Figure 1).[1] Since the early 1980s, the conventional measure of the personal savings rate in Canada, as calculated in the National Income and Expenditure Accounts (NIEA), has been trending downwards. It reached an all-time low of 2.3 per cent in 1998. These developments have raised concerns that recent household consumption levels may not be sustainable.

Many analysts argue that the NIEA measure of personal savings is not reliable for analyzing and forecasting households' consumption behaviour because, among other things, it does not take into account changes in asset values such as capital gains or losses. Those gains or losses do not affect measured income but they can have an impact on consumption. However, the main concern of the NIEA is to provide estimates of the production of goods and services and the income generated by those processes. Within that framework, personal savings is derived by first estimating personal income, then subtracting current transfers to government to obtain personal disposable income, and then subtracting consumption and current transfers to corporations and to non-residents. The savings rate is what is left over, expressed as a percentage of personal disposable income. Capital gains or losses are not included in the NIEA definition of savings on the basis that they do not represent added value, generated by the production process.

Even if one accepts the NIEA definition of savings, there still remain some asymmetries in the way income and taxes are treated. For instance, even though the changes in asset values are not counted as investment income, taxes on *realized* capital gains (or losses) are still subtracted from current income in the NIEA definition. Also, interest earned on accumulation of rights to future pensions is recorded as investment income but no tax is paid on that income until the benefits are drawn down. Thus, the NIEA measure does not take into account trusteed pension benefits as part of current income although it records taxes on those same benefits.

The change in the net worth of the personal sector, as estimated in the National Balance Sheet Accounts (NBSA), provides an alternative measure of savings that is closer to the theoretical concept. For instance, the NBSA estimates of household savings reflect changes in asset values, include the stock of consumer durables in personal assets, and are not affected by the inflation premium in asset returns. The change in the net worth of the personal sector, as a proportion of

1. Personal savings as a share of nominal GDP has decreased since the early 1980s but remained the most important source of national savings up to, and including, 1995.

personal disposable income, is normally much higher than the NIEA savings ratio. Furthermore, the most recent values of this alternative measure of the personal savings rate are not unusually low relative to their average of the last five years or so. This may suggest that the current level of personal savings does not present, as some analysts suggest, a substantial negative risk for household demand in the near term.

However, there still remains a problem with this kind of analysis: there is no assessment of the level of the savings ratio that one would expect to observe based on fundamental factors. Is the observed ratio higher or lower than what would be consistent with the fundamentals? Where should we expect the trend personal savings rate to go in the coming years, based on the underlying fundamentals?

The objective of the present paper is to answer these questions by identifying the long-term determinants of the personal savings rate, using cointegration techniques. Our analysis is performed for both the NIEA measure of the personal savings rate and the alternative NBSA-based measure. However, it should be emphasized that our paper does not deal per se with measurement issues that are currently at the centre of the savings rate discussion in Canada. (See Coiteux [1998] and Appendix 2 at the end of this paper for an overview on measurement issues.)

We consider in our analysis a number of factors that have been identified in the economic literature as potential determinants of personal savings. These include demographics, the rate of return on savings, liquidity constraints, private wealth, public pension plans, government saving/dissaving, and uncertainty about future income growth. We begin our empirical analysis with the NIEA measure of the personal savings rate. Our results suggest that the real interest rate, expected inflation, the all-government fiscal balances as a proportion of nominal GDP, and the ratio of household net worth to personal disposable income are the most important determinants of the trend in this measure of the personal savings rate over the 1965–96 period. This finding is supported by formal statistical tests for cointegration. However, although our best equation captures long-run movement in the NIEA savings rate quite well, there remain some problems, such as the mixed evidence of long-run stability between the savings rate and the above structural factors, which we suspect may be due to the variable used to measure expected inflation.

The results also suggest that the rapid decline in the NIEA measure of the personal savings rate in recent years is essentially attributable to the trend component of the savings rate. Furthermore, based on current projections for the inflation rate and government fiscal balances moving into surpluses, the trend NIEA measure of the personal savings rate could remain low.

When using a measure of the personal savings rate based on the change in the net worth of the personal sector (as estimated in the National Balance Sheet Accounts [NBSA]), the trend is determined by the real interest rate, expected inflation, and the ratio of household net worth to personal disposable income. However, the statistical evidence supporting this long-run relationship is not as conclusive as that for the NIEA savings rate.

The plan of the paper is as follows. Section 2 surveys the existing theoretical and empirical literature on the structural determinants of the aggregate personal savings rate that we consider in our empirical work and describes the specific variables that we use to represent these determinants. Section 3 examines the long-run relationships between the two measures of the personal savings rate and the variables identified in Section 2, using cointegration techniques. The final section of the paper summarizes our main results and comments on future research.

2. Literature review

Personal savings decisions are driven by several motives, including the need to build up assets to finance consumption after retirement, precautionary saving related to the uncertainty about the future, the desire to leave bequests to a subsequent generation, and saving for the acquisition of tangible assets or for large current expenditures. Saving for retirement is generally considered quantitatively the most important saving motive. Much of the analysis of households' consumption and savings decisions is conducted using versions of the life-cycle model.

In the basic life-cycle model, the motivation for saving is providing for consumption during retirement years. Simple versions of this model assume that individuals are far-sighted and base their decisions on future events (income, interest rate, family composition, rate of survival, date of death) that are known with certainty. Capital markets are perfect, so that individuals can borrow against their future income to finance current consumption. As a result, one of the main implications of the life-cycle model is that individuals can separate their consumption profile from their income profile; that is, consumption is not affected by the timing of income. In any one period, an individual's consumption is constrained only by her/his lifetime resources.[2]

In order to equalize the discounted marginal utility of consumption from one period to the next, optimizing households aim to achieve a smooth level of consumption over time. Intertemporal consumption smoothing is achieved by saving when income is high and dissaving when income is low. Individuals tend to dissave (or borrow) when they are young, because of relatively low levels of

2. See Browning and Lusardi (1996) for a theoretical discussion of the assumptions of the standard life-cycle model and their implications.

income and high expenditures related to household formation, and save in their middle years, with asset holdings reaching their maximum at retirement age. Individuals dissave again during retirement by drawing on their accumulated assets, which are entirely exhausted at death. Also, the life-cycle approach predicts a negative relationship between expected lifetime resources and an individual's savings rate. For a given level of current income, the savings rate will be reduced by a permanent increase in wealth, since fewer savings will be needed to provide for future consumption.

However, several of the key assumptions and predictions of the basic life-cycle model are not supported by empirical evidence. In practice, households face limits on their ability to borrow against future resources. For instance, marketable assets are required as collateral to borrow large amounts of money, there are credit limits, and interest rates are higher on unsecured loans. By preventing full intertemporal smoothing of consumption, borrowing constraints may lead a sizable proportion of consumers to link consumption/savings decisions to disposable income flows. Indeed, empirical evidence suggest that consumption tracks household income quite closely over the life cycle (Campbell and Mankiw 1989; Carroll and Summers 1991). In the case of Canada, Wirjanto (1995) estimates the proportion of liquidity-constrained consumers at about 46 per cent while Campbell and Mankiw (1991) estimate this proportion at about 25 per cent.

Also, most empirical evidence does not support the prediction that individuals decumulate and exhaust their wealth during retirement. Rather, it appears that the savings rates of elderly households are not significantly lower than those of working-age households; that the elderly do not decumulate assets, or do so only slowly; and that elderly households transfer significant amounts of wealth to their offspring (Carroll and Summers 1991; Kotlikoff 1988; Weil 1994).[3]

To account for such evidence, more recent versions of the life-cycle model allow for liquidity constraints and for imperfect markets for insurance. In these richer versions of the life-cycle model, risk-averse behaviour in the presence of liquidity constraints and uncertainties regarding the length of life, earnings, medical expenses, and family support generate precautionary saving, and people tend to die with positive wealth that is bequeathed to the next generation. In particular, uncertainty about time of death tends to increase savings during retirement since the elderly do not want to exhaust their wealth before they die (Davies 1981). Continuing saving (or lack of dissaving) during the retirement phase of the life cycle may also reflect the working of an explicit bequest motive and life planning for it, either because the utility of their children or

3. Such evidence is usually obtained in studies that make use of household (micro) data. Meredith (1995) argues that income and wealth are often not defined appropriately in these studies, and that saving is inferred from hypothetically constructed wealth profiles of the elderly that may be subject to considerable mismeasurement problems.

bequests per se enter their lifetime utility function, or owing to the use of bequests to purchase care and attention from their children. In a related paper, Banks, Blundell, and Tanner (1998) argue that the only way to fully reconcile the fall in consumption and rise in savings of retiring households with the life-cycle model is with the systematic arrival of unexpected adverse information.

The literature on household saving points to a number of potential important long-term determinants of the aggregate personal savings rate. In our empirical work, we consider the following structural factors: demographics, the rate of return on savings, liquidity constraints, uncertainty about future income growth, inflation, government saving/dissaving, public pension plans, and private wealth. We consider eight variables to represent these various factors in our empirical work. Although this is a large number of variables to include in such an exercise, it is by no means an exhaustive list of all the variables that can serve to represent the long-run determinants of the personal savings rate.[4] The strength of the bequest motive, for example, is not included in our empirical work, due to the lack of indicators that could serve to represent such a factor appropriately in a study using macrodata.

In the remainder of this section, we review the existing literature on the fundamental factors of personal saving that are taken into consideration in our empirical work. We also describe the specific variables that we have selected to represent these factors in our equations.

2.1 Demographics

Demographic dimensions of particular importance in life-cycle models include the age structure of the population and the expected length of the retirement span relative to the income earning period. In the basic life-cycle model, the age distribution of households has an effect on the aggregate personal savings rate because the savings rates of individuals are assumed to vary with their age. An increase in the proportion of elderly households in the population is expected to reduce the aggregate savings rate because retired households are assumed to dissave, or at least save less than those of working age. Similarly, an increase in the proportion of the population that is of pre-working age is also expected to reduce the aggregate personal savings rate as parents spend a large proportion of their income on taking care of their children.

Most empirical studies using aggregate (macro) data have found that increases in the proportions of both the youth and the elderly in the population depress the aggregate personal savings rate, as predicted by the basic life-cycle model. Studies using cross-country data have been

4. Collinearity may increase with the number of variables, complicating the identification of a unique cointegrating relationship.

more successful than studies using time-series data for individual countries in finding significant effects of the age distribution, probably because the variation over time in the age distribution within one country is relatively small (Masson, Bayoumi, and Samiei 1995). The impact of a change in the proportion of the population represented by the elderly typically exceeds that of the proportion represented by the young (Meredith 1995; Bosworth, Burtless, and Sabelhaus 1991). Nevertheless, for a country like Canada, where the decline in the proportion of the pre-working age population has dominated the increase in the proportion of the elderly population over the last 30 years, the net effect of these changes in the age structure might have been to increase the aggregate personal savings rate.

While studies using aggregate data show that increases in the proportion of the population represented by the elderly have a significant negative effect on the aggregate personal savings rate, studies using household (micro) data (including data for Canada) find little or no tendency for the elderly to dissave or to save at rates markedly lower than those of working-age households (Bosworth, Burtless, and Sabelhaus 1991). Weil (1994) suggests that these contradictory results may be reconciled by taking into account intergenerational relations between households, such as bequests, that would be picked up in aggregate data, but not in microdata. Younger households may lower their savings rate if they expect to receive bequests (as the latter increase their expected lifetime resources). As a result, a negative coefficient on the elderly population ratio in equations for the aggregate personal savings rate could reflect a reduction in the savings of younger age groups, rather than dissaving by the elderly.

As mentioned above, the expected length of the retirement period is another important demographic variable in life-cycle models. Increases in the expected length of the retirement period, either through a higher life expectancy or through a decline in the retirement age, raise the need for more saving in younger ages, putting upward pressure on the aggregate personal savings rate. Evidence supporting this assumption is reported in Sturm (1983).

In previous empirical work, the age structure of the population has been included more often than the length of the retirement period. In particular, these studies consider the youth-dependency ratio and the elderly-dependency ratio. The youth-dependency ratio is defined as the ratio of the pre-working age population (age category 0 to 19 years) to the working-age population (aged 20 to 64). The elderly-dependency ratio is represented by the ratio of the population in the retirement phase (aged 65 and over) to the working-age population (aged 20 to 64). Several studies use a “dependency ratio” variable that combines the two age groups.[5] We have elected to consider the

5. This choice amounts to assuming that the net effects of each age group on the aggregate personal savings rate are identical, which is something that cannot be determined *a priori*.

latter demographic variable in our set of explanatory variables in order to limit the number of variables used in the cointegration analysis.

Although the expected length of the retirement period is not included in our set of determinants, the coefficient on the ratio of the elderly population will be influenced by the effect on saving of the expectation of a longer retirement period arising from a higher life expectancy. This is so because increases in the elderly population ratio come about not only from slower population growth (due to lower fertility rates) but also from greater longevity.[6]

2.2 The real rate of return

The net result of a change in the real rate of return, i.e., a change in the opportunity cost of consumption in the current period, is theoretically ambiguous because of potentially offsetting substitution, income, and revaluation effects. An increase in the real rate of interest tends to encourage individuals to postpone consumption and increase savings in the present period in order to achieve higher consumption levels later. That is, the intertemporal substitution effect of a change in the real rate of interest on savings is positive.

The direction of the income effect depends on whether the individual is a net lender or borrower. A net lender receives more in investment income than he has to pay to service his debt. In that case, higher interest rates increase net investment income, thus encouraging present consumption and lessening the need to save in order to finance future consumption. If present consumption and future consumption are normal goods, it is possible for a higher interest rate to cause present consumption to rise, while the smaller amount of savings will nevertheless grow to a larger amount of future consumption. Hence, for net lenders (net savers), the overall direct effect of an increase in the rate of return on savings behaviour is ambiguous, since substitution and income effects act in opposite directions. Even though in the aggregate the household sector is a net lender to other sectors in the economy (i.e., net source of capital),[7] the positive income effects on lenders, which may be substantially reduced by taxes, can be outweighed by the negative income effect on borrowers (Montplaisir 1997).

The real rate of interest has also another, and indirect, effect on savings. A higher real interest rate results in a fall in non-human wealth, mostly through a decline in the real value of

6. Slower population growth due to lower fertility rate leaves individual savings profiles unchanged, but can lead to lower aggregate savings as the proportion of the low-saving elderly in the population increases if the elderly have low savings rates (Sturm 1983).
7. The household sector was a net lender since the early 1970s with the exception of 1997 and 1998 during which it was a net borrower.

financial assets on which the interest rate is fixed for several years in advance and through lower equity prices since the income flows of equities typically do not rise proportionately with the real interest rate. A higher real interest rate also results in lower human wealth as the expected discounted value of current and future after-tax labour income and public sector transfers falls with an increase in the interest rate. The revaluation effect works in the same direction as the substitution effect, as it acts to reduce present consumption and increase saving in order to maintain constant the real value of the stock of wealth.[8]

The usual presumption is that the total effect on saving of a change in the real interest rate is positive. However, empirical research has reported mixed results with respect to the sign of the direct effect of interest rates on saving. The weight of the empirical evidence, which is concentrated on the United States but also includes studies for the other industrial countries, suggests that the partial correlation between the real interest rate and the savings rate is rather small, irrespective of its sign. Empirical studies focusing more particularly on Canadian data have generally found no significant large real interest rate effects on personal saving (Burbidge and Davies 1994; Beach, Boadway, and Bruce 1988; Salgado and Li 1998). An exception is Thomas and Towe (1996) who obtain a relatively large effect of the real interest rate on personal saving in Canada. However, the sign of the effect is sensitive to the measure of the savings rate.[9]

Although what really matters for consumption/savings decisions is the after-tax real rate of return on savings, most empirical studies of personal saving (or consumption) use a pre-tax real interest rate. This is presumably done because measuring the aggregate marginal income tax rate is not straightforward. In the studies on the personal savings rate in Canada that use an after-tax real interest rate, the marginal income tax rate is usually assumed to be constant over the sample period at 30 per cent (Beach, Boadway, and Bruce 1988; Carroll and Summers 1987). Beach, Boadway, and Bruce (1988) also adjust the marginal tax rate for the fraction of tax-sheltered saving to total household saving. This adjustment reflects the view that tax-deferred savings plans increase the rate of return to savings (at the margin) and thus contribute to increased saving.[10] Carroll and Summers (1987) argue that the upward trend in the Canadian personal savings rate (as measured in the NIEA) in the 1970s and up until 1982 may have been caused by the expansion of the access to tax-preferred

8. Note that the presence of target savers may lessen the effect of higher rates of return to increase aggregate household savings since target savers may reduce their saving in response to a higher return on existing wealth. On the other hand, higher rates of return may force higher saving as higher mortgage services costs will reduce the amount available to pay off the principal.
9. In most studies, the coefficient on the real interest rate will be influenced by the revaluation effect as the regressions do not include a human wealth variable.
10. In Canada, tax-sheltered saving includes employer/employee contributions to registered pension plans, registered retirement savings plans, and registered home-ownership plans, plus tax-free interest on the stock of sheltered saving.

saving through the RRSP program. Also, Burbidge and Davies (1994) suggest that the reduction in the Canadian personal savings rate after 1982 may have been caused by a reduction in the generosity of tax incentives for saving.[11]

A marginal income tax rate of 30 per cent, before adjustments for the fraction of sheltered saving, seems rather low for Canada. For instance, the OECD has recently published estimates of the marginal income tax rates for production workers in Canada in 1978 and 1995. These estimates suggest that the marginal income tax rate in Canada was above 30 per cent and increasing over the last 20 years or so (OECD 1998). Also, the adjustment for tax-sheltered savings made by Beach, Boadway, and Bruce (1988) may not be appropriate. Ragan (1994) shows that, when individuals have access to both tax-sheltered and unsheltered saving instruments and when a progressive income tax system is in place, savings plans that defer taxable income to later years have the effect of increasing future marginal income tax rates. Thus the after-tax return on marginal unsheltered saving is lowered, with the result that the substitution effect of tax-deferred savings plans may work to reduce the level of saving.[12] In any event, Beach, Boadway, and Bruce (1988) found little difference in their estimation results between assuming a zero marginal tax rate and a marginal tax rate of 30 per cent adjusted for the proportion of tax-sheltered savings.

Given this background, we prefer to include the pre-tax real rate of interest in our set of explanatory variables. We then test the sensitivity of the estimation results to the introduction of an after-tax real rate of return, obtained by assuming a constant marginal tax rate of 30 per cent as in previous studies.[13] The pre-tax real rate of interest is measured as the difference between the interest rate on 3- to 5-year government bonds and a measure of expected inflation. The choice for a 3- to 5-year maturity term is based on the existing evidence for Canada, which indicates that most of interest-bearing assets and financial liabilities on the household sector's balance sheet consists of medium- and long-term fixed-rate instruments—particularly contracts with terms of 3 to 5 years. This suggests that interest rates associated with these maturities are likely to exert the most influence on household investment income and liquidity constraints. Short-term interest rate

11. Carroll and Summers (1987) suggest that tax-deferred saving vehicles can generate new saving, not because of the deferral of taxes, but rather because the increased availability and intensive promotion of such vehicles may have made consumers more aware of the benefits of saving and reshaped their attitudes towards saving for retirement. A similar suggestion is made by Poterba, Venti, and Wise (1996), who present microeconomic evidence supporting the view that tax-deferred retirement saving vehicles in the United States (IRA and 401(k) plans) represent largely new saving that would not otherwise have occurred.
12. Tax-sheltered saving may reduce non-registered saving.
13. The after-tax real rate of return is calculated as follows: nominal interest rate *(1-.3) - expected inflation.

developments will influence consumption and savings decisions through their effect on expectations about future rates (Montplaisir 1997).

2.3 Liquidity constraints

Relative to a world with perfect capital markets, borrowing constraints increase savings in anticipation of future consumption needs that cannot be financed through credit (De Gregorio 1993; Jappelli and Pagano 1994). For instance, down-payment requirements tend to induce households to postpone consumption early in the life cycle in order to accumulate enough assets to qualify for buying a house. Also, borrowing constraints, together with uncertainty about future income and a propensity towards prudence by households, generates precautionary savings (Carroll 1992; Carroll and Samwick 1995). The inability to borrow when times are bad provides an additional motive for accumulating assets when times are good, even for impatient consumers.

However, in many industrial countries, changes in the functioning of financial markets in recent decades appear to have resulted in less stringent borrowing constraints for consumers. Improved access to credit markets should, in principle, lead to a permanent reduction in the households' aggregate propensity to save. Indeed, several empirical studies have attributed some of the decline in the personal savings rate over the past decades to improved accessibility to consumer credit. This is due to factors like increased use of personal credit cards and increased credit ceilings for two-income-earner households (Bovenberg and Evans 1989; Sturm 1983).[14] At the same time, in many countries, the average down-payment for first-time home buyers has fallen relative to median family income (often as a result of lower down-payment requirements, as in Canada).

In the present study, we use the ratio of consumer credit to personal disposable income as a rough indicator of the potential lessening of borrowing constraints. The rapid increase in consumer credit relative to income in the 1980s suggests that households may need to do less saving before major purchases. However, developments in consumer credit reflect changes not only in borrowing constraints, but also in the demand for loans induced by factors such as demographics and preferences.[15]

14. Some studies argue that a rising female participation rate has contributed to facilitating access to consumer credit by increasing the proportion of two-earner families (Sturm 1983). It has also been argued that the rising female participation rate has reduced precautionary saving by reducing the variability of household income. However, Summers and Carroll (1987) do not find evidence that an increase in the relative importance of two-earner families has reduced the aggregate personal savings rate in the United States.

15. For instance, there has been a substantial increase in credit card balances in the 1990s, which largely reflects a substitution by consumers of transitory credit (without interest cost; paid within the grace period) for cash to finance consumer purchases (Lau 1997).

It should be noted that a negative coefficient on the ratio of consumer credit to income in the estimations using the NIEA savings rate can reflect more the treatment of durable goods in the NIEA (which tends to depress the measured personal savings rate) than the effect of an improved accessibility by households to debt financing.[16, 17]

2.4 Inflation

Inflation may influence personal saving through several channels. In particular, personal saving may rise in an inflationary environment if consumers mistake an increase in the general price level for an increase in some relative prices and refrain from buying (Deaton 1977). Inflation may also induce households to increase their saving in order to maintain the real value of imperfectly indexed financial assets. Furthermore, when inflation raises uncertainty regarding future income growth, risk-averse households may increase their precautionary saving (Sandmo 1970).[18]

Since we do not use an after-tax real interest rate in our estimations, the coefficient on the inflation variable may also be affected by the interplay between inflation and the tax system. Because taxes are levied on nominal capital income instead of real capital income, an increase in the inflation rate leads to a reduction in the after-tax real yield on savings, even when the nominal interest rate rises in line with inflation. This interaction tends to reduce the savings rate during periods of low inflation (as the real purchasing power of savings tends to be higher because of the smaller tax take) rather than in periods of high inflation. The interaction between inflation and the tax system, which is not explored in this paper, may help to explain the role of inflation beyond that of expectation.

Also, inflation has important long-run effects on the NIEA measure of personal saving because measured income in the NIEA includes the inflation premium that compensates lenders for

16. Consumer credit is extended to persons largely to finance the purchase of durable goods. In the NIEA, expenditure on consumer durables is classified as consumption in the year in which it takes place (i.e., purchase), and therefore depresses personal saving, although expenditure on consumer durables is akin to investment rather than consumption as the associated stream of services provided by these goods may stretch over a long period of time (see Appendix 2).
17. Mortgage debt is not included in our indicator of the severity of borrowing constraints because growth in mortgage debt has been influenced considerably by actual and prospective housing price increases. Including mortgage debt in our indicator would probably reduce further the relation between the indicator and what it is intended to represent.
18. In empirical studies, the unemployment rate, along with inflation, often serves as an indicator of uncertainty about future income prospects. An increase in the unemployment rate may induce risk-averse individuals to perceive the working environment as more risky. They therefore increase their precautionary saving as a means of insuring their consumption against adverse shocks to their income streams.

the expected decline in the purchasing power of their assets (see Appendix 2). Indeed, most of the empirical studies of aggregate personal savings use the NIEA measure of savings and usually find that inflation raises saving (assuming a fixed real interest rate).

In this study, we use the measure of expected inflation that enters in the calculation of our real interest rate as a separate regressor. In the empirical analysis using the NIEA measure of the personal savings rate, the effect of this regressor will be determined by the impact of the inflation premium on measured income and the impact of inflation-related uncertainty on precautionary savings. In the work that uses the change in the estimate of personal net worth to measure personal savings, the coefficient on the inflation rate is expected to reflect mostly the impact of inflation-related uncertainty on precautionary saving. Note that the sensitivity of our estimation results is tested against an alternative measure of inflation expectation.

2.5 Government fiscal balances

According to the modern Ricardian paradigm, rational and far-sighted individuals realize that government spending must be paid for either now or later. Government dissaving will therefore be compensated fully by increased personal saving, in anticipation of future tax liabilities.[19] However, Ricardian equivalence is obtained under a number of stringent assumptions. These include the absence of liquidity constraints and the assumption that successive generations are linked by purely altruistically motivated bequests. This implies that consumption is determined as a function of dynastic resources (the total resources of an individual and all of his/her descendants), which are unaffected by the timing of taxes (Bernheim 1987; 1989).[20]

The most widely accepted view holds that an increase in the government deficit will not be fully offset by higher personal saving because (among other factors) intergenerational transfers are neither universal nor predominantly altruistic in nature. Consequently, households will expect that at least part of the future tax liabilities will be borne by subsequent generations.

19. However, an increase in the deficit that reflects additional public spending on productive investment projects would not be expected to require further taxes later on and thus should not elicit a private saving response.
20. This dynastic view of the family assumes that each family is an infinitely lived unit, a central difference compared with the life-cycle model that assumes finite lifetimes. Other intertemporal models combine the infinite-horizon approach with a constant probability of death, no bequests, and a positive birthrate, thereby introducing a wedge in equilibrium between rates of interest and rates of time preference (Yaari 1965; Blanchard 1985; Buiter 1988). These latter models imply that government deficits/ surpluses are largely but not completely offset by private saving.

Indeed, empirical studies fail to support a full offset of fiscal actions as predicted by the Ricardian equivalence paradigm. Existing evidence for industrial countries suggests that each dollar increase in the government deficit is associated with an increase in private saving of about 0.5 to 0.6 dollars (Bernheim 1987; Masson, Bayoumi, and Samiei 1995). In this study, we use the ratio of the all-government fiscal balances to nominal GDP (on a national accounts basis) as a proxy to test for the Ricardian equivalence paradigm.

2.6 Public pension plans

In Canada, a compulsory public pension scheme financed on a pay-as-you-go basis (PAYGO) was introduced in 1966 (the Canada Pension Plan).[21] Members of the initial generation of beneficiaries of a public pension plan typically contributed only for relatively short periods, if at all. Thus, their implicit return is much higher than the market rate of return and they receive a windfall in the form of positive public pension wealth (the present value of pensions exceeds the present value of contributions), inducing them to reduce their saving. However, if retirement leisure is a normal or superior good, an increase in expected lifetime resources in the form of public pension wealth can encourage earlier retirement. Indeed, there is evidence that public pension systems have contributed to reduce the age of retirement in OECD countries (OECD 1998). This induced retirement effect can cause individuals to increase private saving while working in order to maintain consumption over a longer retirement period.

Members of subsequent generations who contribute throughout their working life may receive negative public pension wealth as the implicit rate of return on their contributions is the economic growth rate (the sum of the growth rates of productivity and of labour input). This growth rate, over long periods of time, tends to be below the market rate of return (workers are assumed to discount contributions and benefits at the market rate of return). This negative public pension wealth would induce them to increase their personal saving.

Also, by providing insurance for retirement consumption in the face of uncertain longevity and in the absence of private market annuities, public pension plans can reduce the amount of precautionary saving motivated by the desire to cover the contingency of living longer than expected (Evans 1983). Indeed, one of the arguments for publicly provided pensions (which are

21. Quebec operates its own public pension plan, which is very similar to the CPP.

typically indexed to price or wage inflation) is that they compensate for the market's failure to provide indexed annuities (Diamond 1977).[22, 23]

On the other hand, public pension wealth and private wealth are rather poor substitutes because of different degrees of liquidity. Savings in public pension plans are locked up until retirement. Public pension wealth can neither be spent in emergencies before retirement, nor be used as collateral for obtaining bank credit, and cannot function as a vehicle for precautionary saving, as can bank deposits or other financial investments. Even if the public pension plan is perceived as being actuarially fair, personal saving would tend to be higher than otherwise because of the illiquidity of public pension wealth.

Clearly, the net effect of a compulsory PAYGO public pension scheme on the aggregate personal savings rate cannot be determined on *a priori* grounds. Empirical studies, and particularly those using U.S. data, tend to find that public pension systems have an overall negative impact on household saving (Mackenzie, Gerson, and Cuevas 1997). In the case of Canada, the empirical evidence about the impact of public pensions on household saving is mixed. In a study using macro time-series data, Denny and Rea (1979) found that the Canada Pension Plan (CPP) had contributed to increase the personal savings rate through an induced-retirement effect. In another study using macro time-series data, Boyle and Murray (1979) found no significant effect from public pension wealth on household saving, suggesting the presence of offsetting wealth and retirement effects. However, the authors also argue that their results may reflect both an incomplete adjustment of household saving behaviour to the CPP and the influence of omitted variables. Finally, two studies using microdata on Canadian households (Daly 1983; Dicks-Mireaux and King 1984) found that public pensions led to lower personal saving.

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22. In a life-cycle model without allowance for bequest motives but where the date of death is uncertain and where there is no social security, uncertainty about longevity should induce individuals to put all their retirement reserves into life annuities. By doing so, they would not run the risk of leaving bequests (which are not valued at all) or the risk of bankruptcy. However, annuity contracts are very rare. The literature identifies a number of reasons that could explain this situation (Bernheim, Shleifer, and Summers 1985; Kotlikoff, Shoven, and Spivak 1986; Kotlikoff 1988; Friedman and Warshawsky 1988). First, annuities are usually unindexed. Therefore, uncertainty with respect to inflation may reduce demand for such annuities. Second, totally annuitizing one's wealth might leave one illiquid and unable to pay major one-time expenses. Third, adverse selection, in the presence of different mortality probabilities, could be sufficiently severe to preclude the operation of a private market for annuities. Fourth, significant bequest motives may explain the absence of demand for annuity protection even when available on quite favourable terms.
23. Over the post-war period, growing insurance against the financial risk of illness, disability, and layoffs has been provided by the public sector through various programs (unemployment insurance, disability insurance, and health insurance). As with public pensions, these social insurance programs may have reduced the precautionary motive for saving. We do not take these programs into account in our empirical work.

As suggested by the discussion above, several studies rely on the construction of a public pension wealth variable, an approach pioneered by Feldstein (1974). The estimated effects of public pension wealth on household saving have been found to be very sensitive to the assumptions made in constructing the public pension wealth variable, especially the assumption regarding workers' expectations of future pension benefits (Mackenzie, Gerson, and Cuevas 1997).[24] For that reason, we prefer to control for the effects of the public pension plan with an indicator of the extent to which public pensions replace pre-retirement income. This indicator, however, offers only a partial account of the effects that public pensions may have on personal saving. Our indicator is defined as the ratio of public pension payments per person aged 65 and over to the personal disposable income per person aged 15 to 64 (excluding public pension payments).[25] Similar variables have been used in previous studies (Modigliani and Sterling 1980; Feldstein 1980; Summers and Carroll 1987).

2.7 Private wealth

In most industrial countries, revaluations of equities and housing have contributed to a substantial increase in the value of household net worth through most of the 1980s and 1990s, reducing the need for saving out of personal income. Empirical studies generally support the view that wealth is an important variable in explaining long-run movements in personal saving (Bovenberg and Evans 1989; Bosworth, Burtless, and Sabelhaus 1991). Therefore, our set of explanatory variables includes the ratio of personal net worth to disposable income. We do not include a measure of human wealth. As with public pension wealth, estimates of human wealth are highly dependent on the assumptions regarding expectations of future income.

In the equations using the NIEA measure of the personal savings rate, the coefficient on the wealth ratio will also be influenced by the fact that the increase in the value of pension (e.g., employer-sponsored pension plans) and mutual fund holdings—which is reflected in the NBSA estimate of personal net worth but not in the NIEA measure of personal income—has probably substituted for saving out of personal income.

24. It is impossible to determine which assumptions workers actually use. *A priori*, given the uncertainty about the length of the retirement period and the level of future contributions and entitlements, there are several plausible assumptions that workers can make about their future net public pension benefits.

25. Using persons aged 15 to 64 or persons aged 20 to 64 yields similar trends for the public pension benefit replacement rate proxy.

3. Empirical analysis

As noted in Thomas and Towe (1996), research into household saving/consumption behaviour in recent years has tended to focus on searching for long-run relationships between saving (or consumption) and selected macroeconomic variables. In large part, this reflects the fact that the data involved have been found to be non-stationary. This implies that conventional statistical methods cannot be used to test relationships between movements in the savings rate and other (non-stationary) macro variables. This approach also implies that short-run movements in the savings rate may be driven by deviations from the long-run relationship between saving and its fundamental determinants.

Our contribution is to examine the long-run determinants of the savings rate, using cointegration techniques. Because of the non-stationary nature of our data, conventional statistical procedures would not result in asymptotically efficient estimates of the estimated parameters, nor would they lead to valid inferences regarding them (Granger and Newbold 1974; Phillips 1986). Our approach to estimating the trend savings rate is performed within a single-equation framework. We examine the possibility that the savings rate is cointegrated with one or more of the structural factors discussed in our literature review. Implicit in our single-equation approach is the assumption that there is only one endogenous variable that is given the economic interpretation of a savings rate equation.[26]

Our analysis is performed for both the NIEA measure of the personal savings rate and an alternative measure based on the change in the net worth position of the personal sector as estimated in the National Balance Sheet Accounts (NBSA). Figures 2 and 3 show the NIEA personal savings rate and the balance-sheet alternative over the period 1963Q1-97Q4.

The NBSA-based savings rate is substantially higher than the NIEA savings rate throughout the entire period. The average value of the NBSA-based savings rate over the period is 27.0 per cent, compared with 10.0 per cent for the NIEA savings rate. Although the NBSA-based measure is much more volatile than the NIEA measure, the broad movements in the two series are relatively

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26. The long-run relationship between the savings rate and the various structural factors using a system of equations approach, such as the VECM methodology (Vector Error Correction Model) proposed by Johansen (1988) and by Johansen and Juselius (1990), is reserved for future research.

similar. Both series display an upward trend during the 1970s followed by a downward trend in the 1980s and 1990s.[27, 28]

The structural factors considered in our analysis are the following:

rr = expected real long-term interest rate (*ex ante*)

ecpi = expected inflation rate

pgdef = all-government fiscal balances as a share of nominal GDP (+ : deficit; - : surplus)

ppbrr = a proxy for the public pension benefit replacement rate

rnu = unemployment rate

rbs = ratio of net worth to personal disposable income

rconsc = ratio of consumer credit to personal disposable income

pyold = dependency ratio: proportion of the population of pre-working age (population aged 0 to 19 years) and of population retired (population aged 65 years and over) as a proportion of the population aged 20 to 64 years

The above variables are illustrated in Figures 5 to 12. Based on casual observation, the savings rate and the structural factors appear to be non-stationary and hence unit-root and cointegration tests are used to examine the long-run relationship between the personal savings rate and its potential long-run determinants. Note that all the variables are measured at a quarterly frequency and are seasonally adjusted.[29] Tables 2 and 3 report the results of unit-root tests.[30] For the level of the savings rate (*savrna* and *savrbs*) and for the eight structural factors considered, the ADF and PP tests are unable to reject the null hypothesis of a unit root with drift against the trend-stationary alternative hypothesis (Table 3). Mixed evidence is found, however, for the Balance Sheet measure of the savings rate (*savrbs*) and for the public pension benefit replacement

27. For the NBSA-based measure of the personal savings rate, disposable income is defined as personal consumption (as measured in the NIEA) plus the NBSA-based estimate of personal savings, consistent with the identity “personal disposable income = consumption + savings.”

28. Net worth is an annual series, measured at year-end. The quarterly series on net worth was obtained by combining the annual net worth estimates and quarterly data from the Financial Flow Accounts on the household sector’s net acquisition of assets, minus its net accumulation of liabilities. Because the financial flows do not include capital gains on the assets already in the portfolios of the household sector, as well as some other adjustments, there is a discrepancy at year-end between the cumulated flows and the net worth estimates. In our series, this annual discrepancy is spread evenly throughout the year.

29. See Appendix 1 for a detailed description of the data.

30. For the ADF test, we follow the lag-selection procedure advocated by Ng and Perron (1995).

rate (*ppbrr*). Stationary tests performed on the first differences of all these variables (Table 2) indicate that the first difference of each series is mean-stationary (in most cases at less than the .01 per cent level). The exception is the demographic variable *pyold* for which both the ADF and PP tests cannot reject the unit-root hypothesis against the mean-stationary in the first difference, suggesting that the dependency ratio (*pyold*) is I(2). Based on casual observation, the first difference of the demographic variable is not stationary over our sample period (see Figure 13). This conclusion is clearly supported by our statistical stationarity tests. Stationary tests performed on the second difference of that variable (bottom of Table 2) indicate that the second difference of the demographic variable is mean-stationary (at the .025 level).

Taken together, these tests suggest that the savings rate and most of the structural factors are integrated of order one, that is, they are I(1)—with the exception of the demographic variable which is I(2))—and it is therefore appropriate to examine the possibility that they are cointegrated.

3.1 Estimating the long-run parameters of the National Income and Expenditure Accounts (NIEA) savings rate

We established in the previous section that the savings rate and most of the structural factors are integrated processes of order I(1), a necessary condition for cointegration. We pursue the empirical analysis by estimating the parameters of the following long-run relationship represented by equation (1):

$$SAVR_t = \alpha LR_t + \upsilon_t \tag{1}$$

where the "residual" υ_t is I(0) under the cointegration hypothesis. $SAVR_t$ is the savings rate, and LR_t is a vector comprising the structural factors listed above.

We estimate the long-run savings rate function (equation 1) using five different estimation procedures. The first estimation procedure is from Engle and Granger (1987) (EG), the second is in the error-correction framework (ECM), the third is the estimation procedure proposed by Phillips and Loretan (1991) (PL), the fourth is the Stock and Watson (1993) leads-and-lags procedure (SW), while the fifth is the fully modified (FM) procedure developed by Phillips and Hansen (1990).[31] We

31. In our analysis, it is unlikely that the real interest rate and the ratio of household net worth to personal disposable income are strongly exogenous with respect to the savings rate. The PL, SW, and FM estimators correct for the endogeneity bias that is likely to be present in the right-hand-side variables and results in cointegrating parameters that are asymptotically efficient, which is not the case for the EG and ECM estimates. In addition, simulation studies by Phillips and Loretan (1991) and Stock and Watson (1993) indicate that the FM, PL, and SW estimates have more desirable finite sample properties than the EG and ECM estimates.

use more than one estimation procedure to ensure that our results are robust with respect to the choice of procedure.

We examine all combinations of possible cointegrating vectors involving the eight structural factors listed above and follow a “general-to-specific” testing procedure in order to isolate a combination of the structural factors that is cointegrated with the observed savings rate. This involves eliminating structural factors in a step-wise manner, on the basis of the least significant long-run parameter and/or on the basis of a counterintuitive sign.[32]

The general specification is the following:

$$\alpha LR = \alpha_1 rr + \alpha_2 ecpi + \alpha_3 pgdef + \alpha_4 rbs + \alpha_5 rconsc + \alpha_6 ppbrr + \alpha_7 rnu + \alpha_8 pyold. \qquad (1.1)$$

As for the unit-root test, the evidence of cointegration is evaluated on the basis of the ADF test and the Phillips-Perron normalized bias test. The estimated long-run parameters corresponding to equation (1.1) over the 1965Q1-96Q4 period along with the cointegration tests are presented in Table 4. To simplify our presentation, we report the estimation results using the Stock and Watson procedure only. Note that these estimates are derived with four lags and four leads on all the variables. Several points are noteworthy. First, among all the combinations examined, there is never evidence of cointegration whenever the dependency ratio (*pyold)* is included in the specification (see first line in Table 4). This result may reflect the fact that the dependency ratio appears to be an I(2) process over our sample period. Excluding the dependency ratio from the general specification results in the following vector:

$$\alpha LR = \alpha_1 rr + \alpha_2 ecpi + \alpha_3 pgdef + \alpha_4 rbs + \alpha_5 rconsc + \alpha_6 ppbrr + \alpha_7 rnu. \qquad (1.2)$$

Second, the evidence that the savings rate is cointegrated with the above seven structural factors is mixed. The ADF test fails to reject the null of non-cointegration at a .10 level, while the PP test rejects the same null at the .05 level. As can be seen from Table 4, all the estimated parameters are of the expected signs and statistically significant with the exception of *ppbrr* and *rnu*. The estimated parameter for α_6 (*ppbrr*) is positive implying that *ppbrr* has positive effects on the savings rate in the long run. Although it is not impossible for PAYGO public pension plans to lead to a

32. Under the cointegration hypothesis, the parameters α have well-defined statistical properties and valid inferences can be made, provided that the appropriate statistical procedures are used. However, under the null of no-cointegration, estimates of α would have no well-defined statistical interpretation (Phillips 1986). Moreover, the estimated t-statistics corresponding to the parameters of the structural factors α would be biased upwards. Consequently, inferences made using conventional statistical procedures would be invalid. Hence, in our methodology, cointegration tests are performed for each long-run relationship examined in order to isolate a combination of the structural factors that is cointegrated with the observed savings rate and for which valid inferences can be performed.

higher personal savings rate, the positively signed coefficient is contrary to our priors. Although the estimated parameter for α_7 *(rnu)* is correctly signed, it is not statistically different from zero.

In line three of Table 4, we report the hypothesized cointegration vector when the public pension benefit replacement rate (*ppbrr)* is excluded from the long-run equation. The evidence of cointegration increased somewhat but remains nevertheless mixed. The ADF test fails to reject the null of non-cointegration at the .10 level, while the PP test rejects the same null at the .025 level. In addition, the estimated parameter corresponding to the unemployment rate (*rnu*) remains statistically insignificant. Estimates of the long-run parameters excluding the unemployment rate (*rnu*) from the vector are reported in the fourth line of Table 4. When only *rr, ecpi, pgdef, rbs,* and *rconsc* are included in the vector, there is more convincing evidence of cointegration. Both the ADF and the PP statistics reject the null of no cointegration, the former at the .10 level and the latter at the .05 level.

Table 5 reports the estimated long-run parameters corresponding to the vector: ($\alpha_1 rr$ + $\alpha_2 ecpi$ + $\alpha_3 pgdef$ + $\alpha_4 rbs$ + $\alpha_5 rconsc$) using all the alternative estimation procedures. It is clear from Table 5 that the estimated long-run parameters are not robust, even qualitatively, with respect to different estimation procedures. In particular, the long-run estimated parameter α_5 associated with the *rconsc* variable changes substantially depending on the estimating procedure used and is statistically significant only in the case of the SW procedure. Moreover, there is no evidence of cointegration when the ECM and PL procedures are used and mixed evidence is obtained with the EG and FM procedures.

Implicit in the inferences presented above is the assumption that the long-run parameters reported in Table 5 are invariant with respect to time. If the long-run parameters were to change through time, these inferences would be invalid. In order to test for this type of misspecification, we examine the stability of the estimated long-run parameters using Hansen's (1992) tests for parameter non-constancy for I(1) processes. Hansen proposes three tests—SupF, MeanF, and Lc—that examine the null hypothesis of a stable cointegrating relationship among I(1) variables against different alternative hypotheses.[33] We apply these tests using estimates obtained from the FM procedure, which are presented in the first line of Table 7. Overall, stability tests when applied over the 1965–96 period suggest that the estimated long-run relationship between the savings rate and the *rr*, *ecpi*, *pgdef* , *rbs,* and *rconsc* variables is unstable.

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33. The SupF test is designed to detect a discrete break in the parameters at an unknown break point, while the MeanF and Lc tests are designed to detect gradual time variation in the parameters.The SupF, MeanF, and Lc tests were implemented using a GAUSS procedure provided by Bruce Hansen.

We examine an alternative specification in which the *rconsc* variable is excluded. The estimated long-run parameters corresponding to the vector ($\alpha_1 rr + \alpha_2 ecpi + \alpha_3 pgdef + \alpha_4 rbs$) are reported in Table 6. As for the previous specifications examined above, we test for cointegration using the "residual-based" version of the ADF t-test and the PP parameter bias test. An alternative approach to testing for cointegration performed within the error-correction framework is also examined. This involves estimating an error-correction model with a general form given by equation (2):

$$C(L)\Delta savr_t = D(L)\Delta LR_t + \gamma[savr_{t-1} - \alpha LR_{t-1}] + \nu_t \qquad (2)$$

where $\Delta savr_t$ is the first difference in the savings rate and ΔLR_t is a vector of the first difference in the long-run determinants that is intended to capture dynamics arising from factors other than the random error term, ν_t. The variables comprising ΔLR_t are I(0) and hence have no permanent effect on $savr_t$. The dynamic relationship between the savings rate and the explanatory variables is modelled using an unrestricted autoregressive distributed lag specification defined by C(L) and D(L), the polynomial lags operators. For $\gamma < 0$, the error-correction term ensures that $savr_t$ converges towards αLR_t in the long-run and provides further evidence of cointegration.[34] A rejection of the *non-cointegration* hypothesis, $\gamma = 0$, against the (stationary) alternative hypothesis: $\gamma < 0$ is evidence that $savr_t$ and αLR_t are *cointegrated*. This suggests that one can test for cointegration in the context of (2) by making inferences on the basis of the t-statistic corresponding with $\hat{\gamma}$, which we will refer to as $\hat{\tau}_\gamma$.[35] As with the "residual-based" tests for cointegration, we test for cointegration within the error-correction framework using alternative estimates of the cointegration vector derived using the four estimation procedures outlined above. For the EG, PL, SW, and FM estimation procedures, we test for cointegration in the error-correction framework, using a two-step procedure. In the first step, we estimate the cointegration vector α using the EG, PL, SW, and FM procedures. In the second step, we estimate the parameter, γ, within the error-correction framework conditional on the estimates of the cointegration vector obtained from the first step (i.e., α^{EG}, α^{PL}, α^{SW} and α^{FM}). For the ECM estimation procedure, this involves estimating the cointegration

34. The Granger Representation Theorem states that, if two variables (or a variable versus a vector of variables) are cointegrated, then there exists an error-correction model that can capture the dynamics underlying the cointegrating relationship between the variables (see Engle and Granger 1987).

35. The limiting distribution of $\hat{\tau}_\gamma$ is not *invariant* with respect to the specification of the error-correction model. The limiting distribution of $\hat{\tau}_\gamma$ depends on the data generating process underlying the variables in the error correction model. (See Banerjee, Dolado, and Mestre [1993] and Kremers, Ericsson, and Dolado [1992].) Banerjee, Dolado, and Mestre (1993) have calculated critical values for $\hat{\tau}_\gamma$ by simulating an error-correction model with artificial data. Although these critical values do not correspond with the error-correction model that we estimate, they provide a guideline for making inferences about cointegration within the error-correction framework.

vector, α^{ECM}, simultaneously with the parameter, γ, by applying non-linear least squares to the error-correction framework. This allows us to examine whether the tests for cointegration within the error-correction framework are robust with respect to alternative estimates of the cointegration vector.

As can be seen from Table 6, the estimated long-run parameters are all of the expected signs and statistically significant, in most cases at conventional levels. Also, the estimates obtained using the alternative estimation procedures are qualitatively the same. These estimates suggest that the *rr*, *ecpi*, and *pgdef* have a positive effect on the savings rate in the long run while *rbs* has a negative effect. Moreover, the cointegration test results indicate definitely stronger evidence of cointegration when compared to the previous specification examined. The evidence supporting a cointegrating relationship between the savings rate and the vector represented by the structural factors *rr, ecpi*, *pgdef,* and *rbs is* quite robust—we can reject the *non-cointegration* hypothesis (at least at the .10 level) on the basis of the ADF and PP tests with virtually all the alternative estimation procedures.[36] Cointegration tests results within the error-correction framework using the five estimation procedures are presented in the last column of Table 6. The estimated parameter associated with the error-correction term is negative, as expected, and statistically significant in all five error-correction models. We can reject the *non-cointegration* hypothesis (at the .05 level) based on the ECM t-statistics ($\hat{\tau}_{\gamma}$), regardless of the estimation procedure used to estimate the cointegration vector. This finding provides further evidence of cointegration between the savings rate and the structural factors *rr, ecpi*, *pgdef*, and *rbs* over the 1965–96 period.

We examine the stability of the above estimated long-run parameters using Hansen's stability tests. The results, presented in the second line of Table 7, are somewhat mixed. There is some evidence of a discrete break in the parameters at an unknown break point in the savings rate specification—the probability value for the SupF statistic is .04. There is, however, stronger evidence of stability when the Lc and MeanF tests are used. The latter are designed to detect gradual time variation in the parameters. The mixed evidence of stability between the savings rate and the vector represented by the structural factors *rr, ecpi*, *pgdef,* and *rbs* may be suggestive of misspecification arising from measurement error.

In our analysis up to this point, we have examined estimates of long-run parameters relating the savings rate to various structural factors. We have found that the real interest rate (*rr)*, expected inflation *(ecpi)*, the all-government fiscal balances as a share of nominal GDP (*pgdef*), and the ratio

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36. In our empirical analysis, we put more emphasis on the results of the Phillips and Loretan procedure, the Stock and Watson procedure, and the Fully modified procedure—given their more desirable finite sample properties (see Footnote 31).

of net worth to personal disposable income (*rbs)* are significant determinants of trend movements in the observed savings rate. Although the trend in the savings rate is best captured by these structural factors, there is still a theoretical case for the other variables left out in the final specification to be important in identifying trend saving. For instance, the absence of statistical evidence in favour of cointegration when the demographic and public pension variables are included in the vector of structural factors does not necessarily mean that the effects of these factors are not important in explaining movements in saving across business cycles. Misspecification arising, for instance, from measurement error may play an important role in determining which long-run determinants are relevant for explaining the trend savings rate. As much as possible, we have used proxies for the structural factors constructed in a manner that is consistent with other research. Also, we suspect that the mixed evidence of long-run stability between the savings rate and the structural factors *rr*, *ecpi*, *pgdef*, and *rbs* may be due to the variable used to proxy expected inflation. Indeed, measurement of an unobservable variable, such as expected inflation, has proved to be somewhat difficult in empirical work (Ricketts, 1996). The evidence of a discrete break in the parameters at an unknown break point in the savings rate specification reported earlier may reflect that fact.

We use an alternative measure of inflation expectations to explore the robustness of our results to our measure of expected inflation. More specifically, we use a measure that is generated by a 3-state Markov-switching model for inflation that allows for shifts in the inflation process (Ricketts 1995). Table 8 presents the estimation results. The estimates of the long-run parameters defining the trend savings rate are very similar to those of the benchmark estimates (Table 6) though the evidence of cointegration is not quite as convincing as that of our benchmark equation.

In an effort to isolate the possible measurement bias related to the use of a proxy for expected inflation, we examine the long-run relationship between a measure of savings rate adjusted for inflation and our selected structural factors. Interestingly, we never found any evidence of cointegration whenever expected inflation is absent from the structural factors considered. This result seems to suggest that the positive relationship between the savings rate and inflation goes beyond the one that is related to the inflation premium necessary to compensate lenders for the expected decline in the purchasing power of their assets (see Appendix 2). Accordingly, we re-examined the long-run relationship between the measure of savings rate adjusted for inflation and our selected structural factors, this time adding expected inflation this time to the right-hand-side variables. We found that the estimated long-run parameter associated with our inflation expectation variable was reduced by about half of a percentage point. Moreover, cointegration was still holding with little change to the estimated parameters on the other structural factors. This result suggests that the positive relationship between the savings rate and inflation has to be explained by other factors, such as uncertainty. For instance, inflation may create uncertainty regarding future real income and lead risk-averse households to increase their precautionary savings (Sandmo 1970). The interaction between inflation and the tax system may also play a role beyond that of expectation.[37]

The estimation results reported in Tables 4 through 6 for the ECM, PL, and SW procedures are derived with four lags and four leads on all variables. This fourth-order dynamic specification was selected in part on the basis of the Final Prediction Error, Akaike's (1969) Information Criterion, and Schwarz's (1978) Bayesian Information Criterion.[38] When we apply an alternative dynamic specification to the ECM, PL and SW procedures, we generally obtain similar estimates of the long-run parameters. For example, estimates of the long-run parameters corresponding to the vector $\alpha_1 rr + \alpha_2 ecpi + \alpha_3 pgdef + \alpha_4 rbs$, obtained using a second-order dynamic specification (see Table 9), are qualitatively the same as those of the benchmark estimates (Table 6). The cointegration tests results reported in Table 9 are overall robust with respect to the dynamic specification.

3.2 Estimating the long-run parameters of the National Balance Sheet Accounts (NBSA) savings rate

We also attempted to estimate the underlying trend in the balance-sheet savings rate following the methodology outlined in the previous section. We took into account the same variables as for the NIEA measure since the fundamental factors influencing savings decisions should be invariant with respect to measurement issues.

Preliminary results suggest that long-run movements in the balance-sheet savings rate are best explained by the real interest rate, expected inflation, and the ratio of household net worth to personal disposable income over our sample period (see Table 10). The all-government fiscal-balances variable is not part of the final equation and the estimated parameter on the real interest rate is now negative. Similar results on the effect of the real interest rate are reported in Thomas and Towe (1996). They note that the inclusion of consumer durables in a measure of savings may result in a downward bias on the estimated parameter of the real interest rate. A measure of return on competitive assets was also included without improving the estimation results. The estimated parameter on the real interest rate remained negative. Nevertheless, the decline in the balance-sheet measure of savings since the early eighties seems to reflect the effect of trend factors (see

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37. We also tested the sensitivity of the estimation results to the introduction of an after-tax real rate of return obtained by assuming a constant marginal tax rate of 30 per cent calculated as follows: nominal interest rate *(1-.3) - expected inflation, and found similar estimates of the long-run parameters.
38. Cozier and Tkacz (1994) finds evidence that changes in the term structure, for example, are related to consumption growth over a period of up to two years, although the maximum effect is reached after one year.

Figure 16). However, the statistical evidence supporting this long-run relationship is not as conclusive as that for the NIEA savings rate. For instance, stability tests suggest that the estimated long-run relationship for the balance-sheet savings rate is unstable and, thus, further work is warranted.

3.3 Empirical interpretation of the trend NIEA savings rate

In this section, we examine empirically the trend savings rate based on the estimates of the following equation ($\alpha_1 rr + \alpha_2 ecpi + \alpha_3 pgdef + \alpha_4 rbs$) using the SW estimation procedure. Although the alternative estimation procedures produce different long-run parameter estimates, the resulting trends are, however, qualitatively similar. The differences in the estimates affect the relative contribution of each long-run factor to the trend savings rate.

Figure 14 illustrates the observed NIEA savings rate along with the trend savings rate over the 1965Q1–98Q3 period. Our results suggest that the upward increase in the trend savings rate from the mid-sixties to the early eighties and the downward trend thereafter stem largely from its strong relationship with expected inflation and, to a lesser extent, from its relationship with the all-government fiscal balances (see Figure 15). The ratio of net worth to personal disposable income has played a more modest role in explaining long-run movements in the savings rate, although it has been more an important factor since the early nineties.

The strong relationship between the NIEA measure of the personal savings rate and the expected-inflation variable reflects in large part a measurement problem. Measured income in the NIEA includes the inflation premium that compensates lenders for the expected decline in the purchasing power of their assets. An implication of this treatment is that the NIEA measure of the personal savings rate tends to rise and fall with the rate of inflation (see Appendix 2).

Figure 4 presents the NIEA measure of the personal savings rate along with a measure adjusted for inflation. The latter was obtained using the methodology outlined in Lau (1993). As can be seen, although the inflation adjustment reduces the amplitude of movements in the adjusted savings rate, the broad movements between the two measures are, however, very similar. The decline in inflation from about 5-1/2 per cent in 1991 to about 1 per cent by the end of 1997 has contributed significantly to narrowing the gap between these two measures. It is noteworthy that, after adjusting for inflation, the savings rate remains correlated with inflation.[39]

39. Over the 1965Q1–96Q4 period, the correlation between the NIEA savings rate and expected inflation is 0.73 while the correlation between the NIEA savings rate adjusted for inflation and expected inflation is 0.53.

As was reported earlier, the estimated long-run parameter on our inflation-expectation variable was reduced by about half when using a measure of the savings rate adjusted for inflation. One possible interpretion for this result is that, in addition to the measurement issue, the positive relationship between the savings rate and inflation could be explained by other factors, such as uncertainty. In particular, inflation may add to the uncertainty regarding future real income and lead risk-averse households to increase their precautionary savings. Another possible interpretation may be found in the interaction between inflation and the tax system, which may play a role beyond that of expectation.

While the contribution of expected inflation to the trend savings rate has been declining in recent years, the role of the net worth to disposable income ratio as a factor in explaining movements in the trend savings rate has increased markedly (Figure 9). The rise in the ratio of net worth to personal disposable income between 1990 and 1997 has contributed to reduce the NIEA savings rate by about 2 percentage points according to our long-run estimates.[40]

Another important determinant of the trend savings rate, over our sample, is the ratio of the all-government fiscal balances to nominal GDP. This ratio appears to have played a role in the rise in the savings rate in the early eighties and nineties and contributed to its decline since 1993.[41] Our coefficient estimate on the all-government fiscal-balances ratio is consistent with other empirical studies for industrial countries, which suggest that a persistent increase in the government dissaving would be offset in a proportion of 50 to 60 per cent by higher household saving (Bernheim 1987; Masson, Bayoumi, and Samiei 1995). The response of households to a persistent change in the government sector fiscal situation may well reflect consumption-smoothing behaviour in the expectation that the shift in fiscal policy would eventually lead in the future either to a change in taxes or government spending.

40. In recent years, households have significantly increased their holdings of stocks, either through direct ownership or through mutual funds. Stocks have increased sharply in value.

41. The correlation between the savings rate and the all-government fiscal-balances variable is 0.51 over the 1965Q1–96Q4 period.

4. Conclusions

In this paper, we examined the long-run determinants of the personal savings rate in Canada over the 1965–96 period. To summarize, the main conclusion we draw from our analysis is that the real interest rate, expected inflation, the ratio of the all-government fiscal balances to nominal GDP, and the ratio of household net worth to personal disposable income are the most important determinants of the trend savings rate as defined in the National Income and Expenditure Accounts (NIEA). In particular, our results suggest that the upward trend in the savings rate from the mid-sixties to the early eighties and the downward trend thereafter stem largely from its strong relationship with expected inflation and, to a lesser extent, from the effects of persistent changes in all-government fiscal balances. Although the ratio of net worth to personal disposable income played a relatively modest role in explaining long-run movements in the savings rate prior to 1990, its rise between 1990 and 1997, boosted by capital gains on equities, is estimated to have contributed to reduce the NIEA measure of the savings rate by about 2 percentage points. While our results need to be interpreted with caution, they suggest that in the current environment of low inflation and government fiscal balances moving into surpluses, the trend NIEA savings rate could remain low. Our results are supported by formal statistical tests for cointegration and appear to hold with respect to alternative measures of expected real interest rates and to several econometric issues.

In the case of the balance-sheet savings rate, the results suggest that the determinants that seem to explain its long-run movements are the real interest rate, expected inflation, and the ratio of household net worth to personal disposable income. However, the statistical evidence supporting this long-run relationship is not as conclusive as that for the NIEA savings rate and so further work would be helpful.

We would like to draw attention to the nature of the statistical evidence relating the personal savings rate and the various long-run determinants. First, our analysis has abstracted from issues relating to the cyclical component of the savings rate by focusing exclusively on its underlying trend. Accordingly, we have little to say about how the savings rate is determined in the short run. Second, the analysis presented in this paper does not encompass all the factors that could potentially influence the savings rate. We have limited our analysis to the factors most discussed in the literature. Many of the potential determinants of personal savings are correlated with each other, making the identification of statistical relationships between the savings rate and its individual structural determinants difficult irrespective of whether the correlation between explanatory variables is spurious or based on causal links.

Third, although there is a theoretical case for all the structural factors considered to be important in identifying trend savings rate, misspecification arising from measurement error may be important in determining which structural factors seem the most relevant for explaining long-run movements in the personal savings rate. We have used proxies for the long-run determinants that are consistent with previous research. Our empirical proxies provide only rough measures of the structural factors that are of economic interest. For these reasons, the absence of a long-run relationship between the savings rate, and the demographic and public pension variables, for example, does not necessarily imply that there is no role for the latter two factors in explaining long-run movements in the personal savings rate. In the case of the public pension variable, the absence of a long-run relationship with the savings rate may well reflect the fact that our proxy is a poor approximation of the complexity of this program. More generally, when analyzing the implications of pension plans for trend savings rate, it may also be necessary to consider contractual and non-contractual pension plans separately. Issues of this nature, however, are deferred to future research.

Fourth, while our main results are qualitatively robust with respect to a variety of issues, they are quantitatively sensitive to alternative estimation procedures as well as alternative dynamic specifications. Moreover, although our best equation captures long-run movements in the NIEA savings rate quite well, there remain some problems such as the mixed evidence of long-run stability between the savings rate and the structural factors *rr, ecpi*, *pgdef*, and *rbs.* We suspect that the mixed evidence of long-run stability may result from the measurement error issue (related to expected inflation) discussed earlier in the paper, and points the way for further investigation on trend savings rate.

We would like to end by commenting briefly on our main empirical findings. According to our results, the upward trend in the savings rate from the mid-sixties to the early eighties and the downward trend thereafter stem largely from its strong relationship with expected inflation and, to a lesser extent, from its relationship with the all-government fiscal balances. The latter result represents an interesting avenue for future research on the relationship between personal saving and fiscal policy.

Table 1

Net savings per major sectors as a percentage of nominal GDP
Annual averages (1961–1998)

	Personal savings	Business savings	Government savings	Non-residents savings	Net total savings	Total CCA	Total gross savings
1961-69	3.7	3.9	2.7	1.4	11.6	11.7	23.3
1970-79	6.7	3.3	1.0	1.4	12.5	11.3	23.7
1980-89	8.9	2.5	-3.1	1.5	9.8	11.7	21.5
1990-98	4.9	1.8	-3.3	2.3	5.9	12.5	18.4
1995	4.7	4.1	-3.6	0.4	5.5	12.5	18.0
1996	3.4	3.4	-1.5	-0.7	4.5	12.8	17.3
1997	1.3	3.3	1.3	1.2	7.1	12.7	19.9
1998	0.7	2.3	1.8	2.2	7.1	12.9	20.0

Table 2

Stationarity tests

Tests in the absence of drift [a]		
	Unit-root tests [b]	
Variables	***ADF:*** $\hat{\tau}_\mu$	***PP:*** $Z(\hat{\alpha})$
Sample: 1965Q1–96Q4 (128 observations)		
Δsavrna	-10.34 [<.01]	-153.05 [<.01]
Δsavrnaaj	-10.81 [<.01]	-141.49 [<.01]
Δsavrbs	-5.76 [<.01]	-137.95 [<.01]
Δrr	-5.11 [<.01]	-86.56 [<.01]
Δecpi	-4.38 [<.01]	-21.71 [<.01]
Δpgdef	-3.04 [.05]	-132.96 [<.01]
Δpyold	-0.59 [>.10]	-2.13 [>.10]
Δppbrr	-12.71 [<.01]	-130.73 [<.01]
Δrconsc	-2.71 [.10]	-185.03 [<.01]
Δrbs	-2.98 [.05]	-154.42 [<.01]
Δrnu	-6.16 [<.01]	-56.15 [<.01]
Δ^2pyold	-3.28 [.025]	-17.52 [.025]

a. In the absence of drift the ADF and PP tests include a constant term but do not include a linear time trend whereas in the presence of drift they include a constant term as well as a linear time trend.

b. The ADF and PP normalized bias statistics test the null hypothesis of non-stationarity (i.e., H_0: y is I(1)) against the alternative hypothesis of stationarity (i.e., H_1: y is I(0)). P-values for the ADF t-statistics and the PP normalized bias statistics (reported in square brackets) are obtained from the critical values reported by Davidson and MacKinnon (1993, Table 20.1).

Table 3

Stationarity tests

Tests in the <u>presence</u> of drift[a]		
	Unit-root tests	
Variables	***ADF:*** $\hat{\tau}_\tau$	***PP:*** $Z(\tilde{\alpha})$
Sample: 1965Q1-96Q4 (128 observations)		
savrna	-1.03 [>.10]	-4.29 [>.10]
savrnaaj	-1.40 [>.10]	-7.45 [>.10]
savrbs	-1.96 [>.10]	-41.66 [<.01]
rr	-2.00 [>.10]	-9.93 [>.10]
ecpi	-1.42 [>.10]	-6.39 [>.10]
pgdef	-1.90 [>.10]	-6.79 [>.10]
pyold	-2.10 [>.10]	1.65 [>.10]
ppbrr	-3.75 [.025]	-14.63 [>.10]
rconsc	-1.98 [>.10]	-5.29 [>.10]
rbs	0.44 [>.10]	-0.23 [>.10]
rnu	-1.90 [>.10]	-4.65 [>.10]

a. See notes to Table 2.

Table 4

Cointegration tests for the national accounts savings rate

Estimates of the long-run parameters ***Sample: 1965Q1-96Q4, 128 observations***	***Cointegration tests***[a]	
(αLR_t)[b]	***ADF*** $\hat{\tau}_\mu$	***PP*** $Z(\hat{\alpha})$
.57 - .10rr + .24ecpi + .28pgdef -.02rbs - .44rconsc - .19ppbrr -. 12rnu - .32pyold (5.31)[c] (0.77) (1.25) (2.63) (3.26) (3.87) (2.62) (0.53) (3.85)	-1.23 [>.10]	-19.62 [>.10]
.16 + .33rr + .88ecpi + .39pgdef - .03rbs - .22rconsc + .04ppbrr + .04rnu (5.91) (7.89) (13.61) (4.48) (3.81) (2.42) (1.36) (0.31)	-4.17 [>.10]	**-54.49** **[.05]**
.11 + .37rr + .96ecpi + .41pgdef - .02rbs - .11rconsc + .11rnu (5.60) (8.12) (15.69) (5.55) (2.76) (1.63) (0.99)	-4.60 [>.10]	**-56.26** **[.025]**
.14 + .27rr + .89ecpi + .69pgdef - .02rbs - .17rconsc (7.88) (4.56) (18.07) (12.80) (3.10) (2.27)	**-4.67** **[.10]**	**-43.51** **[.05]**

a. The ADF and PP statistics test the null hypothesis of *non-cointegration* (i.e., H_0: S_t - αLR_t is I(1)) against the alternative hypothesis of *cointegration* (i.e., H_1: S_t - αLR_t is I(0)). Probability values for the ADF t-statistics (reported in square brackets) are obtained from the critical values reported by MacKinnon (1991, Table 1) while those for the PP normalized bias statistics are obtained from the critical values reported by Haug (1992, Table 2).

b. The estimates of the long-run parameters reported above are obtained using the Stock-Watson procedure.

c. Absolute t-statistics reported in parentheses in Table 4 through Table 10.

Table 5

Cointegration tests for the national accounts savings rate

Estimates of the long-run parameters ***Sample: 1965Q1-96Q4, 128 observations***		***Cointegration tests***[a]	
	(αLR_t)	**ADF $\hat{\tau}_\mu$**	**PP $Z(\hat{\alpha})$**
	$\alpha_0 + \alpha_1$rr $+ \alpha_2$ecpi $+ \alpha_3$pgdef $+ \alpha_4$rbs $+ \alpha_5$rconsc		
EG	.16 + .45rr + .85ecpi + .55pgdef - .03rbs - .02rconsc	-4.08 [>.10]	**-57.93** **[<.01]**
ECM	.55 - .25rr - .81ecpi + 1.47pgdef - .19rbs + 1.80rconsc (1.34) (0.36) (0.47) (1.72) (1.12) (0.88)	-3.51 [>.10]	-16.32 [>.10]
PL	.28 + .03rr + .36ecpi + .83pgdef - .07rbs + .33rconsc (1.68) (0.07) (0.61) (2.94) (1.17) (0.55)	-3.74 [>.10]	-28.21 [>.10]
SW	.14 + .27rr + .89ecpi + .69pgdef - .02rbs - .17rconsc (7.88) (4.56) (18.07) (12.80) (3.10) (2.27)	**-4.67** **[.10]**	**-43.51** **[.05]**
FM	.18 + .39rr + .82ecpi + .60pgdef - .04rbs - .02rconsc (5.39) (4.42) (9.57) (8.99) (3.60) (0.14)	-3.97 [>.10]	**-51.02** **[.025]**

a. The ADF and PP statistics test the null hypothesis of *non-cointegration* (i.e., H_0: S_t - αLR_t is I(1)) against the alternative hypothesis of *cointegration* (i.e. H_1: S_t - αLR_t is I(0)). Probability values for the ADF t-statistics (reported in square brackets) are obtained from the critical values reported by MacKinnon (1991, Table 1) while those for the PP normalized bias statistics are obtained from the critical values reported by Haug (1992, Table 2).

Table 6

Cointegration tests for the national accounts savings rate

Estimates of the long-run parameters ***Sample: 1965Q1-96Q4, 128 observations***		***Cointegration tests***[a] **Error-correction term (γ)**		
	(αLR_t)	***ADF*** $\hat{\tau}_\mu$	***PP*** $Z(\hat{\alpha})$	***ECM:*** $\hat{\tau}_\gamma$
	$\alpha_0 + \alpha_1 rr + \alpha_2 ecpi + \alpha_3 pgdef + \alpha_4 rbs$			γ
EG	.16 + .45rr + .85ecpi + .55pgdef - .03rbs	-4.09 [>.10]	**-58.17** **[<.01]**	**-0.21** **(2.25)**
ECM	.21 + .26rr + .77ecpi + .84pgdef - .04rbs (2.88) (1.33) (4.41) (4.27) (2.54)	-3.76 [>.10]	**-36.88** **[.10]**	**-0.25** **(2.42)**
PL	.12 + .35rr + .99ecpi + .60pgdef - .02rbs (1.65) (1.58) (5.07) (2.57) (1.40)	**-4.69** **[.025]**	**-47.15** **[.025]**	**-0.22** **(2.24)**
SW	.11 + .33rr + .96ecpi + .68pgdef - .02rbs (4.75) (4.98) (15.00) (8.29) (3.95)	**-4.74** **[.025]**	**-45.43** **[.025]**	**-0.23** **(2.32)**
FM	.15 + .48rr + .90ecpi + .58pgdef - .03rbs (4.19) (4.90) (10.00) (8.26) (3.78)	**-4.35** **[.10]**	**-58.22** **[<.01]**	**-0.23** **(2.35)**

a. The ADF and PP statistics test the null hypothesis of non-cointegration (i.e., H_0: $S_t - \alpha LR_t$ is I(1)) against the alternative hypothesis of cointegration (i.e., H_1: $S_t - \alpha LR_t$ is I(0)). Probability values for the ADF t-statistics (reported in square brackets) are obtained from the critical values reported by MacKinnon (1991, Table 1) while those for the PP normalized bias statistics are obtained from the critical values reported by Haug (1992, Table 2). The error-correction term is represented by the parameter γ and the critical values for $\hat{\tau}_\gamma$ in the case of the ECM one-step procedure are from Banerjee et al. (1993, Table 4).

Table 7

Sensitivity analysis of the national accounts savings rate long-run equation estimates

Stability tests

(Sample: 1965Q1-96Q4, 128 observations)

Estimates of long-run parameters[a]	*Stability tests*[b]		
(αLR_t)	L_c	*MeanF*	*SupF*
.18 + .39rr + .82ecpi + .60pgdef - .04rbs - .02rconsc (5.39) (4.42) (9.57) (8.99) (3.60) (0.14)	0.78 [.15]	11.45 [.03]	27.50 [.01]
.15 + .48rr + .90ecpi + .58pgdef - .03rbs (4.19) (4.90) (10.00) (8.26) (3.78)	0.53 [>.20]	6.67 [.19]	19.62 [.04]

a. The estimates of the long-run parameters reported above are obtained using the Phillips-Hansen fully modified estimator procedure (FM) as presented in the last row of Tables 5 and 6. The FM estimator uses residuals that are prewhitened with a VAR(2) to correct for serial correlation.

b. The L_c, MeanF and SupF tests examine the null hypothesis of a stable long-run relationship among I(1) variables against different alternative hypotheses. A rejection of the null hypothesis provides evidence of parameter instability. Probability values are reported in square brackets.

Table 8

Sensitivity analysis of the national accounts savings rate long-run equation estimates

Alternative measure of expected inflation from Markov-switching model

(Sample: 1965Q1-96Q4, 128 observations)

	Estimates of long-run parameters	*Cointegration tests*[a]	
	(αLR_t)	*ADF* $\hat{\tau}_\mu$	*PP* $Z(\hat{\alpha})$
	$\alpha_0 + \alpha_1$mrr + $\alpha_2$msm + $\alpha_3$pgdef + $\alpha_4$rbs		
ECM	.21 + .29mrr + .78msm + .80pgdef - .04rbs (3.30) (1.43) (4.79) (4.41) (2.89)	-3.98 [>.10]	**-68.35** **[<.01]**
PL	.12 + .40mrr + 1.06msm + .52pgdef - .02rbs (1.88) (2.00) (5.96) (2.53) (1.60)	-3.71 [>.10]	**-66.45** **[<.01]**
SW	.12 + .38mrr + .95msm + .66pgdef - .02rbs (5.55) (5.73) (16.22) (7.23) (4.81)	**-4.63** **[.05]**	**-73.74** **[<.01]**

a. See notes to Table 5.

Table 9

Sensitivity analysis of the national accounts savings rate long-run equation estimates

2th-order dynamic specification

(Sample: 1965Q1-96Q4, 128 observations)

Estimates of the long-run parameters	***Cointegration tests***[a]	
(αLR_t)	***ADF*** $\hat{\tau}_\mu$	***PP*** $Z(\hat{\alpha})$
$\alpha_0 + \alpha_1$rr + $\alpha_2$ecpi + $\alpha_3$pgdef + $\alpha_4$rbs		
ECM .20 + .31rr + .67ecpi +.85pgdef - .04rbs (2.02) (1.12) (2.60) (3.14) (1.71)	**-4.34** **[.10]**	**-36.37** **[.10]**
PL .16 + .39rr + .83ecpi + .67pgdef - .03rbs (2.68) (2.12) (5.32) (3.87) (2.30)	**-4.37** **[.10]**	**-51.76** **[<.01]**
SW .14 + .36rr + .88ecpi + .67pgdef - .03rbs (8.24) (5.82) (17.51) (8.72) (7.45)	**-4.60** **[.05]**	**-50.13** **[<.01]**

a. See notes to Table 5.

Table 10

Cointegration tests for the balance-sheet savings rate

Estimates of the long-run parameters ***Sample: 1965Q1-96Q4, 128 observations***	***Cointegration tests***[a]	
(αLR_t)	***ADF $\hat{\tau}_\mu$***	***PP $Z(\hat{\alpha})$***
$\alpha_0 + \alpha_1 rr + \alpha_2 ecpi + \alpha_3 pgdef + \alpha_4 rbs$		
EG .61 - .24rr + .52ecpi - .38pgdef - .09rbs	-3.78 [>.10]	**-80.70 [<.01]**
PL .95 - 1.48rr + .08ecpi + 1.01pgdef - .17rbs (3.54) (2.04) (0.12) (1.42) (2.69)	-4.00 [>.10]	**-60.04 [<.01]**
SW .68 - .86rr + .72ecpi + 0.48pgdef - .11rbs (8.40) (3.57) (3.95) (2.29) (5.72)	**-4.29 [.10]**	**-66.21 [<.01]**
$\alpha_0 + \alpha_1 rr + \alpha_2 ecpi + \alpha_3 rbs$		
EG .68 - .46rr + .32ecpi - .10rbs	**-3.86 [.10]**	**-79.51 [<.01]**
PL .75 - .71rr + .45ecpi - .12rbs (3.19) (1.41) (0.86) (2.22)	**-4.16 [.05]**	**-76.65 [<.01]**
SW .58 - .49rr + .89ecpi - .09rbs (8.83) (1.99) (4.21) (5.63)	**-4.40 [.025]**	**-73.32 [<.01]**

a. The ADF and PP statistics test the null hypothesis of *non-cointegration* (i.e., $H_{0::}$ S_t - αLR_t is I (1)) against the alternative hypothesis of *cointegration* (i.e., H_1: S_t - αLR_t is I(0)). Probability values for the ADF t- statistics (reported in square brackets) are obtained from the critical values reported by MacKinnon (1991, Table 1) while those for the PP normalized bias statistics are obtained from the critical values reported by Haug (1992, Table 2).

Figure 1
Net savings per major sectors as a percentage of nominal GDP
Annual averages (1961–1998)

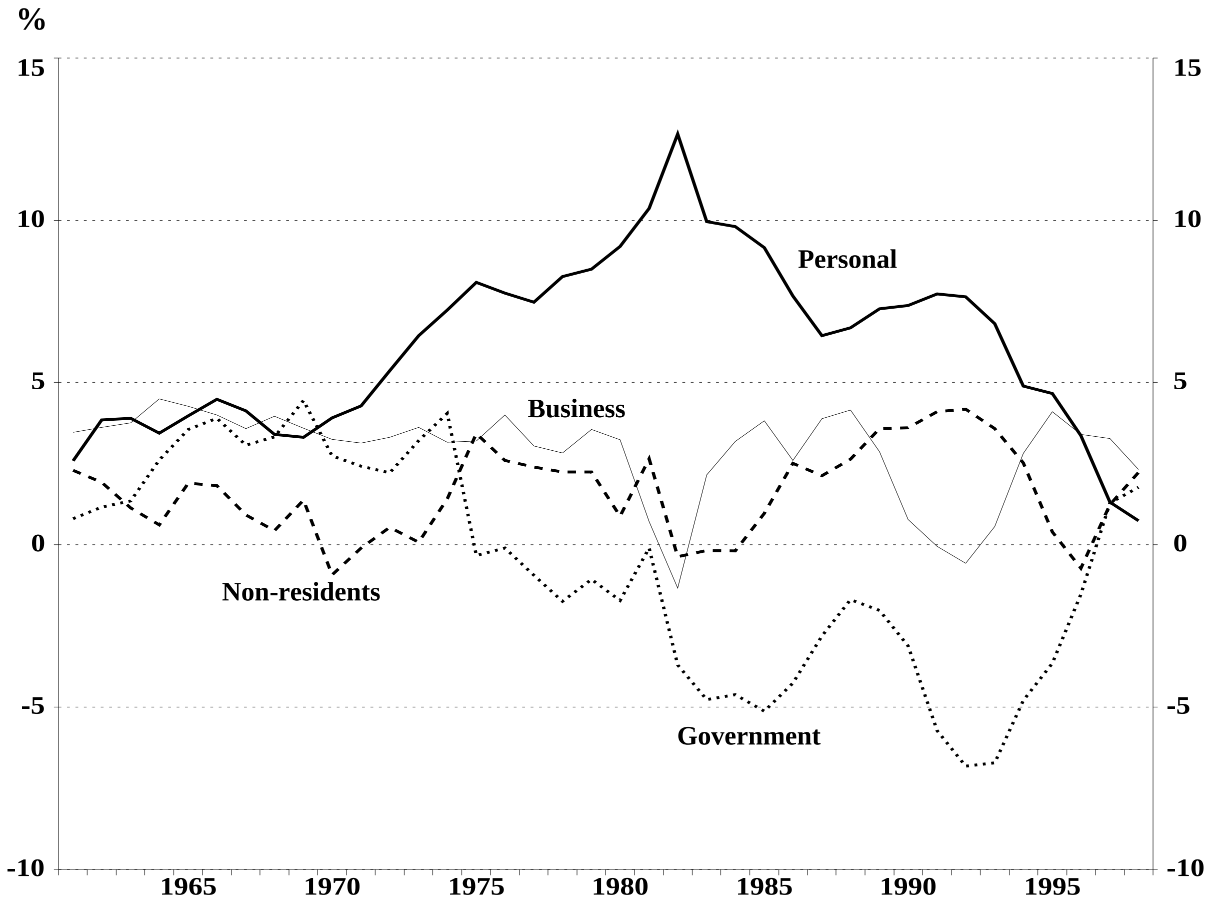


Figure 2
The national accounts measure of the personal savings rate (NIEA) (1963Q1-97Q4)

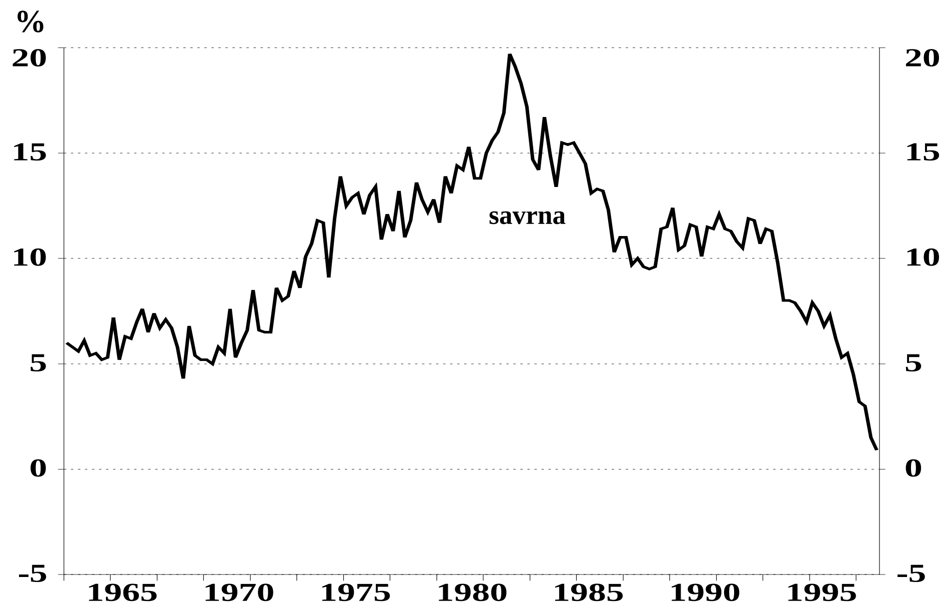


Figure 3
The balance-sheet measure of the personal savings rate (NBSA)

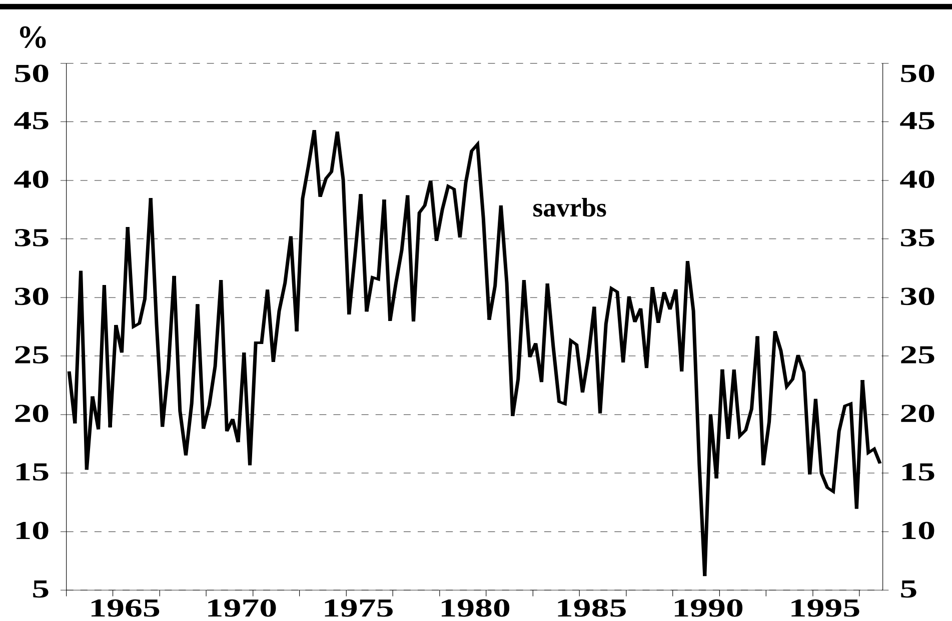


Figure 4
The NIEA measure of personal savings rate adjusted for inflation (1963Q1-97Q4)

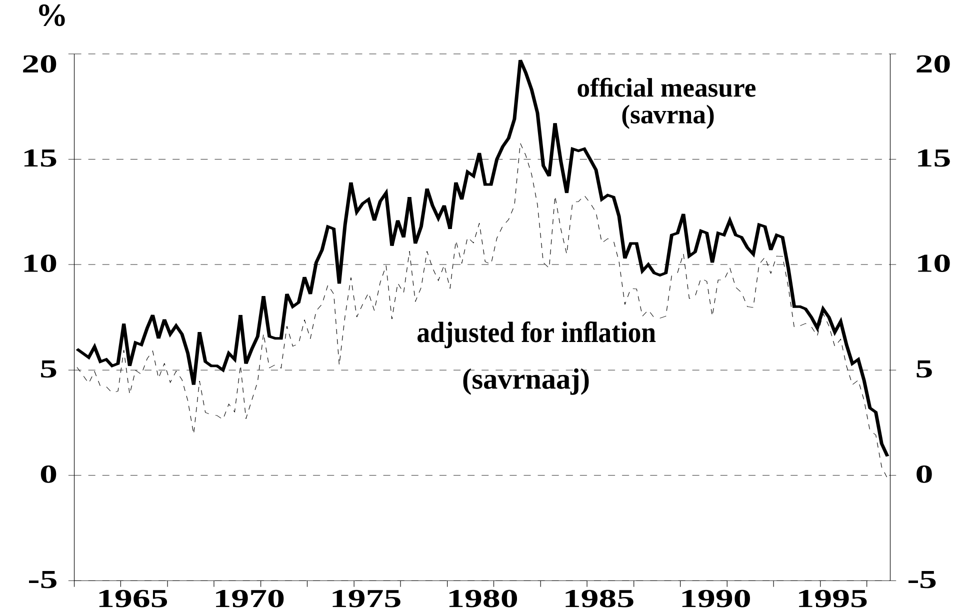


Figure 5
Expected real interest rates (3–5 years)

Figure 6
Expected inflation rate
(1963Q1-97Q4)

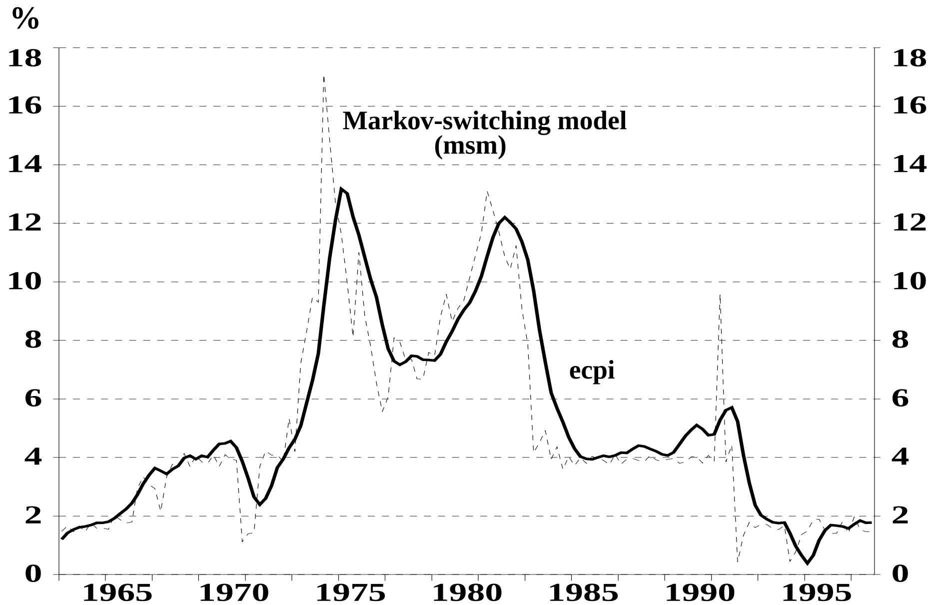


Figure 7
All-government fiscal balances as a share of nominal GDP

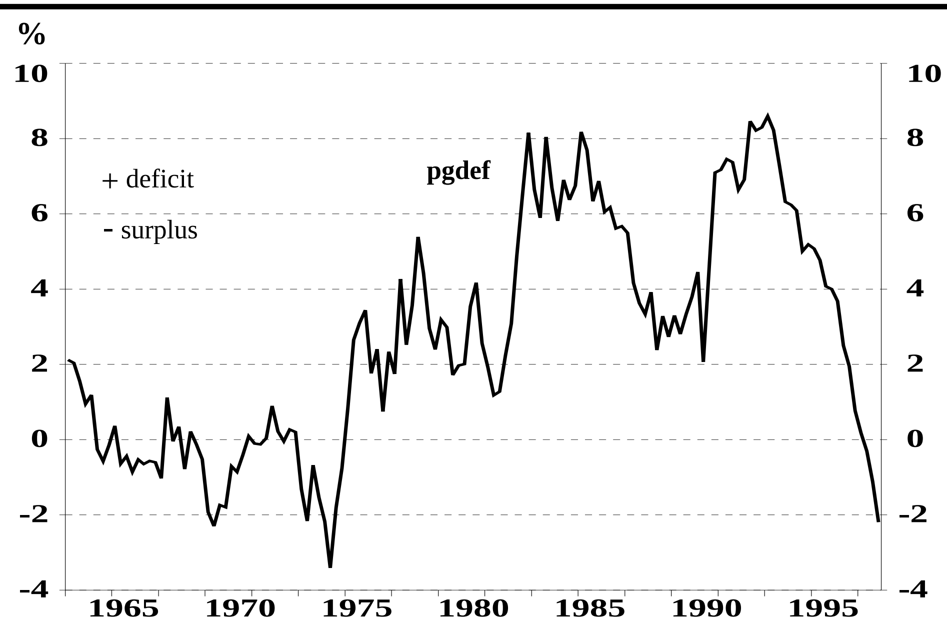


Figure 8
The unemployment rate
(1963Q1-97Q4)

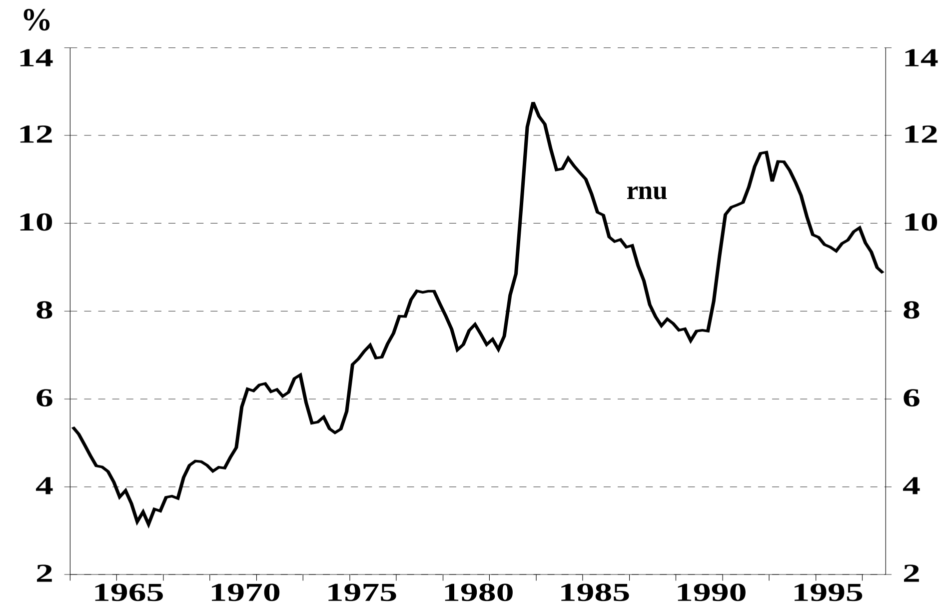


Figure 9
The ratio of balance-sheet net worth to personal disposable income

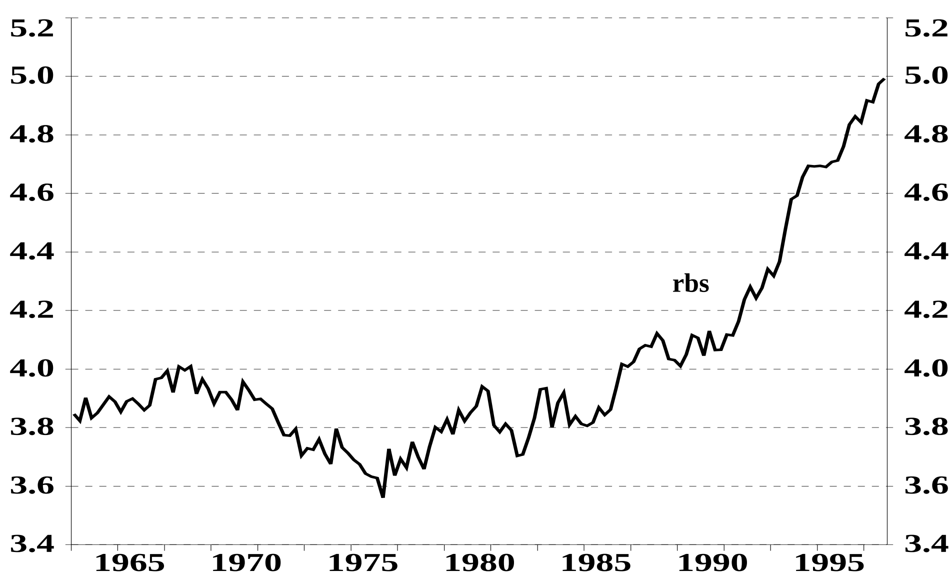


Figure 10
The dependency ratio
(1963Q1-97Q4)

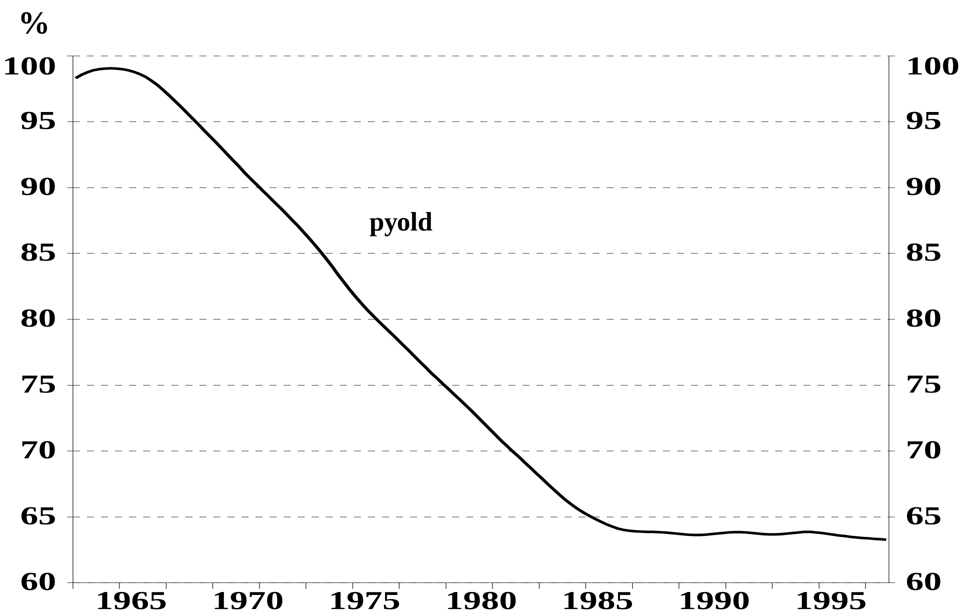


Figure 11
The public pension benefit replacement rate

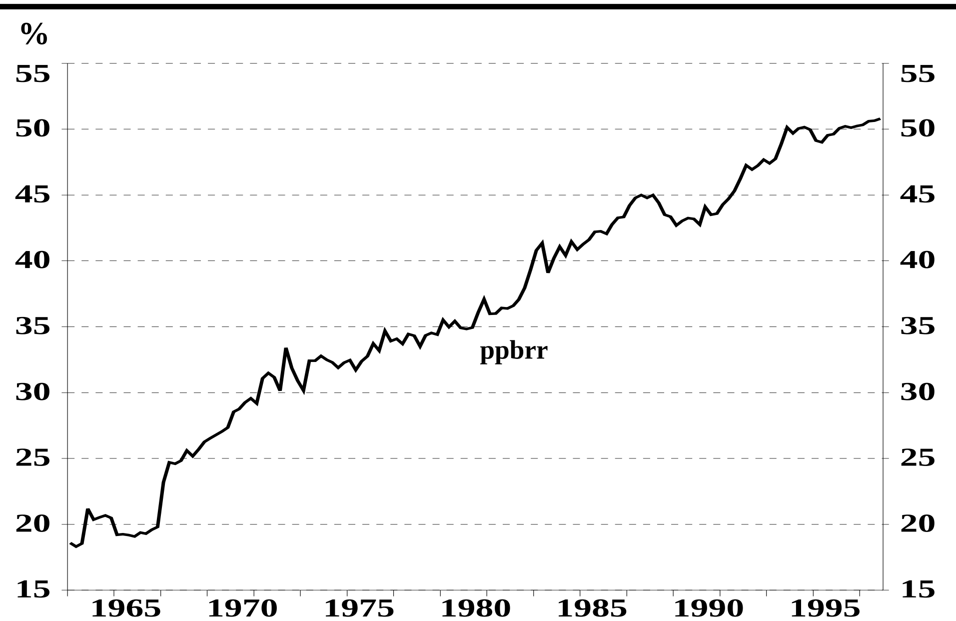


Figure 12
The ratio of consumer credit to personal disposable income (1963Q1-97Q4)

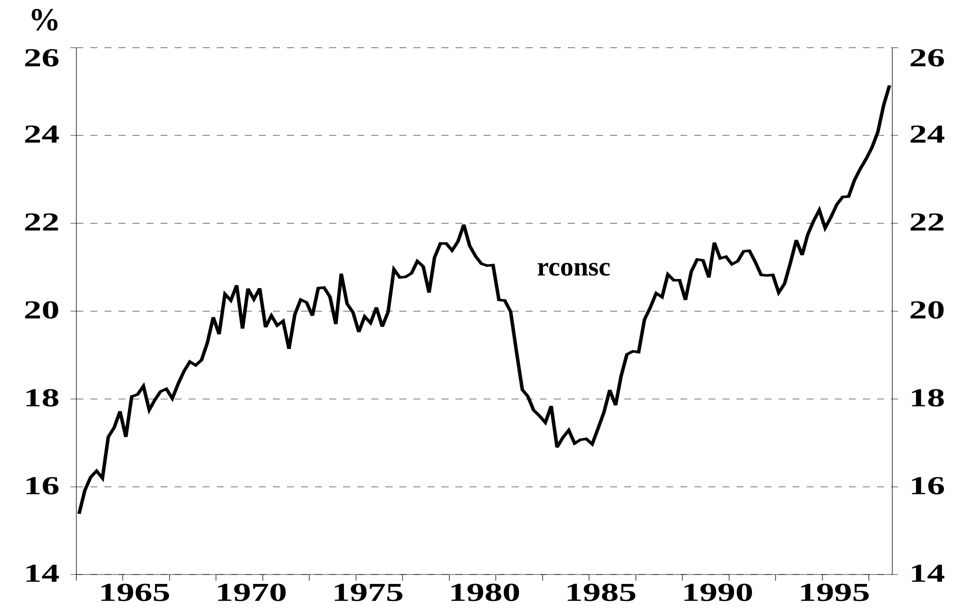


Figure 13
The change in the dependency ratio

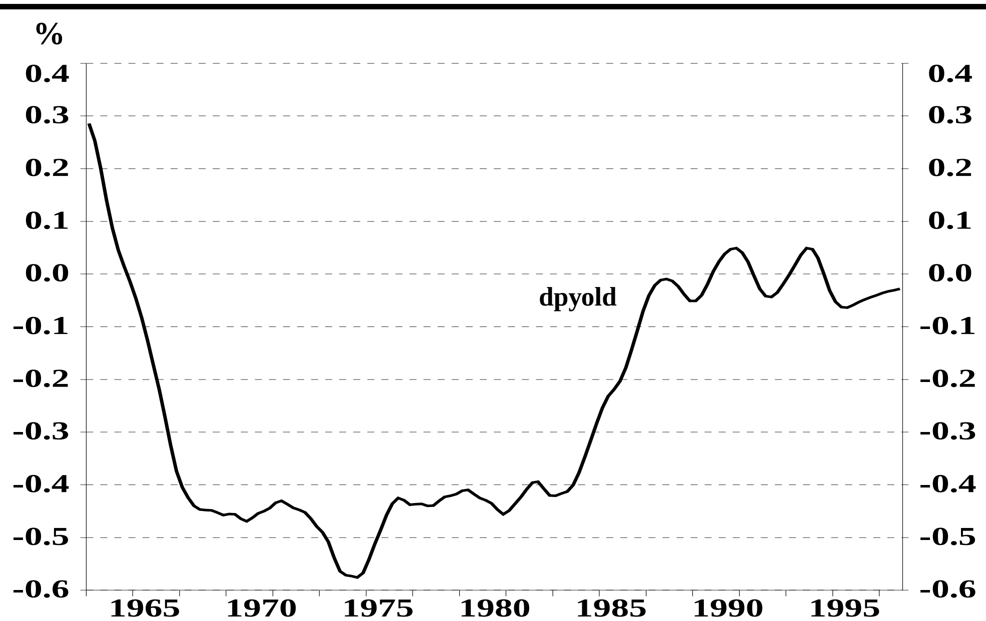


Figure 14
Trend savings rate (NIEA)
(Trend savings rate based on SW estimates reported in Table 6)
(1965Q1-98Q3)

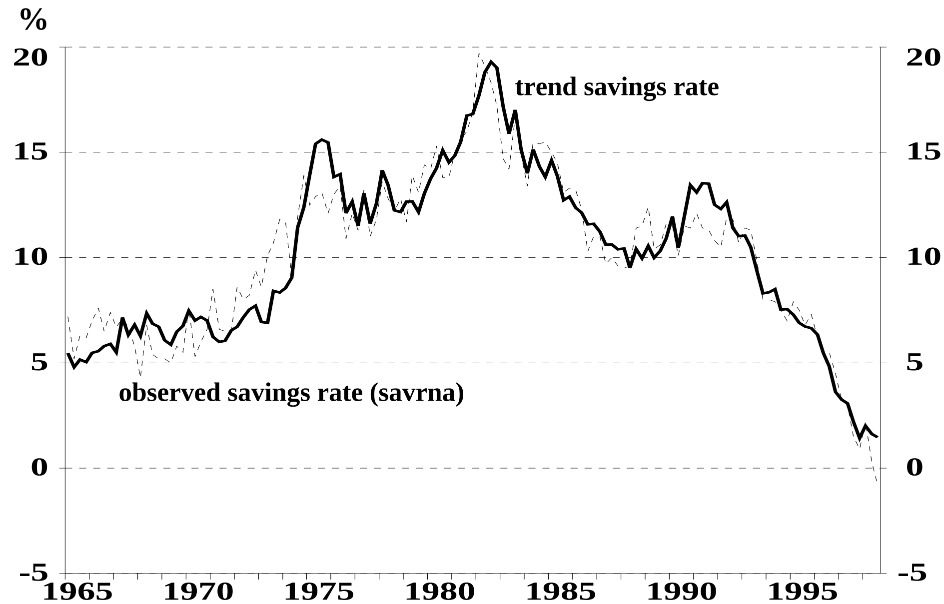


Figure 15
Contribution of long-run determinants to the trend NIEA savings rate

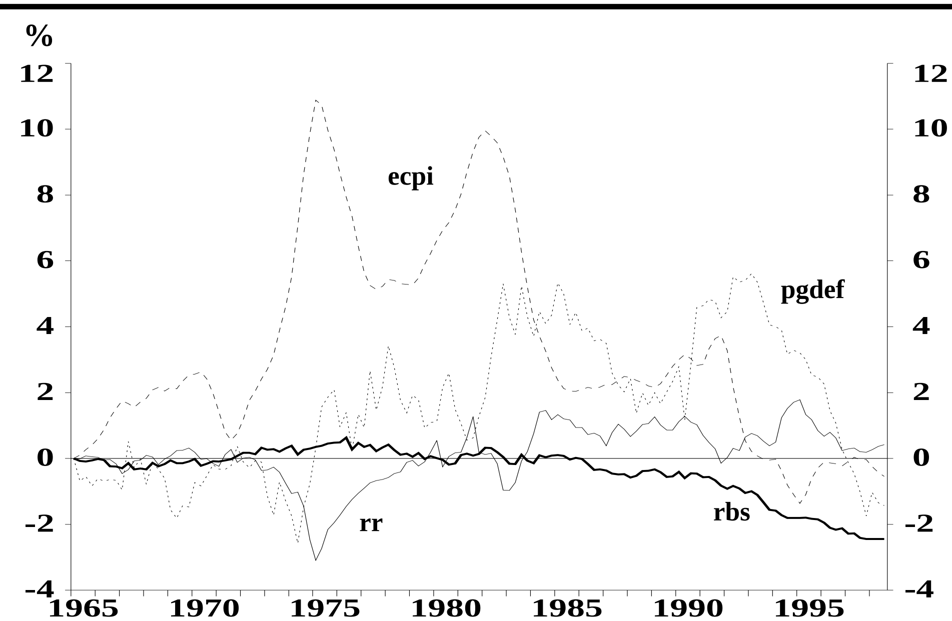
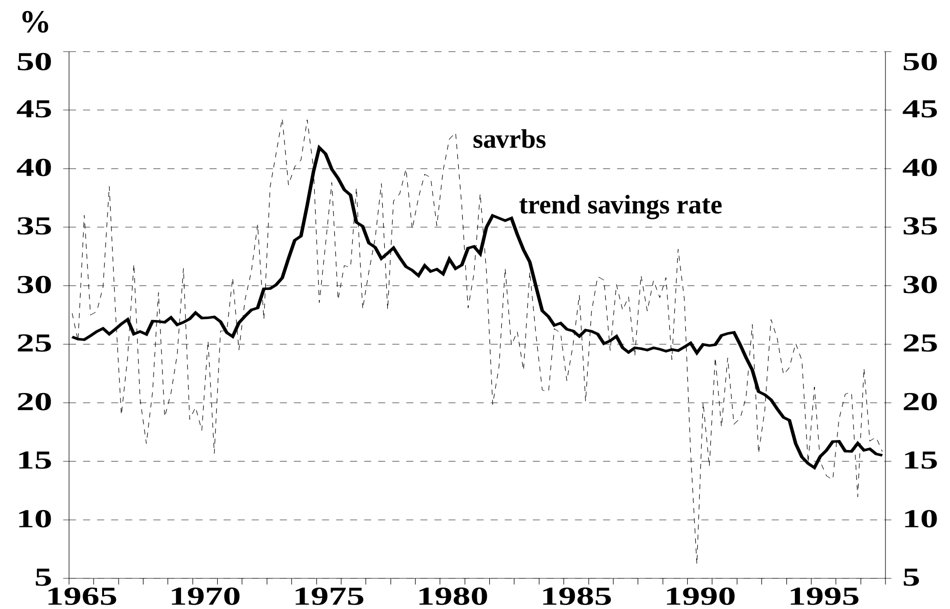


Figure 16
Trend balance-sheet savings rate (NBSA)
(Trend savings rate based on SW estimates reported in Table 10)
(1965Q1-97Q4)



Appendix 1: Description of the data[1]

savrna	=	national accounts personal saving as percentage of personal disposable income (D14915/100)
savrnaaj	=	the NIEA personal savings rate, adjusted for inflation
savrbs	=	balance-sheet personal saving as percentage of personal disposable income defined as: (diff(qknetworth)*4)/(ydp+(diff(qknetworth)*4)-savp)
ydp	=	personal disposable income (nominal) - D14914
savp	=	national accounts personal saving (nominal) - D14913
qknetworth	=	quarterly stock of net worth. The quarterly estimates of the net worth measure have been generated by cumulating quarterly financial flows. The flows estimates are from the Financial Flow Accounts (Matrix 000701) and the stocks estimates are taken from the National Balance Sheet Accounts (Matrix 000751).
ecpi	=	expected inflation: an eight quarter moving average of year-over-year total CPI (B820600) with geometrically declining weights
rr	=	G. of C. Bond Yield Averages (3-5 years - nominal (B14010)) minus ecpi
msm	=	expected inflation for total CPI (B820600) using a Markov-switching model
mrr	=	G. of C. Bond Yield Averages (3-5 years - nominal (B14010)) minus msm
pgdef	=	all-government fiscal balances as a share of nominal GDP (-1*D15075/(D14816 or D14840)). + : Deficit; - : Surplus
rbs	=	ratio of quarterly stock of net worth to personal disposable income: qknetworth /ydp
rconsc	=	ratio of consumer credit to personal disposable income (ydp). The quarterly consumer credit estimates have been generated by cumulating the quarterly financial flows. The flows estimates are from the Financial Flow Accounts (Matrix 000701: D150070) and the stocks estimates are taken from the National Balance Sheet Accounts (Matrix 000751: D160041).

1. The mnemonics given in parentheses refer to Cansim data series. All data series include information available up to the beginning of December 1998 (including the Third Quarter 1998 National Accounts from Statistics Canada, on a 1992 base year). They are available upon request.

rnu = the percentage of the labour force that is unemployed defined as: the number of unemployed/total labour force, D980745 or D980712/D980562. The Statistics Canada labour force series are available beginning in 1976. The series prior to 1976 have been linked at the Bank of Canada by the Research Department.

ppbrr = public pension benefit replacement rate defined as:

((old_age_security + can_pension + que_pension)/pop6599)/((ydp-(old_age_security + can_pension + que_pension))/pop1564).

old_age_security = old age security fund payments, (s.a. millions): D18144

can_pension = transfer payments to persons-Canada pension plan (s.a. millions): D15108

que_pension = transfer payments to persons-Quebec pension plan (s.a. millions): D15149

Population estimates per age group are from the Demographic Division. Data from 1921 to 1971 are from Cansim Matrix no.: 6430. Demographic Data from 1971 to 1997 are from Cansim Matrix no.: 6367-6379.

pop0019 = population , 0-19 years, both sexes , CANADA (thousands)

pop1564 = population , 15-64 years, both sexes , CANADA (thousands)

pop2064 = population , 20-64 years, both sexes , CANADA (thousands)

pop6599 = population , 65+ years, both sexes , CANADA (thousands)

pyold = population age 0-19 and 65+ years as a proportion of population 20-64 years: (pop0019+pop6599)/pop2064.

Nominal GDP = Gross Domestic Product at market prices: D14816 or D14840

Net personal savings: D15234

Net business savings: D15235

Net government savings: D15236

Net non-residents savings: D15237

Total net savings: D15233

Total capital consumption allowances: D15238

Total gross savings: D15233+D15238

Appendix 2: Two measures of the personal savings rate

Our empirical work uses two different measures of the personal savings rate: the conventional measure from the National Income and Expenditure Accounts (NIEA), and an alternative measure defined as the change in the net worth position of the personal sector, as measured in the National Balance Sheet Accounts (NBSA).[1]

In the NIEA, personal saving is the difference between personal disposable income and outlays. The bulk of the outlays consists of personal consumption but also includes current transfers from persons to corporations and to non-residents. The personal savings rate is then the percentage of personal saving to personal disposable income. This measure of the personal savings rate has a number of shortcomings (Dagenais 1992).

On theoretical grounds, personal saving can be defined to equal the change in households' wealth, or equivalently, as a broad measure of disposable income less consumption. Therefore, an appropriate measure of saving requires that disposable income includes all returns on prior saving, and that returns be measured in real terms. Also, consumption should include the services provided by consumer durables, rather than the gross outlay, and should reflect the depreciation of fixed physical assets. However, in the NIEA, returns on prior saving do not reflect capital gains or losses caused by changes in the market value of physical and financial assets. Furthermore, the returns on prior saving included in the NIEA measure of income are measured in nominal terms. This treatment does not recognize that a portion of interest and dividend income received by households is simply compensation for the erosion of the real value of their asset holdings owing to inflation, and hence does not increase households' real net worth. An implication of this treatment is that the conventional measure of the personal savings rate tends to rise and fall with the rate of inflation.

Also, in the NIEA, personal consumption and personal expenditure on consumer goods and services are equivalent. Although expenditure on consumer durables is akin to investment rather than consumption—since the associated stream of services provided by these goods may stretch over a long period of time—expenditure on consumer durables is classified as consumption in the year in which it takes place. (This is unlike the housing services received by homeowners, for which the NIEA include an imputed rent in current expenditure.) An additional drawback of the NIEA estimate of consumption is that it does not take into account the depreciation of physical assets owing to wear and tear.

1. See Statistics Canada (1989) for a description of the NIEA and NBSA.

Also, since personal saving is obtained as the difference between current income and current outlays, any measurement errors in the calculation of personal income or outlays translate directly into errors in the measure of personal saving. Important data for the personal sector tend to be estimated as residuals from the activities of other sectors that are easier to measure. Given the relative magnitude of personal income and personal outlays, relatively small measurement errors in either of these aggregates can be quite large in relation to personal saving.[2]

The change in the National Balance Sheet Accounts' estimate of personal net worth provides an alternative measure of saving that presents several advantages over the conventional measure. Estimates of personal net worth in the National Balance Sheet Accounts (NBSA) are not affected by the inflation premium in asset returns. Also, the NBSA estimates of net worth reflect changes in asset values, include the stock of consumer durables in personal assets, and take into account the depreciation of physical assets.

Although closer to the relevant theoretical concepts, a saving measure based on the change in the NBSA estimates of personal wealth also presents a number of shortcomings. For instance, in the NBSA, assets are not recorded at their market value: tangible assets (residential structures, consumer durables) are measured at replacement cost while most financial assets and liabilities are recorded either at book value (i.e., acquisition cost), as in the case of government bonds, or at "current value," as is the case for equity, with current value obtained as the sum of book value and cumulated retained earnings.[3] Also, household savings held in mutual funds that have not been established solely for investing the proceeds of RRSP contributions and similar tax shelter schemes are not included in the estimate of personal net worth.[4] Furthermore, as in the NIEA, the values ascribed to most of the asset and liability items of the personal sector in the NBSA have been obtained as residuals from the activities of the other sectors. Hence, all errors made in assessing the values pertaining to the other sectors affect the net worth estimates of the personal sector.[5]

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2. In addition, the personal sector includes the activities of the unincorporated business sector, since this sector is not accounted for elsewhere in the national accounts. The unincorporated business sector encompasses private non-profit institutions, trusteed pension plans, and the investment activities of life insurance companies. Clift (1988) suggests that the inclusion of the unincorporated business sector has little impact on measured personal saving.
3. The most important items in the balance sheet of the personal sector are mortgages, consumer credit, and bank loans on the liability side, and shares, currency and deposits, bonds (mainly federal and provincial government bonds), life insurance, and pensions on the asset side.
4. Note also that contributions to public pension plans and related investment income are not counted as household savings because households do not own these plans.
5. Human capital is omitted from the NBSA measure of personal net worth. Similarly, in the NIEA, spending on education, training, and health is treated entirely as consumption when in fact certain types of health, training, and education services could be regarded as investment on the grounds that they increase the expected life and productivity of a nation's stock of human capital.

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