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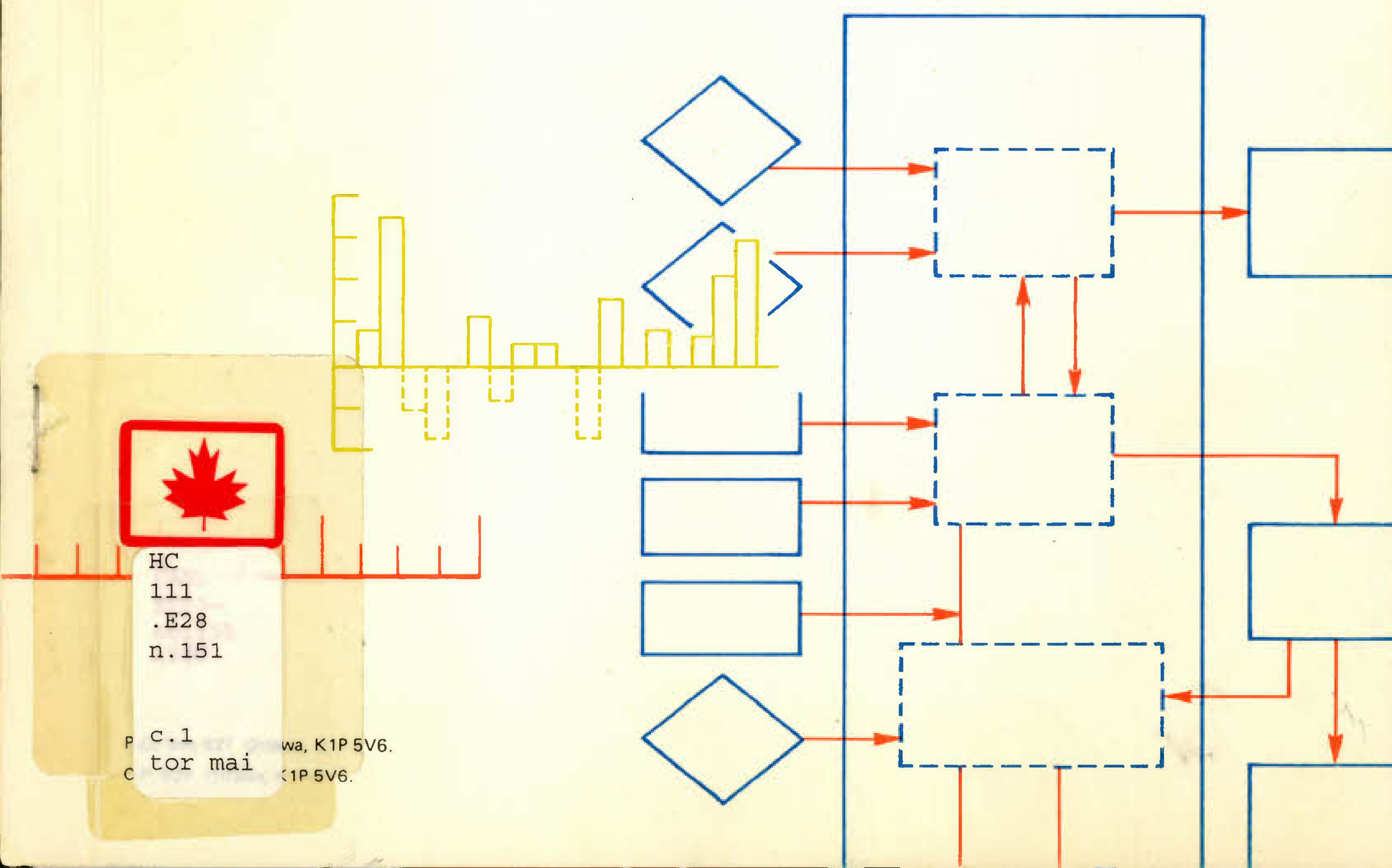

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DISCUSSION PAPER No. 151

Inflation-Related Spurious Elements in Measured Savings of Various Sectors of the Economy: The Canadian Experience 1962-77

by Gregory V. Jump*

Background Paper to the Sixteenth Annual Review

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RÉSUMÉ

Le présent document a pour but de mesurer quantitativement les éléments trompeurs d'origine inflationniste que renferment les variables représentant les revenus globaux et l'épargne totale au Canada pour la période de 1961 à 1977. Les variations du taux prévu d'inflation des prix, d'une année à l'autre au cours de cette période, ont occasionné des mouvements faux dans les flux mesurés de revenu et d'épargne, selon leurs répercussions sur les taux d'intérêt nominaux. Les taux d'intérêt suivent les variations du taux prévu d'inflation et, de ce fait, annulent partiellement les gains et les pertes en capital des personnes possédant des avoirs à revenu fixe. Les mouvements de ces taux d'intérêt ont une influence sur les variables de revenu et d'épargne observées à cause de la convention selon laquelle les recettes d'intérêt, moins les dépenses d'intérêt, entrent dans la composition du revenu calculé. Cependant, les variables mesurées ne comprennent pas les gains et les pertes en capital que les variations des taux d'intérêt d'origine inflationniste se trouvent à annuler. Par conséquent, les flux de revenu et d'épargne ne montrent qu'un côté de la médaille. C'est là une conséquence peu désirable, étant donné que les variations du taux prévu d'inflation feront varier les valeurs observées du revenu et de l'épargne, même si la situation des agents économiques reste la même qu'auparavant.
Le document présente une estimation de l'importance de ces

mouvements du revenu et de l'épargne mesurés pour quatre secteurs de l'économie canadienne : le secteur personnel, celui des entreprises, le secteur public et le secteur étranger. L'auteur a également calculé chacune des valeurs des mêmes variables ajustées pour tenir compte de l'inflation.

A B S T R A C T

This paper is aimed at quantitatively measuring inflation-induced spurious elements in aggregate Canadian income and saving variables over the period 1961-77. Year-to-year variations in the expected rate of price inflation over this interval have caused spurious movements in measured income and saving flows through their impacts on nominal rates of interest. Interest rates rise and fall with the expected rate of inflation in such a way as to partially offset capital gains and losses accruing to owners of fixed-income assets. These interest rate movements find their way into observed income and saving variables because of the convention of including interest receipts, net of interest expenses, as a component of measured income. Measured variables do not, however, include the capital gains and losses which inflation-induced interest rate changes are offsetting. As a result, income and saving flows show only one side of this phenomenon. This is undesireable result insofar as variations in the expected rate of inflation will cause observed values of income and saving to change even when economic agents are no better or worse off than previously. The magnitudes of these movements are estimated in the paper for measured income and saving of four sectors of the Canadian economy: the personal sector, the business sector, the government sector, and the foreign sector. Inflation-adjusted values of the same variables are also computed for each sector.

I. Introduction

In a recent paper (Jump [1979]) the author argued that conventional measures of many income and saving variables will be distorted in the presence of non-zero inflation expectations. The basis for that argument revolves around the current practice of including interest receipts in conventional measures of income. Interest receipts do not accurately reflect the purchasing power associated with interest-bearing assets if the expected rate of future price inflation is not identically equal to zero.

To elaborate on this point, consider the real income stream generated by an interest-bearing asset with real market value of \$1.00 at the start of some time period t. Real after-tax interest receipts generated by this asset during period t are $\frac{(1-\tau)i_t}{(1+p_t)}$ where τ is the tax rate, i_t is the nominal rate of interest, and p_t is the rate of inflation experienced during the period. The real purchasing power of the income stream associated with this asset is the maximum amount which could be consumed in period t without reducing the real value of the asset.[1] This is given by $\frac{(1+p^e)ra_t}{(1+p_t)}$, where p^e is the rate of inflation expected to prevail in the future and ra_t is the *ex ante* real, after tax rate of interest expected to be earned on the asset in the future. The measured value of real interest receipts will accurately reflect the purchasing power only when the after-tax nominal rate of interest is equal to $(1+p^e)$ times the after-tax real rate of interest. This will

1 The real purchasing power may also be defined as the maximum amount the individual can consume during t, and still expect to consume the same amount in real terms in all future periods.

be true only when $p^e=0$ because the real and nominal rates of interest are related via the definition of the real rate.

$$\text{(1)} \quad ra_t = \frac{(1-\tau)i - p^e}{(1 + p^e)}$$

Whenever $p^e \neq 0$, $(1-\tau)i_t$ will not equal $(1+p^e)ra_t$ and measured real incomes, which include interest receipts, will give a distorted picture of the ability of income recipients to make sustainable real outlays on expenditures. If economic agents are rational and concerned with future as well as current expenditures, we would expect current consumption and savings decisions to be based on considerations of purchasing power. Movements in measured incomes which are not accompanied by changes in purchasing power would be expected to have little or no impact on current expenditures. For example, a rise in p^e which leads to an increase in i so as to leave the value of ra unchanged might be expected to leave consumption expenditures unaffected. The individual who has experienced these changes is no better or worse off than previously. The real value of his wealth has not been altered, nor does he face any different rates of transformation of current for future consumption. If his original consumption decision was optimal, it will continue to be optimal. But measured income and saving of this individual will be changed by these events. His measured income will rise, reflecting the increase in the nominal interest rate. His measured savings, defined as the difference between measured income and consumption, must rise by the same amount. The individual will appear to be saving a larger fraction of his measured income, and indeed he will be. But he will be doing so in order to purchase more assets so that the real value of his wealth is maintained intact through the coming period of rising prices.

In the earlier paper it was found that the purchasing power associated with a given interest-bearing asset conforms to a definition of income first proposed by J.R. Hicks [1939]. Differences between Hick's concept of income and measured income represent "spurious elements" in the latter - spurious in the sense that variations in this difference carry no implications for real expenditure decisions. It was then shown that spurious elements arise in the aggregate incomes and savings of various sectors of the economy.

In order to understand saving behaviour, it was argued that measured series must be purged of their spurious elements. Savings changes due to truly behavioural decisions will be confused with inflation expectations changes in conventionally-measured data. Only when these spurious elements are removed will the true behavioural patterns in observed events be apparent.

Inflation-adjusted savings are readily calcuable. In a world in which the interest receipts of a sector of the economy are taxable and its interest outlays are tax-deductible, the correction procedure was shown to be

$$(2) \qquad \bar{S}_{jt} = S_{jt} - p^e_t NA_{jt-1} ,$$

where S_{jt} denotes measured savings of sector j in time perid t, $\bar{S}_{jt}$ is inflation-adjusted savings purged of its spurious element, p^e_t is the rate of price inflation expected to prevail over the indefinite future, with the expectation held as of period t, and NA_{jt-1} is the market value of net interest-bearing assets (assets-liabilities) held by sector j at the end of the preceding period. The product, $p^e_t NA_{jt-1}$, measures the spurious element appearing in sector j's measured saving (and also in its measured income).

From equation (2) it is apparent that if a sector of the economy is a net creditor (i.e., $NA_j>0$), its adjusted saving will be lower than its measured saving whenever $p^e>0$. For a net debtor, the opposite holds. This means that if p^e were to rise and nominal rates of interest were to adjust so as to leave the real, after-tax rate of interest faced by each sector unaltered, measured savings of net creditor sectors would rise while that of net debtors would decline. These movements would, of course, be totally spurious - no real expenditure changes would be expected to occur. Debtors would increase their sales of interest-bearing assets and creditors would purchase them so that the real value of net assets of each sector remains unaffected. Note that $\sum_j NA_j=0$; i.e., one sector's assets are another sector's liabilities. The spurious elements cancel in the aggregate, and the increase in p^e will simply re-distribute measured saving among the various sectors.

Our contention in this paper is that inflation-related spurious movements can explain many of the anomalies in recent saving observations. The late 1960s and early 1970s were periods of rapidly accelerating inflation rates, at least some of which were incorporated in inflation expectations. Measured saving by households and the rest-of-world (both net creditors) rose sharply during this era while saving by business and government (both net debtors) declined. Much of this re-allocation of savings must be spurious. How much remains to be determined.

In the remainder of this paper we present some computations designed to isolate the spurious elements in savings by four sectors of the Canadian economy - households, businesses, government and the rest-of-world. The computations follow directly from equation (2). Some additional analysis is presented in the next section of the paper in order to verify that the adjustment shown in this equation is valid in the Canadian context where interest receipts and outlays are not always treated symmetrically for tax purposes.

In section III, estimates of the expected rate of inflation over the indefinite future are derived. Section IV deals with some problems in measuring the market value of net interest-bearing assets. The inflation-adjusted savings series are presented in section V on an annual basis for 1962-77. Concluding comments are presented in section VI.

II. Spurious Elements, Tax Considerations, and the Foreign Sector

We are interested in extending the earlier results of Jump [1979] to more complex tax regimes. The original derivation of spurious elements considered a world in which the tax treatment of interest receipts and outlays is symmetical - receipts are taxable as income while outlays are tax-deductible. Under existing Canadian tax law, this symmetry is accorded to businesses but not to persons or non-residents. Interest receipts of persons and non-residents are generally taxable (the latter at with-holding tax rates), while their interest outlays are generally not tax deductible. There are some exceptions: certain interest earnings of persons (e.g., receipts from RRSP's; the first $1,000 of interest, dividends and capital gains) are tax-sheltered. Interest paid on loans incurred for the purpose of earning income is tax-deductible. These exceptions are important factors affecting savings but they will not be of concern to our analysis, for we shall show that spurious elements in measured saving are identical to the product $p_t^e NA_{t-1}$, independent of the nature of taxation. In other words, tax considerations may influence true saving behaviour but they do not affect the size of the spurious component.

This result follows from the realization that rational individuals will not hold taxable interest-bearing assets at the same time that they have non-deductible, interest-bearing debt obligations outstanding. Since the nominal, after-tax yield on such assets is $(1-\tau)i$ and the after-tax cost on debt liabilities is i, situations in which both assets and liabilities are held will be costly. Individuals will avoid such situations whenever transactions costs do not prevent them from reducing assets in order to eliminate liabilities.[2]

Transaction costs can be a barrier in certain circumstances. For example, penalty charges are commonly assessed individuals who pre-pay their mortgage liabilities. This can and often does lead to situations in which individuals simultaneously hold small amounts of saving deposits or other interest-bearing assets and have outstanding mortgage liabilities. But in such cases it is unlikely that asset holdings will be large relative to debt liabilities. In addition, such assets are likely to be held for only as long as the pre-payment penalty period lasts. The typical mortgage contract allows pre-payment without penalty on the annual anniversary of the date of the original mortgage loan.

Where interest receipts are non-taxable or where interest costs are tax-deductible, the after-tax cost of liabilities will equal the after-tax yield on assets. Individuals faced with these opportunities may rationally decide to simultaneously hold both assets and liabilities.

These arguments suggest that we can consider the household sector to consist of three categories of individuals; (1) those who hold interest-bearing assets but have no debts, (2) those who have debts but no interest-bearing assets, and (3) those who have both assets and debts subject to symmetrical tax treatment. Individuals who do not fall into one of these three categories are likely to be a minor fraction of the total household sector.

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2 Note that we are referring here to interest-bearing assets and liabilities. A situation in which an individual holds non-interest bearing assets in conjunction with interest-bearing liabilities is not ruled out.

As regards the identification of spurious elements in their measured savings, individuals in categories (1) and (3) present no problems. The earlier paper, Jump [1979], has already shown that inflation-adjusted savings for these individuals may be computed according to equation (2). The questionable computation regards individuals in category (2). Let us consider one such individual with market value of liabilities L_{t-1}, at the end of period t-1. Assume the individual has wage income w_t in period t and that this is expected to vary in the future with the expected rate of inflation, p_t^e. Further assume that he is taxed at rate τ on wage income and that interest payments, $i_t * L_{t-1}$, are non-deductible.

For period t, this individual's measured real income is

$$(3) \quad y_t = (1 - \tau) \frac{w_t}{P_t} ,$$

where P_t is the price level prevailing during t.

Hicks' concept of real income for this individual is the maximum amount he could spend on real consumption in t, after making interest payments, and still expect to consume the same in real terms in all future periods. This quantity may be computed by finding the value of $\bar{y}_t$ which satisfies the following

$$(4) \quad \sum_{j=0}^{\infty} \frac{(1-\tau)w_t/P_t}{(1+d)^j} - (1 + i_t)L_{t-1} = \sum_{j=0}^{\infty} \frac{\bar{y}_t}{(1+d)^j}$$

The variable d represents the rate of discount applied to future real income and consumption. Since the individual is a lender, the opportunity cost to him of increasing current consumption is the real, before-tax rate of interest he faces. It is a real rate because we are dealing with real quantities. It is a before-tax rate because interest payments on debt are not tax-deductible. The appropriate rate of discount is therefore

$$d = r_b = \frac{(1 + i_t)}{(1 + p_t^e)} - 1.0 ,$$

the real before-tax interest rate.

Substituting r_b for d, equation (4) reduces to

$$(5) \quad \bar{y}_t = (1-\tau) \frac{W_t}{P_t} - (1 + p^e) r_b \frac{L_{t-1}}{P_t}$$

$$= y_t - (1 + p^e) r_b \frac{L_{t-1}}{P_t}$$

Hicks' income for this individual differs from his measured real income by the quantity $-(1+p^e) r_b \frac{L_{t-1}}{P_t}$. Of this difference, $-p^e r_b \frac{L_{t-1}}{P_t}$, represents the spurious effect of expected inflation, while $-r_b \frac{L_{t-1}}{P_t}$ represents a correction attributable to the fact that Hicks' concept regards real interest liabilities as a reduction in purchasing power.

Assuming that the individual is making nominal expenditures of C_t on consumption, the nominal value of his conventionally measured saving is

$$(6) \quad S_t = P_t y_t - C_t - i_t L_{t-1}$$

His inflation-adjusted nominal saving is

$$(7) \quad \bar{S}_t = P_t \bar{y}_t - C_t = S_t + p_t^e L_{t-1}$$

The spurious element in the individual's measured saving is $p_t^e L_{t-1}$. This is completely analogous to the spurious elements in the saving of individuals in categories (1) and (3) in that it depends only upon expected inflation and net assets. We could, in fact, rewrite equation (7) as

$$(7') \quad \bar{S}_t = S_t - p^e NA_{t-1} ,$$

where NA_{t-1} is net assets, $= 0-L_{t-1}$ in this case.

Equation (7') is identical to equation (2) in the preceding section. The correction necessary to purge measured saving of its spurious element is the same for a debtor as it is for a creditor, even though the tax treatment of interest receipts and outlays is different.

Clearly the correction procedure embodied in equations (2) and (7') generalizes to the household sector as an aggregate. Moreover it generalizes to all sectors of the economy. For any sector subject to symmetrical tax treatment, equation (2) has already been shown to apply in the earlier paper. If a sector is not subject to symmetrical tax treatment, then the arguments of rationality invoked earilier suggest that agents in that sector will not simultaneously hold both interest-bearing assets and liabilities. Debtors will have different discount rates from creditors, but both will have spurious savings elements dependent upon the product of p^e and NA.

The spurious element in saving by the rest-of-world is unique in the sense that it will distort not only measured savings but also total aggregate income, or GNP. This occurs because GNP is defined to include the difference between interest received from and interest paid to the rest-of-world. We shall demonstrate this effect in rather roundabout fashion.

Consider the interest payments associated with total Canadian dollar interest-bearing assets, $AROW_{t-1}$, and liabilities, $LROW_{t-1}$, of the foreign sector. Non-resident recipients of measured interest, $i_t AROW_{t-1}$, are required to pay a withholding tax to the Canadian government on these receipts. This suggests that the real purchasing power in Canada of this interest stream (Hicks' concept of real income) is equal to

$$(1 + p_t^e) ra_t' \frac{AROW_{t-1}}{P_t}$$

where p_t^e and P_t are as previously defined. The variable ra_t' denotes the real interest rate, after withholding taxes, earned on these assets. The fact that recipients of these receipts may also be subject to taxes in their countries of residence is irrelevant to this definition. Any subsequent taxation will affect only the foreign distribution of the purchasing power. It can not alter the total.

Under the strong assumption that international capital markets adjust to equate *ex ante* real, after-tax rates of interest in foreign and domestic settings, the real purchasing power associated with interest payments made to Canadians by non-residents is equal to

$$(1 + p_t^e)ra_t' \frac{LROW_{t-1}}{P_t} .$$

Once again, the fact that recipients of these receipts may be subject to further taxes will affect only the distribution and not the total size of this quantity.

Saving by the rest-of-world is defined in both the National Income and Expenditure, and Financial Flow Accounts to include the difference: (interest paid to the rest-of-world less withholding taxes) - (interest received from the rest-of-world less withholding taxes). Algebraically we can represent this as

$$(8) \quad SROW_t = So_t + (i_t(1-\tau_{WC})AROW_{t-1} - i_{Ft}(1-\tau_{WF})LROW_{t-1}),$$

where τ_{WC} is the Canadian withholding tax rate, τ_{WF} is the foreign withholding tax rate, i_{Ft} is the foreign interest rate and So_t is saving from other, non-interest related sources.

Given the definition of ra_t' and the assumption requiring equality of international real, after-tax interest rates, inflation-adjusted saving in the rest-of-world can be shown to reduce to the analogy of equation (2).

$$(9) \quad \overline{SROW}_t = SROW_t - p_t^e(AROW_{t-1} - LROW_{t-1}).$$

$$= SROW_t - p_t^e NAROW_{t-1}$$

This result is not surprising. However, now let us consider the spurious effect of inflation expectations on the balance of international payments. The current account balance includes the negative of foreign saving as defined above. Hence there is a spurious element here and an inflation-adjusted current balance may be computed as

$$(10) \quad \overline{BOPCRNT}_t = BOPCRNT_t + p_t^e NAROW_{t-1}$$

In words, the existence of an inflation expectation, $p^e > 0$, will cause a spurious lowering of the current account balance in a country which, like Canada, is a net foreign debtor. The meaning of this can probably best be understood by considering what would happen to the current account balance in the event of a change in p^e.

Suppose that the expected rate of price inflation were to rise in both Canada and the rest-of-world. Suppose also that nominal rates of interest adjust to this change so as to leave all real, after-tax rates of interest unchanged. Then no economic agent, either foreign or domestic, would want to alter his real expenditures. The measured value of Canada's balance of payments on current account would worsen as a result of this and rest-of-world saving would rise. This might suggest that Canada's international competitive position had deteriorated, but in fact it would not have. Net interest paid abroad would indeed have increased, but foreign debt holders would willingly use this increase to purchase additional Canadian debt instruments. The real values of assets and liabilities would remain unchanged. Canada's exchange rate would also be unaffected - the measured worsening in current account being offset by an inflow of new debt purchases on capital account. The inflation-adjusted measure of the current account would show that no real effects had occurred. It would be unchanged.[3]

Finally, we consider the spurious effects of foreign interest transactions on measured GNP. Nominal GNP includes the difference between gross interest receipts from and payments to the rest-of-world. Algebraically this is shown as

$$(11) \quad GNP_t = GNP_{o_t} + i_{Ft} LROW_{t-1} - i_{c_t} AROW_{t-1} ,$$

where GNP_{o_t} is gross output from other sources.

Recall that Hicks' concept of real income associated with interest receipts from abroad was shown to be

$$(1 + p_t^e) ra_t' \frac{LROW_{t-1}}{P_t} .$$

This represented real purchasing power after the payment of withholding taxes. For GNP considerations purchasing power <u>before</u> withholding taxes is the relevent concept. For interest receipts from abroad this is equal to

$$\frac{(1 + p_t^e) ra_t'}{(1 - \tau_{WF})} LROW_{t-1}$$

in nominal terms. Hicks' concept of the value of interest payments made

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3 An alternative scenario would be where p^e rises in Canada only. If Canadian real, after-tax interest rates are unaffected, the value of the Canadian dollar <u>must fall</u> by the change in p^e. This would keep the (real) value of $\overline{BOPCRNT}$ constant but the real value of measured BOPCRNT would show a spurious decline.

abroad is analogous and equals

$$\frac{(1 + p_t^e)ra_t'}{(1 - \tau_{WC})} \ AROW_{t-1} \ .$$

Inflation-adjusted GNP may therefore be computed as

$$(12) \quad \overline{GNP}_t = GNP_t - p^e \left(\frac{LROW_{t-1}}{1 - \tau_{WF}} - \frac{AROW_{t-1}}{1 - \tau_{WC}} \right)$$

$$\cong GNP_t + \frac{p^e}{(1 - \tau_W)} \ NAROW_{t-1}$$

The spurious element in nominal GNP is magnified by the inclusion of a withholding-tax factor. In the approximation we ignore possible discrepancies between withholding rates in Canada and the rest-of-world and represent this factor as $(\frac{1}{1-\tau_W})$, where τ_W may be assumed to be the domestic rate. The approximation is likely to be very close to accurate insofar as Canada has reciprocal withholding tax arrangements with a number of countries. In later computations of $\overline{GNP}$, the approximation is utilized.

Note that the sign of the spurious element in GNP will be negative when $p^e>0$ and NAROW>0. An international debtor country will experience a spurious decline in measured GNP whenever inflation accelerates. That same country will also experience a spurious fall in real GNP under these circumstances. Inflation-adjusted values for real GNP may be computed from

$$(13) \quad \overline{RGNP}_t = RGNP_t + \frac{p^e}{(1 - \tau_W)} \left(\frac{AROW_{t-1}}{PX_t} - \frac{LROW_{t-1}}{PM_t} \right)$$

Interest receipts from abroad are deflated by the implicit price index for imports, PM, in computing real GNP. Interest payments to abroad are deflated by the implicit price index for exports, PX. These two price indexes are used in correcting for the spurious element contained in the measured series.

We may now proceed with confidence to compute inflation-adjusted savings for the major sectors of the economy. The only obstacles are obtaining a series for inflation expectations and the market values of net assets. These are discussed in the next two sections.

III. Inflation Expectations

To generate a series for the expected rate of price inflation, we use the ARIMA forecasting procedure of Box and Jenkins [1970]. Expectations of future inflation are assumed to be derived from past inflation experience according to

$$(14) \quad p^e_{t+1} = \overline{P}_{N,t} + a_1(P_t - \overline{P}_{N,t}) + a_2(P_{t-1} - \overline{P}_{N,t}) ,$$

where p^e_{t+1} denotes the one-year rate of price inflation expected to prevail during t+1, P_t is the actual rate of inflation during period t and $\overline{P}_{N,t}$ is the compound average rate of inflation over the N previous years ending in t. Given that we are working with a limited number of annual observations, we could not afford much experimentation with alternative specifications. It was decided that the deviation-from-moving average form of equation (14) would be the most efficient way to utilize our few degrees of freedom, while still expressing p^e_{t+1} as a function of actual inflation over a number of past periods.

The parameters, a_1 and a_2, in this expression were estimated under the assumption that expectations are on average unbiased so that actual inflation may be expressed as

$$(15) \quad P_{t+1} = p^e_{t+1} + U_t,$$

where U_t is a random disturbance term with $EU_t=0$ and $EU_tU_{t-j}=\sigma^2$, when j=0, and 0 otherwise. Annual rates of change in the Consumer Price Index were used to measure actual inflation, P_t.

Ideally, we should allow the computed value of expectations for period t+1 to depend only upon information available during time period t. A separate regression of P_{t+1} on the independent variables should be performed for every year of the sample period - in order to prevent the estimates of a_1 and a_2 used in computing p^e_{t+1} from being influenced by actual events beyond period t. This did not prove to be feasible, once again because of a limited sample size. We were not anxious to use annual price data prior to the end of the Korean War in preparing the estimates because of the distortions introduced by price controls during that period. To allow for a reasonable lag on the ARIMA process, we felt that a moving-average over at least five years should be used in measuring the variable $\overline{P}_{N,t}$. With a five-year minimum, the maximum number of observations available for the estimation was the twenty-one values spanning the interval 1957-77. This left too few observations to perform separate regressions for the early 1960s.

Our hope was that we could estimate one equation which would describe the entire sample period. This is a legimate way to proceed only if the values of the parameters a_1 and a_2 are stable over the whole interval. We note that actual inflation rates were relatively stable from the late 1950s through the mid-1960s. The recent bout of high inflation began with an acceleration in about 1968. If we could show that the parameters in our specification are stable across this break in actual performance, the use of a single set of estimates for the entire period would become palatable. To this end, we performed a Chow test on the stability of the parameters in the 1957-67 interval versus the 1968-77 interval. The results, summarized in Table 1, are highly supportive of stability over the entire period. The computed F-statistic from the regressions is 0.04 while the critical value of F at the 0.05 confidence level is 19.43. We can obviously not reject the hypothesis that the parameters were stable.

Table 1

TEST OF PARAMETER STABILITY

Interval	Estimated Parameter Values* a_1	a_2	$\bar{R}^2$	Sum of Squared Residuals
1957-77	1.2559 (0.1945)	-0.7525 (0.2786)	0.66	0.0032
1957-67	1.1540 (0.2695)	-0.6848 (0.3968)	0.60	0.0006
1968-77	1.2835 (0.3031)	-0.7746 (0.4314)	0.62	0.0025

* The figures in parentheses are standard errors.

The Chow test was performed for regressions based on a five-year moving average for the variable $\bar{P}_{N,t}$. Preliminary regressions using N = 5, 7, 10 for the 1962-77 period showed that N=5 produced the best fit and all subsequent computations utilize this averaging period. The estimates of a_1 and a_2 used to compute the expectations series are those shown in the first row of Table 1.

The inflation expectations required to compute inflation-adjusted savings are long-term expectations; i.e., the average rate of inflation expected to prevail over the indefinite future. We clearly had to set finite limits to the future horizon in order to perform the computations, and we arbitrarily selected ten years as a cut-off point. The following procedure was used to construct a series for ten-year inflation expectations. With estimated values for a_1 and a_2, equation (14) was used to compute the expected rate of inflation one year into the future. The moving average term, $\overline{P}_{5,t}$, was updated using this projection, and a projection for P_{t+2} was computed. With continual updating, the one-year expectation was projected to period $t+10$. Then the compound expected rate of inflation over these ten years was computed as the geometric mean of the one-year rates. The forecasting procedure was repeated for every year from 1962-78, producing a timeseries, $p10^e$, for the ten-year expectation. Values for this series are shown, along with the one-year expectation, $p1^e$, in Table 2. Actual inflation rates for as much of the interval as they are available are also shown for purposes of comparision.

It is evident from the table that the one-year expectation conforms with actual experience fairly well. The same cannot be said for the ten-year expectation. Values for $p10^e$ fall below actual observed ten-year rates for every year in the 1962-69 period of overlap. Of course, this does not mean that $p10^e$ is a poor representative of actual expectations over this interval. The acceleration of inflation which began in the late 1960s was probably not anticipated very far in advance.

To the extent that nominal interest rates incorporate inflation expectations, <u>ex ante</u> real rates of interest can be used as a criterion by which to judge whether the $p10^e$ series is reasonable. Available empirical evidence suggests that inflation expectations are incorporated

Table 2

INFLATION EXPECTATIONS AND EXPERIENCE FOR THE CPI

(Percentages)

	$p1^e$	$p1^1$	$p10^e$	$p10^1$	r^2
1962	1.1	1.2	1.3	2.9	4.1
1963	1.5	1.7	1.4	3.3	4.0
1964	1.9	1.8	1.6	3.9	3.9
1965	1.7	2.5	1.5	4.8	4.2
1966	2.5	3.7	2.1	5.6	4.4
1967	3.9	3.6	3.2	6.0	3.9
1968	3.0	4.1	2.8	6.4	5.1
1969	3.9	4.5	3.7	6.9	5.1
1970	4.5	3.4	4.2	-	5.0
1971	2.6	2.8	3.1	-	5.2
1972	3.0	4.8	3.4	-	4.9
1973	5.8	7.6	5.0	-	3.5
1974	8.3	10.9	6.5	-	3.7
1975	10.7	10.8	8.5	-	2.3
1976	9.1	7.5	8.3	-	2.2
1977	5.4	8.0	6.8	-	1.9
1978	8.8	9.0	9.3	-	1.7

1 p1 shows the actual one-year rate of inflation for each year. p10 shows the actual compound rate of inflation over ten years, beginning with the year indicated; e.g., p10 for 1962 is the actual rate of inflation for the ten years ending in 1971.

2 _Ex ante_ real rate of interest on long-term corporate bonds (= McCloud, Young, Weir yield on industrial bonds - $p10^e$).

into nominal short-term interest rates on approximately a one-to-one basis.[4] If the same applies to long-term interest rates - and the available evidence here is less complete - then the *ex ante* real rate, computed by subtracting $p10^e$ from a nominal long-term rate, should show some stability over time. One such real rate, based on the McCloud, Young, Weir yield on industrial bonds, is shown in Table 2. This rate is positive over the entire sample period, but shows a declining tendency in the 1970s. It gives a somewhat ambiguous indication of the reasonability of the ten-year inflation expectations.

Some empirical studies have obtained results which are consistent with the notion that the real rate of interest has been constant over the past several decades.[5] Our real rate is clearly not constant. There is, however, another school of thought which argues that the real rate has risen and fallen with periods of tight and easy monetary policy. There is no consensus among the adherents of this line of thought as to which periods in the past can be characterized as easy or tight, but most agree that 1969-70 was a tight money era while 1974-75 (prior to the Bank of Canada's adoption of targets for monetary aggregates) was an easy money period. Our real rate moves in a manner roughly consistent with this assessment: it is near its peak value in 1969-70 and below its twenty-two year average in 1974-75.

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4 For a summary of this evidence, see Thomas Sargent [1976].

5 See, for example, the studies by J.L. Carr and L.B. Smith [1972] and E. Fama [1975].

Perhaps the most that we can say about the $p10^e$ series is that it yields a series of _ex ante_ real rates of interest which does not contradict one view of past events. It was generated by a rather naive forecasting procedure, and so we cannot expect much more of it. There is, in addition, the caveat that the relationship which connects long-term interest rates with inflation expectations is not fully understood. It could well be that inflation expectations alter long-term rates on something other than a one-to-one basis. If so, it is not clear how one might expect the _ex ante_ real rate to behave during a period of accelerating inflation.

IV. Measuring Interest-Bearing Assets and Liabilities at Market Values

As earlier described, the spurious element in the measured savings of a particular sector of the economy is identifiable as the product of the expected rate of inflation over the indefinite future and the lagged value of net interest-bearing assets (assets-liabilities) held by that sector. Net assets should be measured at market values in computing the spurious element. This presents somewhat of a problem, since the obvious source of data on financial assets and liabilities is the Financial Flow Accounts, which record end-of-year stocks in book values rather than market values. Some method of converting book values into market values had to be devised.

The market value of an asset at time t, M_t, is related to its book value, B_t, according to

$$(16) \quad M_t = \left(\frac{C}{i_t}\right)B_t + \left[\left(1 - \frac{C}{i_t}\right)\left(\frac{1}{1+(1-\tau)i_t}\right)^n\right]B_t ,$$

where C is used here to denote the coupon rate of interest payable on the asset, i_t is the market rate of interest at time t, n is the remaining term to maturity of the asset, and τ is the effective rate of tax applied to interest receipts. The expression is valid for a coupon-type asset which makes annual interest payments of $C*B_t$.

If either $C \cong i_t$ or n is large, the expression may be approximated by

$$(17) \quad M_t \cong \left(\frac{C}{i_t}\right)B_t$$

In actually converting Financial Flows Accounts book values into estimates of market values, we assume approximation (17)) to be valid. This greatly simplifies the task of estimating market values but introduces one further problem: coupon rates of interest are, themselves, not directly observable from aggregate data.

To get around this new obstacle, we argue that coupon rates on newly-issued assets and liabilities are normally set equal to prevailing market rates of interest. Thus the average coupon rate at time t, $\overline{C}_{jt}$, applicable to the aggregate net assets of sector j may be deemed to be given by

$$(18) \quad \overline{C}_{jt} = \sum_{\ell=0}^{N} w_{j\ell} i_{t-\ell}; \quad \sum_{\ell} w_{j\ell} = 1.0.$$

The weight, $w_{j\ell}$, represents the fraction of sector j's total net assets which were acquired ℓ periods to time t.

Time series for the market value of end-of-year net interest-bearing assets held by each of the four major sectors of the economy were computed as

$$(19) \quad NA_{jt} = \left(\frac{\overline{C}_{jt}}{i_j}\right) B_{jt}$$

The computations spanned the interval 1961-77, inclusive. Values for B_{jt} were obtained from the Financial Flow Accounts book values of (net financial assets - net holdings of currency and non-interest bearing bank deposits - net claims on associated enterprises - net holding of equities - net holdings of foreign currency and deposits - net holdings of official international reserves).[6]

Values for the average coupon rate of interest, $\bar{C}_{jt}$, were estimated by taking a simple four-year average of the yield on 3-to-5-year Government of Canada bonds. That is, with reference to equation (18), $\bar{C}_{jt}$ was computed by setting $w_{j\ell} = 1/4$ for $\ell = 0, 1, 2, 3$. The same estimate was used for all sectors.

Ideally, we should recognize that the average maturity of assets and liabilities varies from sector-to-sector across the economy. For example, non-financial corporations tend to acquire short-term interest-bearing assets and issue long-term debt. Financial intermediaries do just the opposite. If our sectorial disaggregation were to be carried to a finer level than the four-way breakdown we are actually using, it might be possible to allow $\bar{C}_{jt}$ to vary from one sector to another. However, with our broad aggregates, financial and non-financial corporations get lumped together in one "business sector". The maturity structures of these two sub-aggregates get mixed together, and there exist no data which would enable us to determine the average maturity of outstanding business net assets at any particular point in time. Nor is there information pertaining to the average maturity of net assets held by our other three sectors.

As a practical matter we assume that each of our sectors has the same average term-to-maturity. The selection of a four-year averaging

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6 The Financial Flow Accounts do not separately distinguish interest-bearing from non-interest bearing bank deposits. We allocated Bank of Canada data on time and savings deposits at Chartered Banks among the household, business and rest-of-world sectors on the basis of the shares of total deposits and currency held by these sectors.

period is rather arbitrary, though subsequent computations have revealed that increasing or decreasing this by one or two years does not alter the picture shown by our inflation-adjusted savings series. Our averaging period is appropriate if new debt is issued with an average maturity of four years. Computations based on aggregate stocks outstanding in recent years suggest an average term-to-maturity at new issue of about four years across all assets and liabilities.

One such computation is shown in Table 3 for the year 1977. Reasonable estimates of the average maturity at new issue are made for the various types of financial instruments outstanding. A weighted average of these values is computed, where the weights represent shares of total quantities outstanding at the end of 1977. For example, government and corporate bonds are normally issued with maturities of 10 years. The contribution of bonds to the overall average maturity at new issue is taken to be the product of 10 years and the ratio of bonds to total financial assets. Given the estimated maturities for other assets shown in the table, the weighted average term-to-maturity at issue for 1977 is computed to be 4.27 years - not far off the 4.0 years figure used as our averaging period.

The computed time series for the estimated market value of net assets held by the four sectors of the economy are presented in Table 4. Book values from the Financial Flow Accounts are also shown for each sector.

Table 3

COMPUTATION OF AVERAGE TERM-TO-MATURITY AT NEW ISSUE

ACROSS ALL FINANCIAL INSTRUMENTS, 1977

	Outstanding at year-end, 1977 in $billions	Share of total outstanding	Approximate term-to-maturity at new issue in years
Government and corporate bonds	146.7	0.24	10.0
Mortgages	97.2	0.17	5.0
Treasury bills and short-term paper	20.4	0.04	0.25
Consumer credit	30.9	0.05	1.0
Trade credit	41.1	0.07	0.125
Bank and other loans	81.0	0.14	0.25
Life insurance and pension liabilities	55.2	0.09	10.0
Interest bearing bank and near-bank deposits	114.7	0.20	0.125
Total	578.2	1.000	4.27

Table 4

BOOK VALUES AND ESTIMATED MARKET VALUES OF NET INTEREST-BEARING ASSETS BY SECTOR 1961-77

(All values end-of-year in $billions.)

	Sectors							
	Households		Businesses		Governments		Rest-of-World	
	Market Value	Book Value	Market Value	Book Value	Market Value	Book Value	Market Value	Book Value
1961	22.1	22.0	-8.7	-8.6	-18.9	-18.8	5.5	5.4
1962	23.5	23.4	-9.0	-9.0	-20.5	-20.4	6.0	6.0
1963	24.8	24.8	-8.7	-8.7	-22.0	-22.0	5.9	5.9
1964	24.4	25.4	-9.2	-9.6	-21.8	-22.7	6.6	6.9
1965	25.3	26.5	-9.9	-10.3	-22.3	-23.4	6.8	7.2
1966	25.8	29.1	-10.8	-12.2	-21.5	-24.3	6.5	7.3
1967	29.5	32.0	-12.3	-13.3	-24.2	-26.3	7.0	7.6
1968	28.6	33.6	-11.5	-13.5	-23.6	-27.7	6.4	7.6
1969	28.9	34.7	-12.8	-15.4	-23.5	-28.3	7.4	8.9
1970	36.8	38.7	-15.8	-16.6	-29.8	-31.3	8.8	9.2
1971	53.5	44.0	-21.8	-17.9	-41.6	-34.2	9.9	8.1
1972	53.0	49.9	-21.5	-20.3	-39.5	-37.2	8.0	7.5
1973	51.1	55.1	-23.6	-25.4	-33.9	-36.5	6.4	6.9
1974	53.0	63.9	-26.2	-31.6	-32.9	-39.7	6.1	7.3
1975	67.4	71.3	-34.0	-36.0	-43.0	-45.4	9.5	10.1
1976	76.3	81.5	-41.6	-44.4	-49.1	-52.4	14.4	15.4
1977	83.5	88.6	-43.8	-46.5	-55.5	-58.9	15.8	16.8

V. Computational Results

Inflation adjusted values of saving by the household, business, government and rest-of-world sectors were computed on an annual basis for 1962 to 1977, the period for which net assets data are available. The computations follow equation (2) and utilize the constructed series for inflation expectations and market values of net assets described in the previous sections. Measured savings data are the Financial Flow Accounts gross domestic saving by sector. These data differ from sectoral saving reported in the National Income and Expenditure Accounts by including estimated values of capital consumption allowances for each sector. Other than this, the sectoral definitions and concepts are completely compatible between the two systems of accounts.

The savings series are reported in Table 5. The figures show spurious elements in sectoral savings to have been rising over the sample period with the gradual upward movement in inflation expectations. The household and rest-of-world sectors are net creditors of interest-bearing assets; hence, inflation-adjusted savings for these two sectors lie below their conventionally-measured counterparts throughout the sample period. By 1977 - the year of greatest inflation expectations - the spurious elements in the savings of these two sectors total \$6.2 billion - \$5.2 billion for households and \$1.0 billion for the rest-of-world. These are the amounts by which measured savings for these sectors overstate the Hicks' concept of true saving.

Because inflation expectations re-allocate measured saving from net debtors to net creditors, measured savings by the business and government sectors - both net debtors - understate the true saving positions of these

Table 5

MEASURED VERSUS INFLATION-ADJUSTED GROSS SAVING
BY SECTOR 1962-77

($billions)

	Sectors							
	Households		Businesses		Governments		Rest-of-World	
	SH	$\overline{SH}$	SB	$\overline{SB}$	SG	$\overline{SG}$	SROW	$\overline{SROW}$
1962	3.3	3.0	4.5	4.6	1.2	1.4	0.8	0.7
1063	3.6	3.3	4.9	5.0	1.4	1.6	0.5	0.4
1964	3.5	3.1	5.7	5.9	2.1	2.4	0.4	0.3
1965	4.1	3.7	6.2	6.3	2.6	3.0	1.1	1.0
1966	5.2	4.6	6.6	6.8	3.3	3.7	1.2	1.1
1967	5.1	4.3	7.0	7.3	3.1	3.8	0.6	0.4
1968	5.0	4.2	7.7	8.0	3.5	4.2	0.3	0.1
1969	5.5	4.5	8.0	8.4	5.0	5.8	1.1	0.8
1970	5.9	4.6	8.5	9.1	4.0	5.0	-0.9	-1.2
1971	6.7	5.5	9.1	9.6	3.8	4.8	-0.2	-0.5
1972	8.4	6.6	10.1	10.9	4.1	5.5	0.7	0.3
1973	11.3	8.6	12.5	13.6	5.5	7.5	0.2	-0.2
1974	14.6	11.3	14.1	15.6	8.2	10.4	2.1	1.6
1975	17.5	13.0	15.4	17.6	2.3	5.1	5.3	4.7
1976	19.8	14.2	19.0	21.8	2.8	6.4	4.3	3.6
1977	21.8	16.6	21.3	24.2	1.6	5.0	4.6	3.6

sectors. For 1977 the understatement is collectively $6.3 billion - equal, except for rounding error, to the overstatement for households and rest-of-world.

It is clear from these figures that spurious elements have been large in relation to total measured saving in recent years. For 1977 the spurious elements as a per cent of measured saving are equal to +24 per cent for households, -14 per cent for businesses, -394 per cent for governments and +22 per cent for the rest-of-world. These are substantial magnitudes which have been increasing in importance in recent years. Of the overall increase in conventionally-measured household saving from 1970 to 1977, for example, some 25 per cent is due to a rise in the spurious element. This must explain most, if not all, of the much cited increase in the rate of personal saving during the 1970s.

To put the saving figures in a little better perspective we have computed saving rates for each of the four sectors. These are reported in Table 6. The symbol sj is used there to denote conventionally-measured saving by sector j as a per cent of nominal GNP. The symbol $\overline{sj}$ denotes inflation-adjusted saving as a per cent of inflation-adjusted nominal GNP. The adjusted GNP values are presented in the following table and were computed from equation (12) using a constant value of 0.15 for the withholding tax rate.

The saving rate series reveal a number of interesting results. First, the conventional saving rate for households shows a strong upward drift in the 1970s to unprecedented high levels for 1973-77. This movement is considerably muted in the inflation-adjusted series. The adjusted rate does rise to high levels in 1974-77, but the values are not out of the range

Table 6

MEASURED VERSUS INFLATION-ADJUSTED RATES OF SAVING BY SECTOR 1962-77*

(Percentages)

	Sectors							
	Households		Businesses		Governments		Rest-of-World	
	sH	$\overline{sH}$	sB	$\overline{sB}$	sG	$\overline{sG}$	sROW	$\overline{sROW}$
1962	7.7	7.0	10.5	10.8	2.8	3.3	1.8	1.6
1963	7.8	7.1	10.6	10.8	2.9	3.6	1.1	0.9
1964	6.9	6.1	11.4	11.7	4.1	4.8	0.8	0.6
1965	7.4	6.7	11.1	11.3	4.7	5.4	2.0	1.9
1966	8.4	7.5	10.6	10.9	5.3	6.0	2.0	1.8
1967	7.7	6.4	10.5	11.0	4.7	5.7	0.9	0.6
1968	6.9	5.7	10.6	11.0	4.8	5.8	0.4	0.1
1969	6.9	5.6	10.0	10.5	6.2	7.3	1.4	1.1
1970	6.8	5.4	9.9	10.5	4.6	5.8	-1.1	-1.4
1971	7.1	5.8	9.6	10.1	4.1	5.0	-0.2	-0.5
1972	8.0	6.2	9.6	10.3	3.9	5.2	0.6	0.3
1973	9.1	6.9	10.1	10.9	4.5	6.1	0.2	-0.1
1974	9.9	7.6	9.6	10.6	5.5	7.0	1.4	1.1
1975	10.6	7.9	9.3	10.6	1.4	3.0	3.2	2.9
1976	10.4	7.4	9.9	11.3	1.5	3.3	2.3	1.8
1977	10.4	7.8	10.2	11.4	0.8	2.4	2.2	1.7

* sj = 100%*(measured saving by sector j ÷ GNP).

$\overline{sj}$ = 100%*(inflation-adjusted saving by sector j ÷ inflation-adjusted GNP).

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of historical experience. The adjusted rate is as high or nearly as high in 1962-63 and again in 1966 as it is in the last years of the sample period.

It appears that the rate of household saving may well have increased, beginning in 1974, but not nearly to the extent suggested by the conventional measure. This movement might be explained by the introduction of a number of tax-related policy changes designed to encourage personal saving. The exclusion of the first $1,000 in interest and dividends from income taxes was introduced in 1974. The introduction of RHOSP's came in the same tax year.[7] Both of these policies reduced tax liabilities and increased the after-tax return to saving by persons. It would be surprising if correctly-measured saving rates did not show some increase as a result.[8]

Second, the inflation-adjusted rate of business saving shows remarkable stability over the sample period. Its value varies in the narrow range of 10.1 - 11.7 per cent of adjusted GNP. The mid-1970s, which appear to be a period of low business saving when the conventional rate is used, do not look to be in any way abnormal when corrected for spurious elements.

Third, the inflation-adjusted rate of government saving shows that recent low levels of government saving are not entirely without precedent.

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7 RHOSP stands for Registered Home Owner Savings Plans. Taxpayers who do not own homes are permitted to contribute up to $1,000 per year for a maximum of ten years in a RHOSP. The contributions are tax deductible and the earnings of the plan are tax exempt provided the funds are ultimately used towards the purchase of a home.

8 Inflation-adjusted personal saving as a share of GNP for the United States does not show the same rise that occurs in the Canadian series during this time interval. In fact, U.S. rates were at historically low values in 1975-76. See Jump [1979] for details.

The early 1960s were also a time of low saving by the government sector. Much concern has been expressed by politicians and businessmen over the recent deterioration in the goverment's budgetary position. The fear is that this may indicate some permanent new trend. It is impossible for us to refute that fear purely on the basis of our computations, but let us note that the recent decline in government saving has not been as sharp as conventionally-measured data might suggest. There is a distinct possibility that this represents a cyclical, rather than a secular, phenomenon.

Unfortunately, our data sample does not reach as far back as the 1958 or 1960-61 recessions. We can not determine whether inflation-adjusted government saving rates during those periods behaved in a manner similar to what we have observed during the recent cyclical slowdown. However, we can compute the conventional government saving rate for these past periods. Spurious elements contained in them are likely to have been small in that era of reasonably stable prices; so values for sg are likely to be close to those for $\overline{sg}$. We find that sg was 1.0, 1.9, 2.2, and 2.1 per cent in 1957-61, respectively. These values are uniformly smaller than anything we have observed in adjusted saving rates in the 1970s. There is a strong suggestion that recent events have been cyclically inspired.

Finally, we note that high values for the inflation-adjusted rate of saving by the rest-of-world in recent years is also not beyond the realm of historical experience. This rate was as high in 1965-66 as it has been in 1976-77.

Inflation-adjusted values for some additional macroeconomic variables of interest are presented in Table 7. Included here are nominal and real GNP, the Federal Government surplus on the National Income and Expenditure Accounts basis and the balance of payments on current account. We shall not comment on these figures except to point out the following:

(1) The spurious elements which cause the measured values of both nominal and real GNP to understate true incomes will also contaminate measured rates of growth in these series whenever p^e is changing. The gradual rise in inflation expectations over our sample period has caused rates of growth in both income series to be understated. For any one year this effect is not large because of the rather slow rate at which p^e has risen.

(2) Neither the size of the Federal Government deficit nor the size of the deficit on current account of the balance of payments is as large as recent observations with conventional measures might imply. There are substantial spurious elements in both of these variables. The correctly-measured federal deficit was nearly \$2.0 smaller in 1977 than its reported value, while the current deficit was \$1 billion less.

Table 7

MEASURED VERSUS INFLATION-ADJUSTED VALUES
FOR SELECTED VARIABLES 1962-77

($billions)

	Nominal GNP		Real GNP		Federal Government Surplus*		Balance of Payments on Current Account	
	Measured	Adjusted	Measured	Adjusted	Measured	Adjusted	Measured	Adjusted
1962	42.9	43.0	58.5	58.6	-0.5	-0.3	-0.8	-0.8
1963	46.0	46.1	61.5	61.6	-0.3	-0.1	-0.5	-0.4
1964	50.3	50.4	65.6	65.7	0.3	0.6	-0.4	-0.3
1965	55.4	55.5	70.0	70.1	0.5	0.8	-1.1	-1.0
1966	61.8	62.0	74.8	75.0	0.2	0.5	-1.2	-1.0
1967	66.4	66.6	77.3	77.6	-0.1	0.3	-0.5	-0.3
1968	72.6	72.8	81.9	82.1	-0.0	0.4	-0.1	0.1
1969	79.8	80.1	86.2	86.5	1.0	1.5	-0.9	-0.7
1970	85.7	86.0	88.4	88.8	0.3	0.8	1.1	1.4
1971	94.4	94.8	94.4	94.8	-0.1	0.4	0.4	0.7
1972	105.2	105.6	100.2	100.6	-0.6	0.3	-0.4	-0.1
1973	123.6	124.0	107.8	108.2	0.4	1.6	0.1	0.5
1974	147.5	148.0	111.7	111.9	1.1	2.3	-1.5	-1.0
1975	165.4	166.0	113.1	113.4	-3.8	-2.2	-4.8	-4.2
1976	191.5	192.4	119.4	119.8	-3.2	-1.2	-3.8	-3.0
1977	210.1	211.3	122.6	123.1	-7.4	-5.5	-4.2	-3.2

* National Income and Expenditure Accounts basis.

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VI. Concluding Comments

Estimates of the inflation-related spurious elements in a number of important macroeconomic variables were computed in the preceding section. The magnitudes of these estimates suggest that many events observed during the recent era of accelerating inflation expectations are simply the consequence of errors of measurement in conventional data series. When adjusted for inflation expectations, these events look suspiciously similar to past experiences of what occurs during a cyclical downturn.

We have gleaned from our adjusted series perhaps all that can be said without subjecting them to the tests of economic analysis. Indeed, the real value of the series is that they provide a corrected set of data for use in future research. If one wants to empirically study saving behaviour, then inflation-adjusted saving is the appropriate measure to use as the dependent variable. To use conventionally-measured values is to invite the statistical rejection of some well-established economic proposition regarding the behavioural determinants of the saving decision.

The implications of our analysis for empirical research are far-reaching. Inflation-related spurious elements contaminate nearly every income or saving variable for which data are collected. Our focus has been on saving, but enough of the spurious elements in measured incomes have been touched upon to reveal the extent of the problem.

In one sense our analysis has been distinctly one-sided as regards the implications of changes in inflation expectations. The focus has been on identifying how expectations changes alter spurious elements in the measured values of variables. We have had little to say about how measured values themselves might respond to such changes.

We are now in an era of historically high inflation expectations. Inflation is a matter of prime concern to policy makers. Suppose that they are successful in causing inflation to abate in the future, so that economic agents gradually reduce their expectations of inflation rates for the more distant future to levels well below those which presently prevail. We know that this would lead to reductions in spurious errors of measurement, but how would it impact upon actual measured values of income and saving variables?

We can answer this question under only one set of circumstances. If a reduction in inflation expectations causes nominal interest rates to fall in such a way as to leave all real, after-tax rates of interest unchanged, then measured values will decline by exactly the declines in their spurious elements. If this condition is not met, it is not, in general, possible to predict what will happen to measured values of variables. We can say only that the new measured values, whatever they are, will contain spurious elements which are smaller by amounts related to the change in p^e and the market values of net assets.

The nature of the tax system is such that it is probably impossible for a change in inflation expectations to leave the real, after-tax rates of interest faced by every economic agent unchanged. Indeed, available empirical evidence suggests that the economy is not inflation-neutral in this regard. Changes in inflation expectations appear to affect nominal interest rates on approximately a one-to-one basis, which means that real, after-tax rates of interest tend to fall when p^e rises and vice versa. In this kind of setting, a gradual reduction in p^e would result in a transfer of real wealth from debtors to creditors and induce behavioural responses in real expenditures and savings decisions. In the absence of a detailed analysis of these behavioural responses, it is impossible to predict how either measured values or inflation-adjusted values of various variables might respond. We can predict only how the differences between the two concepts will be affected.

Our inability to say more about the consequences of a change in inflation expectations should not be viewed as a short-coming of the analysis. Ours is a study directed at problems of measurement. Issues of economic behaviour have not been investigated. As earlier stated, the value of the study lies in providing an understanding of the ways in which observed data may be purged of spurious measurement errors. Only by correctly measuring variables of interest will we be able to empirically test theoretical hypotheses regarding their behaviour.

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