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by

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ABSTRACT

An econometric model of the portfolio behaviour of the Canadian household sector is developed to study the linkages between demands for financial assets. The theoretical basis for the model is a version of the well-known Brainard-Tobin framework, which is extended to integrate the consumption-savings and portfolio-allocation decisions. This integration allows joint estimation of the real expenditure and asset-demand equations as well as empirical testing of the importance of the sector's real-financial linkages. The model consists of nine equations: three real expenditure equations, four asset equations, and two liability equations. These are estimated using quarterly data over the period 1968-83. Where appropriate the assets are measured in market-value terms.

Empirical support is found for integration, for the purposes of modelling both real expenditures and portfolio allocations. Also, the model possesses properties that are broadly consistent with the stylized facts. These include: 1) a general rise in nominal interest rates and expected inflation results in only minor portfolio adjustments, while 2) a general rise in real interest rates leads to a reduction in the magnitude of both sides of the balance sheet, and 3) a rise in expected inflation causes an increase in real expenditures financed through an increase in liabilities. As is frequently the case with this class of model, however, the individual parameter estimates and therefore the responses of the model to individual interest rate shocks are of mixed quality.

RÉSUMÉ

Dans le présent modèle économétrique, l'auteur formalise le comportement des ménages canadiens en matière de portefeuille afin d'étudier les liens qui existent entre les demandes d'avoirs financiers par ces derniers. Le schéma bien connu de Brainard-Tobin, qui constitue l'assise théorique du modèle, est élargi afin d'intégrer les décisions de consommation et d'épargne aux décisions de répartition du portefeuille. Cela permet d'effectuer une estimation conjointe des équations relatives à la dépense réelle et à la demande d'avoirs financiers et d'évaluer l'importance des liens existant entre les variables réelles et les variables financières. Ces équations, au nombre de neuf, sont réparties comme suit : trois pour la dépense réelle, quatre pour les avoirs et deux pour les engagements. Elles sont estimées à partir des données trimestrielles sur la période 1968-1983. Les avoirs sont mesurés aux prix du marché là où la chose est de mise.

Les résultats empiriques confirment la pertinence de l'intégration tant pour les équations de dépense réelle que pour celles des avoirs financiers. En outre, le comportement du modèle est dans l'ensemble conforme à l'observation, à savoir par exemple qu'une hausse générale des taux d'intérêt nominaux et des taux attendus d'inflation n'entraînent que de faibles ajustements du portefeuille, tandis qu'une hausse générale des taux d'intérêt réels provoque une diminution tant des avoirs que des engagements, et qu'une hausse des taux anticipés d'inflation engendre une augmentation des dépenses réelles, laquelle est financée au moyen d'une augmentation des engagements. Toutefois, comme cela se produit souvent avec ce type de modèles, l'estimation des coefficients individuels, et partant, les réactions du modèle à des chocs de taux d'intérêt sont peu fiables.

INTRODUCTION

A better understanding of the linkages between the demands of the household sector for various financial assets can facilitate the analysis of incoming data and can also provide new insights into the effects of monetary policy. These linkages are the focus of an econometric analysis of the portfolio behaviour of the Canadian household sector over the 1968-83 period. The parameters of a system of asset-demand equations are estimated, taking into account the cross-equation restrictions implied by theory.

As with any modelling exercise various issues must be considered prior to estimation, including alternative theoretical frameworks, the appropriate level of aggregation, choice of data and type of estimation technique. I have adopted the integrated approach to model structure advocated by Purvis (1975, 1978) and Parkin et al. (1975). In these models the consumption-savings and portfolio-allocation decisions, which typically are presumed to be separable, are treated as one decision. As a result the scale variable becomes income, rather than wealth, and the system of equations that emerges consists of the usual block of asset-demand equations, but these are expressed in flow terms, supplemented by a block of real expenditure equations. The usual cross-equation adding-up restrictions therefore provide explicit links between real and financial variables.

As is often the case, the level of aggregation selected was determined largely by data availability and computing constraints. The integrated model consists of nine equations: three in the real expenditure block representing consumption of non-durables, durables and housing, and six in the financial block representing currency and deposits, equity, bonds, life insurance and pensions, mortgages, and consumer credit. The data used constitute an important feature, distinguishing this study from previous ones. First, rather than relying on a single source for the data, each category is constructed separately using what is believed to be the most reliable source, among which are the national accounts, the financial-flow accounts, and Bank of Canada data. Where the financial-flow accounts have been used, the inconsistent quarterly flow and annual stock data have been reconciled first. Second, where appropriate, an attempt has been made to measure the asset categories in market-value terms; the series in question are durables, housing, equity, and bonds.

Issues related to estimation techniques are touched upon here, but have been examined more thoroughly in a previous paper (Poloz, 1983). The results of that study, which examined the errors-in-variables problem associated with the scale variable (Walsh, 1981) and the usefulness of ridge regression as a means of overcoming multicollinearity, prompted the use of traditional estimators in the present study such as ordinary least squares and restricted Zellner seemingly unrelated regression.

1 PORTFOLIO MODELS, DATA, AND ESTIMATION PROBLEMS

1.1 Theoretical Issues

The theoretical basis of most modern models of portfolio behaviour is the so-called "pitfalls" literature, originated by Brainard and Tobin (1968) and later refined by Ladenson (1971, 1973), Clinton (1973) and Smith (1975). This literature carries the essential message that because the portfolio-allocation decision is constrained by total wealth, the asset-demand functions emerging from this optimization problem are not independent. Specifically, an increase in the rate of return on one asset might lead to an increase in its share in the portfolio, but with wealth held constant these additional funds must come from elsewhere in the portfolio, resulting in a zero net effect. Thus, a piecemeal approach to estimating asset-demand equations, which considers one equation or perhaps a subset of the system, runs the risk of imposing unacceptable restrictions on the excluded equations.

All models in the pitfalls tradition feature a stock of wealth that is exogenous to the portfolio-balance problem, since it is determined separately by the consumption-savings decision. This dichotomy may be justified if consumption expenditure and the asset vector are weakly separable in the utility function, or if the asset vector exhibits constant relative-risk aversion (see Purvis, 1975). However, this separability can break down in the presence of portfolio-adjustment costs that differ between assets. In the absence of adjustment costs the constraint on the consumption-savings decision may be summarized in terms of current income and total wealth. In the presence of adjustment costs, however, this decision may be influenced by the composition of total wealth, so that the level of savings, and hence consumption, will depend not on the gap between actual and desired wealth but rather on the vector of gaps between the actual and desired levels of each asset. This vector of gaps is, of course, an important determinant of the portfolio adjustments that occur in a given period. In recognition of this interdependence between the consumption-savings and portfolio-balance decisions, the integrated approach of Purvis (1975, 1978) and Parkin et al. (1975) treats both problems as one. There is no longer a wealth constraint, but rather an income constraint which says that current income plus beginning-of-period wealth must equal current consumption expenditure plus end-of-period wealth. Wealth thus becomes an endogenous variable while current income is the exogenous input into the problem.

In accordance with Backus and Purvis (1980), the integrated model of portfolio adjustment may be stated more formally as follows. In each period the agent is presumed to have a target demand for each asset, and the n-vector of these demands is represented by a^*. These steady-state asset demands are assumed to be linearly homogeneous in trend income (YE), and to depend linearly on the $k \times 1$ vector of explanatory variables, x, which consists primarily of the rates of return on each of the assets in the portfolio:

$$a^*/YE = Ax \qquad (1.1)$$

where A is an $n \times k$ matrix of parameters. In the short run, actual asset holdings (a) will differ from target demand due to adjustment costs and because of deviations of income (Y) from trend (YE). This notion is modelled according to the following multivariate partial-adjustment mechanism:

$$a - a(-1) = \Delta a = B(a^* - a(-1)) + D(Y-YE) \qquad (1.2)$$

where B is an $n \times n$ matrix of adjustment coefficients, D is the $n \times 1$ vector of coefficients on transitory or unexpected income (Y-YE), and the notation (-1) denotes a time lag of one period. The consumption function is implicit in the adding-up constraint, which says that income must equal consumption (C) plus the change in total net asset holdings in the current period:

$$C = Y - \sum_i \Delta a_i \qquad (1.3)$$

Combining equations (1.1) - (1.3) yields the complete set of n+1 estimating equations:

$$\begin{bmatrix} C/YE \\ \Delta a/YE \end{bmatrix} = \begin{bmatrix} f & b & d \\ F & B & D \end{bmatrix} \begin{bmatrix} x \\ -a(-1)/YE \\ (Y-YE)/YE \end{bmatrix} \qquad (1.4)$$

where F = BA is n×k and f, b and d are 1×k, 1×n and 1×1. The adding-up constraint implies restrictions on the column sums of the coefficient matrix. Specifically, assuming that the first element of x is the unit vector, the first column of the (n+1)×k matrix, formed by stacking f and F, must sum to unity, while the remaining columns of this matrix and those of the (n+1)×n matrix, formed by stacking b and B, must sum to zero, and the single (n+1)×1 column, formed by stacking d and D, must sum to unity. These restrictions may be verified by noting that after imposing them and summing across all n+1 equations the system reduces to:

$$Y/YE = 1 + (Y-YE)/YE = Y/YE. \qquad (1.5)$$

In the integrated model the real expenditure block consists of the first three equations — consumption of non-durables, durable goods, and housing. The latter two are treated as assets. The financial block consists of six equations representing four asset categories (currency and deposits, equity, bonds, life insurance and pensions) and two liability categories (mortgages and consumer credit). Liabilities enter the model negatively. Both asset demands and real expenditures depend, according to system (1.4), on the vector of variables, x, on the lagged stock of each individual asset, and on unexpected income. Thus, integration has empirically testable implications for both blocks of equations. With respect to the financial block, integration implies that four additional explanatory variables will appear in each asset-demand equation, namely, the lagged stocks of durables and housing and their associated rates of return. Thus, a test of the joint significance of these four variables for the equations of the financial block of system (1.4) provides one measure of the importance of integration for financial model building. The substantive implication of integration for the real expenditure block is that the composition of lagged wealth, rather than simply its total, is an important determinant of expenditures on non-durables, durables, and housing. The empirical significance of this "asset-composition effect" (Purvis, 1978) provides a measure of the relevance of integration for the modelling of real-expenditure decisions. The real-expenditure equations also differ from those normally found in econometric macro models in that a vector of interest rates, contained in x, rather than simply a representative rate, enters explicitly.

1.2 Previous Studies

This paper has a great deal in common with that of Backus and Purvis (1980) who estimated an eight-asset integrated household portfolio model for the United States. The eight assets considered were: durables, housing, money (M3), bonds, equity, non-marketables (pensions, savings bonds, etc.), mortgages, and loans. On the basis of ordinary least squares estimation, the authors found strong support for integration, but its relevance was measured by its contribution to the real-expenditure block. An interesting feature of this work is the use of Theil-Goldberger mixed estimation in an attempt to overcome the problem of multicollinearity. Bayesian estimation has also been used by Kopcke (1977) in analyzing a non-integrated model of U.S. household portfolios. This is one alternative to the imposition of zero restrictions, or the use of stronger theoretical restrictions, such as those of the linear expenditure system estimated by Saito (1977). It should be noted, however, that the influence of the priors on the final estimates can be rather large in instances where the likelihood function is very flat. The size of this influence depends critically on the specification of the prior variance-covariance matrix, about which there is generally scant knowledge for such models.

More recently, Motley (1982) estimated a highly aggregated integrated model of U.S. household portfolios. The four assets considered were durables, housing, financial assets, and financial liabilities. An innovation was the use of after-tax real rates of return, expected and unexpected inflation, the average tax rate, and the unemployment rate as explanatory variables. Other studies that have used the integrated approach include Kohli and McKibbin (1982) who estimated an Australian model, and Purvis and Sparks (1977), who analyzed the Canadian data. Purvis and Sparks aggregated households, government, and major financial institutions into a simplified 'household' sector to overcome difficulties with the data. Multicollinearity was dealt with by imposing zero restrictions (based on priors and weak t-statistics) throughout the coefficient matrix. Although the estimates themselves were not entirely satisfactory, the authors found empirical support for integration. Other portfolio studies for Canada include Donovan (1978), who estimated a four-asset (savings deposits at banks, at near banks, Canada Savings Bonds, and near bank term deposits) model with special emphasis on deriving the demand functions from a specific underlying indirect utility function, and Brox and MacLean (1983), who attempted to model the entire Canadian flow-of-funds matrix. Their model is not integrated but expenditures on real assets enter some of the asset-flow equations as exogenous variables.

1.3 The Data

Table 1 illustrates the structure of the portfolio of the Canadian household sector. The outstanding stocks at the end of 1983 are provided, as well as the average shares over the sample and their standard deviations. Also given are the mnemonics used in the model. Details of the construction of the data set are given in the Appendix.

The stock of total net wealth is almost equally divided between real wealth and net financial assets. By far the largest component of the portfolio is the market value of housing, whereas the smallest allocation is to bonds and short-term paper. Because of its small size this category was made the residual asset in estimation. The sample standard deviations of the portfolio shares are generally fairly small relative to the

Table 1

THE PORTFOLIO OF THE CANADIAN PERSONAL SECTOR

	Outstanding stock* 1983Q4	Mnemonic	Mean share 1968-83	Standard deviation of share 1968-83
Durables	114,405	DU	0.136	0.007
Housing	364,116	HO	0.436	0.053
Real wealth	478,521		0.572	0.058
Currency, Deposits	230,803	CD	0.229	0.029
Equity	199,059	EQ	0.187	0.044
Bonds, Short paper	18,299	BO	0.037	0.019
Life insurance, Pensions	140,697	LP	0.143	0.010
Mortgages	-98,331	-MO	-0.104	0.022
Consumer credit	-46,979	-LO	-0.063	0.005
Net financial worth	443,548		0.428	0.058
TOTAL NET WEALTH	922,069		1.000	

* Millions of dollars at market prices

respective means. The notable exception is the smallest category, bonds, whose standard deviation exceeds one-half the sample mean.

The nominal asset stocks are all deflated by a common price index and then first differences are calculated to produce real flows. The sum of these real-asset flows (for which we use the stock mnemonics given in Table 1 preceded by the symbol Δ) plus the flow of real consumption expenditure on non-durables (CON), gives the scale variable (Y) of the model. This is an income concept similar to real personal disposable income, but with two important differences. First, because four of the assets are measured in market-value terms, this income concept includes real capital gains[1]. Second, because asset stocks are put into real terms before the flows are constructed, the lagged real asset stock used to calculate the flow has been deflated by the lagged price level. This method avoids the incorporation of an inflation premium, as occurs in the national accounts through interest income. As an empirical matter, the scale variable that emerges from this model generally lies between national accounts real personal disposable income and real gross national expenditure.

For the purposes of this study consumption is defined as expenditures on non-durables, semi-durables, and services from the national accounts, plus an estimate of the flow of services from the stock of durables. This adjustment is made so that the treatment of durables is comparable to the national accounts treatment of housing, where depreciation of the housing stock, in the form of imputed rent, is counted as part of non-durables consumption. The net change in holdings of durables is equal to purchases of new durables less an estimate of the depreciation of the stock held in the previous period. The market price for this category is taken to be the durables-expenditure deflator of the national accounts. The housing-expenditure category is treated identically, except that the relevant market price index is taken to be that of the Multiple Listing

1. The empirical relevance of capital gains for savings behaviour in the United States has been demonstrated by Peek (1983).

Service (MLS) survey[2]. The currency and deposits category uses Bank of Canada data on personal deposits at chartered banks, trust and mortgage loan companies, credit unions, and caisses populaires, and also includes Canada Savings Bonds and an estimated proportion of outstanding currency. The market value of equity is calculated by combining the price/earnings ratio of the TSE300 (Toronto Stock Exchange index) with national accounts data on aggregate corporate earnings; the resulting total is split into resident and non-resident components, and the former is assumed to be held entirely in the household-sector portfolio[3]. The two liability categories, mortgages and consumer credit, enter the model negatively. Both are based on Bank of Canada data collected from eight different categories of lending institutions and apply only to household borrowing.

In constructing the categories for bonds and short-term paper and life insurance and pensions, the financial-flow accounts have been used. The bond category uses Sectors I and II (households and unincorporated businesses) holdings of federal, provincial, municipal and other bonds and short-term paper, but deducts Canada Savings Bonds as reported by the Bank of Canada. As noted above, Canada Savings Bonds have been included in the currency and deposits category. The bond-price index is a weighted average of indices taken from publications of the brokerage firm McLeod Young Weir Limited. This applies to all except the federal bonds, for which a price is constructed from appropriately weighted coupon data and a consol approximation. Data on life insurance and pensions are taken directly from the financial-flow accounts. In both cases the quarterly flow data and the annual stock data, which are not consistent with one another, have been reconciled; details are provided in the Appendix.

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2. This index was used because, unlike indices of housing construction costs, the MLS index captures the inflation in land prices, which may be very important from the point of view of the household.

3. This assumption introduces the possibility of some double counting in the calculation of household net wealth, since equity holdings of financial institutions have not been deducted. According to the financial-flow accounts the share of total equity held by these institutions has been about 20 per cent in recent years.

All the above variables enter the model in real terms, the stocks having been deflated by the national accounts implicit deflator for consumption expenditure (P) before calculation of the real flows. The sum of these real flows is the scale variable, Y, which is decomposed into expected (YE) and unexpected (Y-YE) parts by fitting a simple first-order autoregression (AR1) and using the fitted values for YE and the residuals for (Y-YE). Experiments with linear and squared time trends were performed with this regression, but they added no significant explanatory power to the simple AR1 process.

In addition to the eight lagged asset stocks, each equation also contains the expected inflation rate, seven nominal rates of return, and a proxy for expectations of future interest rate levels. An eight-quarter moving average of the actual rate of inflation of the consumption deflator, using data up to and including the previous quarter, serves as a proxy for the expected rate of inflation ($\dot{P}^e$). The rate of return on durables (RDU) has been constructed in the same way from the durables price index[4]. The rate of return on housing (RHO) is equal to national accounts total rents (imputed and paid) as a percentage of the market value of housing, plus the expected rate of inflation of the housing price index. The latter is also an eight-quarter moving average, using data up to the preceding quarter. The rate of return on currency and deposits (RCD) is an appropriately weighted average of 11 rates of return paid on its 11 components (see Appendix for details), where the weights are the lagged proportions held in each category. The rate of return on equity (REQ) consists of the stock-dividend yield of the TSE300, plus the expected rate of change of the TSE300 price index. The latter is constructed exactly as are the expected inflation variables described for the consumption deflator and durables and housing indices. The rate of return on bonds (RBO) is an appropriately weighted average of nine underlying bond rates (see Appendix for details) where the weights are the lagged proportions for each category, plus the expected rate of change in

4. Implicit in this is the assumption that the service flow derived from the stock of durables is a constant proportion of that stock.

the bond-price index, calculated as were the other four expected rates of price change[5]. The model does not contain an interest rate for the life insurance and pensions category. This is because no specific data are available; a rate constructed from other market rates would add no information to our system. The mortgage rate (RMO) is taken to be that on five-year conventional mortgages, while the rate applicable to consumer credit (RLO) is the four-year chartered bank rate charged for new car loans. Finally, a proxy is constructed for expectations of future interest rate movements using the first difference of the 90-day commercial paper rate ($\Delta R90$). This variable may be viewed as a proxy for regressive expectations, whereby a positive change in one period leads one to expect an offsetting negative change in the next period, or for extrapolative expectations, according to which a positive change in one period indicates additional positive changes in future periods. The interpretation of the variable therefore depends on the sign of the coefficient. Alternatively, one can think of this variable as relaxing somewhat the dynamic restrictions imposed by the vector partial-adjustment model.

The interest rates in the model are therefore all nominal and, where appropriate, include expected returns due to capital gains. The presence of the expected rate of inflation in the model permits the calculation of both nominal and real interest rate effects on the portfolio. One difficulty with the interest rates is that they are not all comparable because they pertain to different maturities. In earlier work (Poloz, 1983) an attempt was made to adjust all interest rates for this effect by calculating each on a 90-day comparable basis[6]. Unfortunately, these adjustments increased the degree of multicollinearity in the model and therefore reduced the precision of the estimated parameters. The results presented here were generated in both ways; the maturity-adjusted results are not presented because they are uniformly inferior in terms of fit and

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5. The same eight-quarter moving average was used for all such proxies under the presumption that households would use the same information set in each case. The eight-quarter lag was chosen on empirical grounds during preliminary estimation.

6. For example, the five-year mortgage rate was adjusted by subtracting the difference between the yield on five-year Government of Canada bonds and that on 90-day treasury bills.

parameter precision. The cause of this is unclear, since the two sets of results being compared have in common an assumed model structure that may be misspecified in various ways.

In addition to the exogenous variables discussed above, the usefulness of other variables suggested by previous work with such models was examined during preliminary estimation. These variables included the rate of unemployment, population distribution, and a dummy variable intended to capture the effects on equity of some tax changes in 1972 (see Amoaku-Adu, 1983). None of these added significantly to the explanatory power of the equations and so were omitted from this study.

Full documentation of data sources and further details of data construction can be found in the Appendix. The data are quarterly, seasonally adjusted and run from 1968Q2 to 1983Q4[7]. The starting point was chosen to enable the use of Bank of Canada sources for several categories. The endpoint was determined by the availability of the year-end financial-flow accounts. Because of the presence of lagged asset stocks in the model, estimation began in 1968Q3, giving a total of 62 observations.

1.4 Econometric Issues

The most important feature of this model is the explicit recognition of the income constraint, which results in a series of adding-up restrictions on the parameters of the system. These adding-up conditions hold automatically in equation-by-equation application of ordinary least squares (OLS) estimation provided that each equation contains the same set of regressors, including one that is the sum of the dependent variables (Nicholson, 1957). Walsh (1981) has pointed out a problem with such models, however. Because they often rely on the use of flow-of-funds data, these models typically suffer from a classical problem of errors in variables. This arises because flow-of-funds data contain measurement

7. Seasonally unadjusted data were adjusted using the X-11 method on the relevant aggregate categories prior to estimation.

error, a point emphasized by the discrepancy between savings measured in the flow-of-funds accounts and savings as reported in the national accounts. The scale variable will contain these measurement errors, and therefore will be correlated with the residuals of each equation. Walsh proposed a two-stage procedure whereby the scale variable is first regressed on a set of instruments and its fitted value used in the structural equations. Although in previous work using this procedure the parameter estimates changed quantitatively, no qualitative differences were observed. Moreover, this comparison failed to uncover any important differences in simulation ability or in inferences made on the basis of hypothesis tests (see Poloz, 1983). This may be an indication of the very limited extent to which flow-of-funds data are used in this study, or may imply that the bias problem pointed out by Walsh is minor in this instance when compared with the precision problem associated with multicollinearity. In any case, the two-stage procedure is not used here.

A second type of simultaneity problem may be important in a model such as this. It relates to the more common difficulty of identifying demand and supply equations in empirical work on financial markets. Although the theoretical model describes the decision process of an individual household, and therefore presumes that each equation represents a demand function, there may be prominent supply effects in the parameter estimates when dealing with data for the aggregate household sector. This possibility is not addressed here, but it is recognized from the outset that the reported estimates might contain this element of bias.

Perhaps the greatest obstacle to be overcome if we are to isolate the linkages between financial assets is multicollinearity. As already noted, some recent research has used Bayesian estimation to overcome this, with limited success. In early work on this project (Poloz, 1983), ridge estimation was used in this context. A major shortcoming of this technique is that systems ridge-estimation packages were unavailable, so the adding-up conditions could not be preserved. The resulting model often simulated better than did versions using OLS estimation or Walsh two-stage techniques, but was less useful in evaluating the importance of cross-equation linkages. In light of these results, the assessment of these linkages is likely to be better served by adopting the more traditional approach of excluding irrelevant variables from the coefficient matrix while ensuring that the adding-up restrictions continue to hold through systems estimation. This is the approach taken here.

2 ESTIMATION AND SIMULATION RESULTS

2.1 Single Equation Estimation

The flow model described in equation set (1.4) was estimated for the nine categories using single-equation ordinary least squares. With the exogenous variable vector containing a constant, seven interest rates, expected inflation, and the first difference of a market interest rate, each equation contains 19 explanatory variables. The adding-up conditions hold automatically in this situation. Estimation results are given in Table 2.

Given the potential for multicollinearity, the degree of statistical significance of the estimates is surprisingly high. Of the 171 parameters about one quarter (42) are statistically significant at the 0.95 level, and more than one half (92) bear t-statistics that exceed unity. The $\bar{R}^2$ statistics range from a low of 0.073 for the bond category to a high of 0.999 for consumption; only that for the bond category is less than 0.5. The Durbin-Watson and Durbin h-statistics indicate that four of the nine equations suffer from significant first-order autocorrelation. This study does not deal with this problem, but its presence should inject a note of caution into any subsequent interpretation of the results.

Very little can be said with respect to the appropriateness of the signs of most of the individual coefficients. Although the signs of the own-interest-rate parameters in general are expected to be positive, the complexity of the dynamic structure can at times result in signs contrary to expectations. Moreover, in the case of a market-valued asset the price effect of a change in rate might be opposite in sign to and outweigh the positive quantity effect. In Table 2 three own-rate coefficients have positive signs, while four have negative signs. Of these seven, only the negative own-rate coefficient in the housing equation is statistically significant at the 0.95 level, although the positive parameter on RCD in the currency and deposits equation has a t-statistic of 1.63. The own-adjustment coefficients are expected to be negative, and this expectation is met for all except that in the life insurance and pensions equation, which is not statistically significant at the 0.95 level.

Table 2

UNCONSTRAINED SINGLE-EQUATION ESTIMATION, 1968Q3-1983Q4
(absolute values of t-statistics in parentheses)

	Equation									
Variable	Consumption CON/YE	Durables ΔDU/YE	Housing ΔHO/YE	Currency & Deposits ΔCD/YE	Equity ΔEQ/YE	Bonds ΔBO/YE	Life Ins. & Pensions ΔLP/YE	Mortgages -ΔMO/YE	Consumer credit -ΔLO/YE	Σ
Constant	0.096782	0.022634	-0.241149	0.069632	1.141880	0.007915	0.037143	-0.088608	-0.046228	1
	(2.60)	(0.48)	(0.74)	(1.12)	(2.65)	(0.06)	(0.75)	(2.51)	(1.74)	
$\dot{P}^e$	0.003262	0.005576	0.108827	-0.001360	-0.115869	0.009902	-0.003058	-0.005480	-0.001800	0
	(0.95)	(1.28)	(3.61)	(0.24)	(2.92)	(0.77)	(0.66)	(1.68)	(0.73)	
RDU	-0.006660	-0.003660	-0.022300	0.006283	0.018755	-0.009057	0.006155	0.004869	0.005614	0
	(2.44)	(1.06)	(0.93)	(1.38)	(0.60)	(0.88)	(1.69)	(1.88)	(2.88)	
RHO	-0.001051	-0.000294	-0.023169	-0.005144	0.027878	0.001952	-0.003061	0.001960	0.000930	0
	(1.17)	(0.26)	(2.93)	(3.41)	(2.68)	(0.58)	(2.54)	(2.29)	(1.45)	
RCD	-0.003997	0.006130	-0.084773	0.013745	0.064499	0.000971	-0.000888	0.004860	-0.000548	0
	(0.79)	(0.96)	(1.92)	(1.63)	(1.11)	(0.05)	(0.13)	(1.02)	(0.15)	
REQ	0.000097	-0.000040	0.002721	-0.001353	-0.002492	0.001923	-0.000222	-0.000026	-0.000607	0
	(0.24)	(0.08)	(0.76)	(1.99)	(0.53)	(1.26)	(0.41)	(0.07)	(2.09)	
RBO	-0.000118	0.000335	-0.000259	0.001152	-0.001568	0.000648	0.000636	-0.001144	0.000318	0
	(0.24)	(0.55)	(0.06)	(1.43)	(0.28)	(0.36)	(0.99)	(2.50)	(0.92)	
RMO	-0.001956	-0.004523	-0.034325	-0.026673	0.058736	0.013111	-0.007908	0.002941	0.000597	0
	(0.39)	(0.72)	(0.78)	(3.19)	(1.02)	(0.70)	(1.18)	(0.62)	(0.17)	
RLO	0.001121	-0.002610	0.094183	0.015136	-0.095014	-0.016753	0.007590	-0.002980	-0.000673	0
	(0.28)	(0.52)	(2.70)	(2.27)	(2.06)	(1.12)	(1.42)	(0.79)	(0.24)	
ΔR90	0.004404	-0.001795	0.023545	-0.003739	-0.012619	-0.006184	0.000504	-0.000971	-0.003143	0
	(3.71)	(1.20)	(2.27)	(1.89)	(0.92)	(1.39)	(0.32)	(0.86)	(3.72)	
(Y-YE)/YE	0.029623	0.020319	0.321111	0.013443	0.612117	0.012937	0.022356	-0.010276	-0.021631	1
	(5.11)	(2.78)	(6.33)	(1.39)	(9.14)	(0.59)	(2.88)	(1.87)	(5.23)	
DU(-1)/YE	0.394508	-0.096983	-0.379959	-0.124719	0.542064	-0.004190	-0.005422	-0.083258	-0.242040	0
	(4.50)	(0.88)	(0.49)	(0.85)	(0.54)	(0.01)	(0.05)	(1.00)	(3.87)	
HO(-1)/YE	0.038964	0.026243	-0.023879	0.042329	-0.071340	-0.004117	0.013361	-0.008616	-0.012945	0
	(4.33)	(2.31)	(0.30)	(2.81)	(0.69)	(0.12)	(1.11)	(1.01)	(2.02)	
CD(-1)/YE	0.087949	-0.016413	-0.086753	-0.094645	0.353293	-0.160908	-0.068259	0.033096	-0.047361	0
	(2.47)	(0.37)	(0.28)	(1.59)	(0.86)	(1.20)	(1.43)	(0.98)	(1.87)	
EQ(-1)/YE	0.012708	0.006022	0.130597	0.021882	-0.099987	-0.067412	0.006046	-0.000492	-0.009364	0
	(1.48)	(0.56)	(1.74)	(1.53)	(1.01)	(2.10)	(0.53)	(0.06)	(1.53)	
BO(-1)/YE	0.074764	0.089793	0.278179	-0.060437	-0.119559	-0.173316	-0.072857	0.047958	-0.064524	0
	(2.08)	(1.98)	(0.88)	(1.00)	(0.29)	(1.28)	(1.51)	(1.41)	(2.51)	
LP(-1)/YE	-0.122084	-0.005423	-0.106009	0.122106	-0.528155	0.272170	0.088608	0.086472	0.192314	0
	(2.01)	(0.07)	(0.20)	(1.20)	(0.75)	(1.19)	(1.09)	(1.50)	(4.43)	
-MO(-1)/YE	0.196938	-0.007722	0.301346	0.090384	-0.626561	0.119580	0.011660	-0.077246	-0.008379	0
	(5.23)	(0.16)	(0.91)	(1.44)	(1.44)	(0.85)	(0.23)	(2.16)	(0.31)	
-LO(-1)/YE	-0.014848	-0.040398	-1.328630	-0.225494	2.323580	-0.460976	-0.035544	0.201768	-0.419459	0
	(0.09)	(0.20)	(0.95)	(0.84)	(1.26)	(0.77)	(0.17)	(1.33)	(3.68)	
$\bar{R}^2$	0.99909	0.71991	0.89199	0.60306	0.84938	0.07300	0.51867	0.94222	0.91208	
SER	0.010142	0.012792	0.088773	0.016957	0.117090	0.038079	0.013564	0.009610	0.007232	
SSR	0.004423	0.007037	0.338870	0.012364	0.589480	0.062350	0.007911	0.003971	0.002249	
DW	1.71	2.32	1.85	2.49	1.94	2.21	2.78	2.28	2.27	
DURBIN h	-	2.59	0.75	2.18	0.40	*	3.99	1.13	2.41	
F(18,43)	3,714.80	9.71	29.99	6.15	20.11	1.27	4.65	56.26	36.16	

* Indicates that Durbin h could not be calculated as it required taking the square root of a negative number.

An increase in expected inflation leads to a statistically significant increase in housing expenditure and a reduction in the market value of equity holdings. Effects of increases in expected inflation that are not statistically significant, but whose t-statistics exceed unity, are increases in durables purchases and in mortgage debt. Variable ΔR90 is intended to capture expectations of the future course of interest rates; the results show that an increase in the general level of interest rates leads to statistically significant increases in consumption, housing, and the absolute value of loans. It also leads to empirically less important reductions in expenditures on durables, currency and deposits, and bonds. These results suggest that ΔR90 is capturing extrapolative expectations, but this inference should not be taken too literally.

These preliminary results could be analyzed in much greater detail, especially with respect to the cross-equation linkages that are the central focus of this study. The discussion of these linkages is reserved for section 2.3, where the restricted estimation results, which exclude the empirically irrelevant variables from the model, are examined.

2.2 Hypothesis Testing

Five hypotheses were tested with respect to the model structure. The results are given in Table 3. In each case the calculated F-ratio has been normalized on the critical value at the 0.95 level, so that a result greater than one implies rejection of the null hypothesis.

The first three hypotheses relate to the empirical relevance of integration. The null hypothesis "Integration (1)" examines the importance of integration to the real expenditure block (the asset-composition effect) by aggregating the lagged financial instruments in each equation into two components, assets and liabilities. These restrictions are rejected by the data for the consumption and housing equations. The null hypothesis "Integration (2)" restricts the model further, aggregating the lagged financial instruments into one category, net financial wealth; this hypothesis is rejected for all three real expenditure equations. These results imply that real expenditures depend

Table 3

HYPOTHESIS TESTING
(Ratios of calculated F-statistics to critical values at the 0.95 level)

Equation	Hypotheses: Integration (1)	Integration (2)	Integration (3)	Cross rates	Cross adjustment
Consumption	1.78*	5.61*	-	-	-
Durables	0.99	1.01*	-	0.33	1.24*
Housing	1.37*	1.61*	-	0.89	1.92*
Currency & Deposits	-	-	1.53*	2.38*	2.31*
Equity	-	-	0.90	0.81	0.82
Bonds & Short paper	-	-	0.17	0.21	0.77
Life insurance and Pensions	-	-	1.17*	-	0.40
Mortgages	-	-	0.81	3.04*	4.63*
Consumer credit	-	-	2.25*	0.89	3.11*

Notes

1. An asterisk denotes rejection of the null hypothesis at the 0.95 level. Since the figures reported are ratios of calculated to critical values, this is true for all statistics that exceed unity.
2. All tests are calculated against the specifications presented in Table 2.
3. Hypotheses and respective degrees of freedom are as follows:
   Integration (1) - Lagged financial instruments may be aggregated into assets and liabilities; $F_c(4,43) = 2.60$
   Integration (2) - Lagged financial instruments may be aggregated to net financial wealth; $F_c(5,43) = 2.44$
   Integration (3) - Joint hypothesis that expenditure block rates of return and adjustment items are zero in financial block equations; $F_c(4,43) = 2.60$
   Cross rates - Joint hypothesis that cross interest rate effects are zero; $F_c(6,43) = 2.33$
   Cross adjustment - Joint hypothesis that cross adjustment items are zero; $F_c(7,43) = 2.24$

not only on the level of wealth in the previous period, but on its composition as well. Thus, integration of the consumption-savings and portfolio-balance decisions is important in a statistical sense from the standpoint of modelling real expenditures.

The empirical relevance of integration for the financial block is tested under the third null hypothesis, "Integration (3)." In this case imposing the null hypothesis that integration is irrelevant to the financial block entails excluding the rates of return and adjustment items that originate from the real expenditure block: RDU, RHO, DU(-1)/YE, and HO(-1)/YE. This null hypothesis is rejected by the data at the 0.95 level for currency and deposits, life insurance and pensions, and loans. It is also very nearly rejected for the equity and mortgage categories. The only equation for which rejection is not at least borderline is that for bonds which, as can be observed in Tables 1 and 2, constitutes a very minor proportion of the total portfolio and is statistically very poorly determined. On balance, then, one can infer that integration of the consumption-savings and portfolio-balance decisions is statistically relevant for modelling asset demands as well as for modelling real expenditure decisions.

The inference that integration is statistically significant from the viewpoint of portfolio modelling is an important one, and is perhaps the most interesting conclusion of this study. Of course, the existence of certain institutional linkages, between durables and consumer credit on the one hand and between housing and mortgages on the other, would lead one to expect this result for these categories. But the importance of integration for the remaining categories implies that support for the hypothesis is fairly broadly based.

The last two hypotheses consider the importance of treating the asset-demand equations (including the real assets, durables and housing) as part of a system rather than individually. Constraining the coefficients on all cross interest rates to be zero is rejected by the data for only the currency and deposits and mortgage equations, but is very nearly rejected for housing, equity, and loans as well. The last null hypothesis imposes zero restrictions on all cross-adjustment items. These restrictions are rejected for all equations except equity, bonds, and life insurance and pensions. As with previous tests, however, we note that the results for equity and bonds are sufficiently close to rejection that a change in sample period could reverse the inference fairly easily. In any case, the central message from the latter two tests is that the cross-equation linkages are statistically important but that the most important of these linkages come by way of the adjustment matrix rather than the interest rate matrix.

Before concluding this section, the reader should note an important qualification. The parameter estimates in Table 2 and the associated hypothesis tests in Table 3 have proved to be rather sample sensitive. This stems in part from the fact that there is not an abundance of data, so that updating the sample by one year increases degrees of freedom by about 10 per cent. Also, updating the data set generally means revising some of the existing data. A more important source of this sensitivity, however, may well be the highly interdependent specification of the model itself. A change in any one of the dependent variables has a direct impact on the system scale variable which, along with the lagged-adjustment variables, can have a very widespread ultimate effect on the model. For this reason there is a tendency to emphasize the broad inferences obtained from such models, rather than the individual parameter estimates themselves. This approach to interpreting the results is adopted in this study, but the reader is cautioned that in some cases even the general conclusions drawn here have shown some sample dependency. Naturally, the results presented are presumed to dominate those based on subsamples, given the additional degrees of freedom, but this general rule holds only in the absence of structural change, which is not tested for explicitly.

2.3 Systems Estimation with Zero Restrictions

The important linkages in the model were further isolated by imposing zero restrictions in the coefficient matrix, based on t-statistics and priors, while estimating the model's nine equations simultaneously, subject to the adding-up constraints. The estimation procedure used was the restricted iterative Zellner seemingly unrelated regression package of TSP. Since imposing the cross-equation constraints renders one of the equations redundant, the bond equation was omitted from the system estimation. The system was re-estimated a number of times, with one zero restriction imposed per equation, but excluding at most one parameter per row, at each iteration. Own interest rates and the scale variable were retained regardless. This procedure was repeated until the parameter estimates presented in Table 4 emerged.

A total of 82 zero restrictions have been imposed in the final version, leaving 89 explanatory variables, a number very close to the number of t-statistics that exceeded unity in the unrestricted version presented in Table 2. The usual summary statistics are presented but should be interpreted with caution because they depend on degrees of freedom for each equation, a concept that has little meaning in this situation because of joint estimation.

With respect to the signs of the parameter estimates, all own-adjustment coefficients are now negative and statistically significant[8], with the exception of that for life insurance and pensions, which has been excluded. Of the own-interest-rate coefficients, those for currency and deposits, equity, bonds, and mortgages are positive and statistically significant, as one might expect. The same coefficient for durables and housing is significantly negative, while that for loans is negative but not statistically significant. Although these results are somewhat mixed, it must be recognized that it is, by definition, difficult to isolate partial derivatives such as these when interest rates tend to move together. Also, as noted previously, a negative own-rate coefficient is a theoretical possibility in the case of a market-valued asset, since the price and quantity responses will be in opposite directions.

The expected inflation rate has been excluded from several equations, presumably because in those cases its effects have been captured adequately by one or more of the nominal interest rates. The remaining

8. Although we continue to describe the results using conventional criteria, we recognize that, strictly speaking, such an interpretation is invalid, given the iterative procedure used to obtain the parameters.

Table 4

CONSTRAINED ITERATIVE ZELLNER ESTIMATION, 1968Q3-1983Q4
(Absolute values of t-statistics in parentheses)

Variable	Equation: Consumption CON/YE	Durables ΔDU/YE	Housing ΔHO/YE	Currency & Deposits ΔCD/YE	Equity ΔEQ/YE	Bonds ΔBO/YE	Life Ins. & Pensions ΔLP/YE	Mortgages -ΔMO/YE	Consumer credit -ΔLO/YE	Σ
Constant	0.105096	0.042946	0.118519	0.099932	0.708851	-0.003672	0.060306	-0.097625	-0.034354	1
	(13.98)	(3.08)	(1.46)	(5.01)	(7.43)	(0.16)	(5.48)	(8.49)	(4.56)	
$\dot{p}^e$	-	0.004113	0.079736	-	-0.077936	-	-	-0.005912	-	0
	-	(2.63)	(9.29)	-	(9.06)	-	-	(4.70)	-	
RDU	-0.006348	-0.005909	-	-	-	-	0.002398	0.005289	0.004570	0
	(7.53)	(5.70)	-	-	-	-	(3.01)	(5.18)	(5.63)	
RHO	-	-	-0.013783	-0.003416	0.017836	-	-0.002006	0.001368	-	0
	-	-	(3.60)	(4.76)	(4.50)	-	(5.81)	(3.33)	-	
RCD	-0.004246	-	-0.007861	0.012107	-	-	-	-	-	0
	(4.10)	-	(1.80)	(2.82)	-	-	-	-	-	
REQ	-	-	-	-0.001449	0.002026	-	-	-	-0.000577	0
	-	-	-	(6.43)	(8.99)	-	-	-	(5.63)	
RBO	-	-	-	-	-	0.000863	-	-0.000863	-	0
	-	-	-	-	-	(4.98)	-	(4.98)	-	
RMO	-	-	-0.102338	-0.016081	0.116539	-	-0.002318	0.004198	-	0
	-	-	(6.36)	(4.97)	(7.03)	-	(2.37)	(3.90)	-	
RLO	-	-0.001812	0.083706	0.006183	-0.087117	-	-	-	-0.000960	0
	-	(1.87)	(5.96)	(2.33)	(6.13)	-	-	-	(1.33)	
ΔR90	0.004268	-	0.013505	-0.003767	-	-0.010666	-	-	-0.003340	0
	(5.83)	-	(3.37)	(3.08)	-	(2.98)	-	-	(5.20)	
(Y-YE)/YE	0.031797	0.026923	0.284997	0.006811	0.658956	0.005250	0.014789	-0.004860	-0.024663	1
	(7.50)	(5.12)	(7.53)	(0.96)	(12.87)	(0.26)	(2.73)	(1.22)	(7.37)	
DU(-1)/YE	0.421492	-0.072167	-	-	-	-	-	-0.115623	-0.233702	0
	(18.96)	(3.39)	-	-	-	-	-	(4.30)	(9.13)	
HO(-1)/YE	0.035527	0.034761	-0.080426	0.023105	-	-	-	-	-0.012967	0
	(8.13)	(8.38)	(10.02)	(4.45)	-	-	-	-	(3.66)	
CD(-1)/YE	0.095656	-0.029932	-0.071051	-0.046788	-	0.047594	0.004520	-	-	0
	(6.99)	(3.97)	(4.92)	(4.76)	-	(3.86)	(3.53)	-	-	
EQ(-1)/YE	0.013572	-	0.185368	0.017805	-0.248221	0.031477	-	-	-	0
	(5.46)	-	(7.34)	(4.42)	(8.79)	(3.07)	-	-	-	
BO(-1)/YE	0.041785	0.040538	-	-	-	-0.058096	-	-	-0.024228	0
	(2.66)	(2.75)	-	-	-	(2.69)	-	-	(3.30)	
LP(-1)/YE	-0.143228	-	-	-	-	-0.107768	-	0.130239	0.120757	0
	(6.91)	-	-	-	-	(5.01)	-	(9.71)	(11.63)	
-MO(-1)/YE	0.196202	-	-	-	-0.142777	-	-	-0.053426	-	0
	(15.96)	-	-	-	(7.82)	-	-	(4.64)	-	
-LO(-1)/YE	-	-	-	-	0.258353	-	-	0.105984	-0.364338	0
	-	-	-	-	(4.62)	-	-	(2.10)	(8.94)	
$\bar{R}^2$	0.99905	0.70757	0.88072	0.55980	0.80574	N/A	0.53143	0.94082	0.89357	
SER	0.010270	0.012965	0.092533	0.017712	0.131895	N/A	0.013274	0.009647	0.007892	
SSR	0.005273	0.008909	0.436680	0.016000	0.90461	N/A	0.009868	0.004746	0.003177	
DW	1.68	1.87	1.60	2.36	1.45	N/A	2.52	2.06	1.77	
DURBIN h	-	0.50	1.56	1.40	2.23	N/A	-	0.24	0.95	
DYNAMIC RMSPE	2.41	2.72	3.18	1.56	8.78	57.69	1.36	5.08	3.99	

NOTE: $\bar{R}^2$ and SER are only approximations since they use degrees of freedom for each individual equation. Summary statistics are not available for the omitted residual bond equation.

coefficients indicate that an increase in expected inflation leads to an increase in expenditures on durables and housing, financed by a reduction in equity holdings and an increase in mortgage liabilities. These patterns seem reasonable. Equally acceptable are the effects of ΔR90; evidently expectations of further increases in the level of interest rates lead to higher consumption and housing expenditures, financed by reductions in currency and deposits and bonds together with an increase in outstanding loans.

The allocation of unexpected income is essentially unchanged from that found in the unrestricted estimates, the most important observations being that all categories increase in absolute value and that the largest allocations are to equity and housing. This interpretation presumes, of course, that there is no simultaneity between the dependent variables and unexpected income. Since the portfolio is dominated by movements in the housing and equity categories, the scale variable is similarly affected, by construction. Thus, it is possible that the parameters on unexpected income reveal more about sources than about uses. The response of expanding both sides of the balance sheet when faced with a positive income shock is an interesting finding and may seem slightly counter-intuitive. A possible explanation is that a significant segment of the household sector is fully levered according to some income-dependent criteria selected by lending institutions, so that unexpected income allows the extension of more credit which is subsequently withdrawn when a negative shock hits. If this were the case, perhaps the model would pick up the responses of debtor households in the liability categories and of creditor households in the asset categories.

Perhaps the most intuitive way of analyzing the cross-equation linkages is to consider in each row the offsetting effects of a change in each explanatory variable. We start with the rate of return on durables (RDU) and note that it has rather unexpected impacts on the portfolio. Specifically, an increase in RDU leads to reductions in durables expenditure, consumption, and in both loans and mortgages outstanding, and to an increase in life insurance and pensions. Perhaps our assumption that the service flow derived from durables is a constant proportion of the stock is partly responsible for these results. However, a similar problem exists with the rate of return on housing, RHO. Increases in this variable lead to reductions in housing, currency and deposits, life insurance and pensions, and outstanding mortgage debt, and to an increase in equity. The only intuitive result here is that a reduction in housing expenditure is accompanied by a contraction in mortgage debt. The interest rate associated with currency and deposits, on the other hand, has some expected effects on the portfolio. These include an increase in currency and deposits in response to an increase in the own-rate, and corresponding declines in consumption and housing expenditures. Unfortunately, the effects of changes in this rate are somewhat less pervasive than might have been anticipated.

The results also indicate that increases in the rate of return to equity lead to increased allocations to that category, financed through drawdowns of currency and deposits and to an increase in outstanding loans. The bond rate has a very limited impact on the model. This is not surprising, given the size of this category relative to the overall portfolio. A positive own-effect is observed, but the estimates imply that the increase in bonds is financed through an increase in mortgage liability. In contrast, movements in the two liability rates have widespread effects on the portfolio. An increase in the mortgage rate leads to a contraction in mortgage liability and to a corresponding reduction in housing expenditure. This change also leads to a reallocation of funds into equity, which is a little surprising; in addition to reducing housing expenditure the household reduces holdings of currency and deposits and life insurance and pensions. Finally, as already mentioned, the loan rate takes on a negative (but not statistically significant) sign in the loans equation. However, an increase in the loan rate is found to reduce both expenditures on durables and the allocation to equity, which seems reasonable. The positive effects on housing and currency and deposits are less easy to explain.

The above discussion refers to impact effects only and therefore ignores the potentially important dynamic interactions that occur in subsequent periods by way of the adjustment matrix. The comparative dynamics of some selected partial shocks and of some less counterfactual system-wide shocks, are examined in section 2.5.

Before turning to the simulation results, a few comments regarding the adjustment matrix are in order. First, the Eigenvalues of the system were calculated as a check against dynamic instability. This calculation posed a slight difficulty because, as written in Table 4, the imposed zero restrictions render the adjustment matrix singular. This problem was eliminated by replacing the zero own-adjustment coefficient for the life insurance and pensions category with a series of statistically small values ranging from -0.05 to 0.05; the resulting Eigenvalues were affected only slightly by these changes, and the largest value that emerged was only 0.34. Thus, although some of the roots were complex, there appears to be no problem of dynamic instability in the restricted model. With respect to the individual adjustment coefficients, we note that the process of adjustment is rather slow for most equations, with estimates of less than 10 per cent per quarter for all except equity and loans, which adjust at rates of 25 per cent and 36 per cent per quarter, respectively. More will be said about the overall speed of adjustment in section 2.5. Finally, we note that there are a large number of statistically significant adjustment items in the consumption equation, a finding that further supports the asset-composition hypothesis of Purvis (1978).

2.4 Simulation Results: Historical

The root-mean-squared percentage simulation errors (RMSPE) for the dynamic within-sample simulation of the model are provided in the last row of Table 4. In each period of this simulation the simulated values of all the asset levels from the previous period are substituted into the relevant lagged dependent variables. The nine equations must therefore be simulated simultaneously, and persistent errors in any one equation will affect the simulation properties of the other equations through the endogenous adjustment matrix. Nevertheless, the nature of the model is such that even when simulated in this mode a great deal of information is provided on the right-hand side, since the scale variable, which in fact is the sum of the variables to be explained, is treated as exogenous.

For the purposes of this simulation the real asset stocks, as opposed to the flows, are treated as the endogenous variables. The RMSPE statistics cover a wide range, from lows of less than 2 per cent for life insurance and pensions and for currency and deposits, to a high of over 50 per cent for the residual asset, bonds. However, seven of nine equations have a RMSPE in the range of 5 per cent or less, a respectable performance.

Actual and simulated values for the dynamic simulation are compared in Figures 1 to 9. All graphs have been plotted in real terms (real market-value terms, where appropriate) to avoid compressing the scale unduly. Also, with the exception of consumption, which remains in flow terms, the graphs are in terms of stocks rather than flows.

Values for consumption expenditure are plotted in Figure 1. The model underpredicts actual consumption during the period of very rapid growth from 1970 to 1972, but overpredicts during the subsequent slowdown over 1973-77. From there to the end of the sample, however, the equation predicts extremely well. Real holdings of durables (Figure 2) are also underpredicted early in the sample period, but the fit is very good during 1974-76. The equation then overpredicts for the remaining eight years of the sample. The equation for housing (Figure 3) overpredicts slightly during the early 1970s, but fits extremely well for the remainder of the sample, with the exception of the sharp break in trend that occurred in 1977-78. Interestingly, the equation predicts an even sharper break than that which actually took place. The model does a very good job of capturing the major downturn of 1982 and the subsequent rebound.

The model also predicts the currency and deposits series very well (Figure 4) although it must be admitted that the smoothness of the series makes this task less difficult than for other categories. Nevertheless, the model tends to overpredict during the first six years and to underpredict during the last four. The equity series (Figure 5) is one of the most variable, and predicting its movements is correspondingly difficult. Nevertheless, the model manages to capture the major turning points, and only experiences large errors during 1971-72. There is also a persistent underprediction during the steep increase over 1978-81. The

FULL DYNAMIC INTRASAMPLE SIMULATION

Figure 1
REAL CONSUMPTION EXPENDITURE (CON/P)

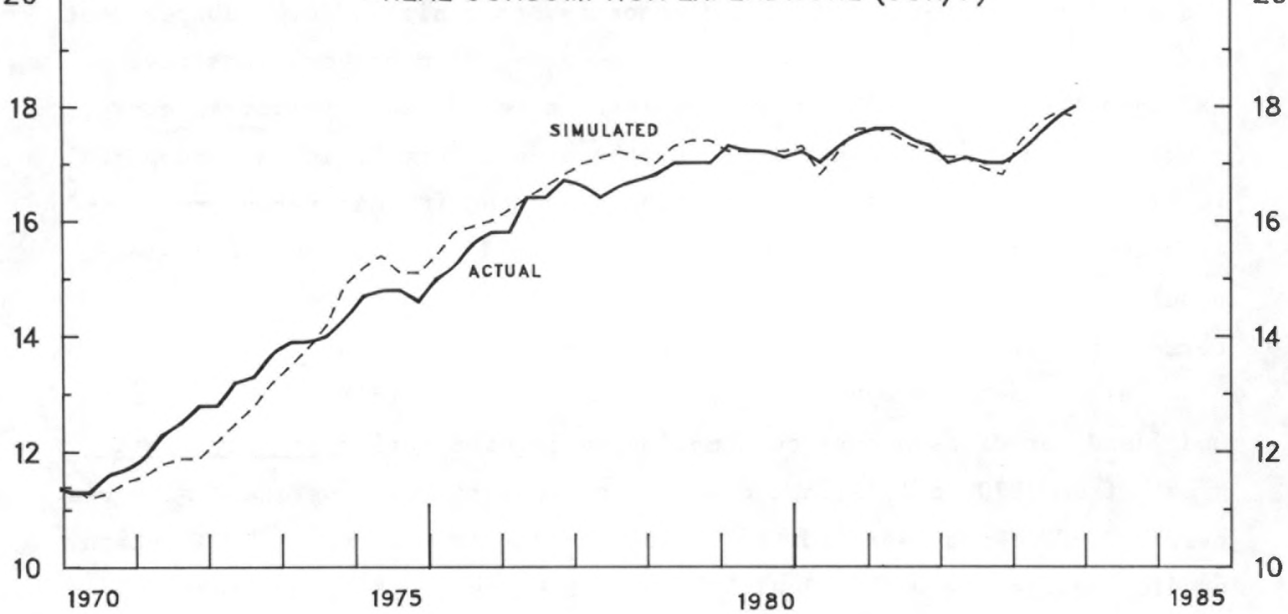


Figure 2
REAL HOLDINGS OF DURABLES (DU/P)

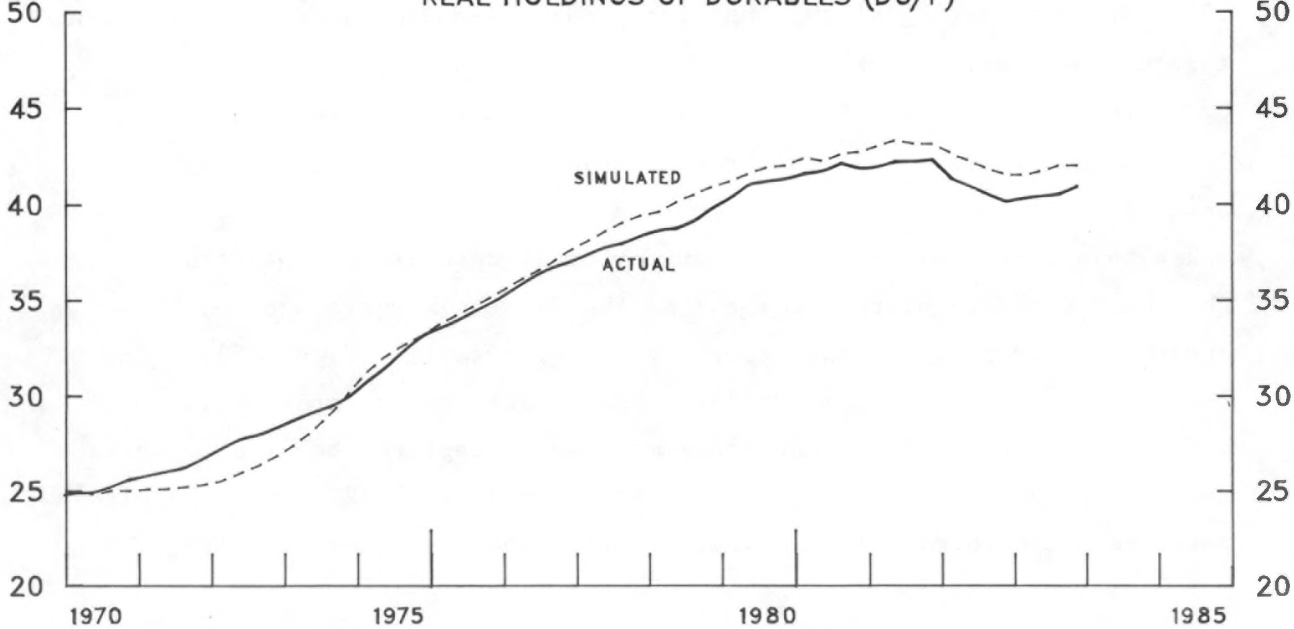


Figure 3
REAL HOLDINGS OF HOUSING (HO/P)

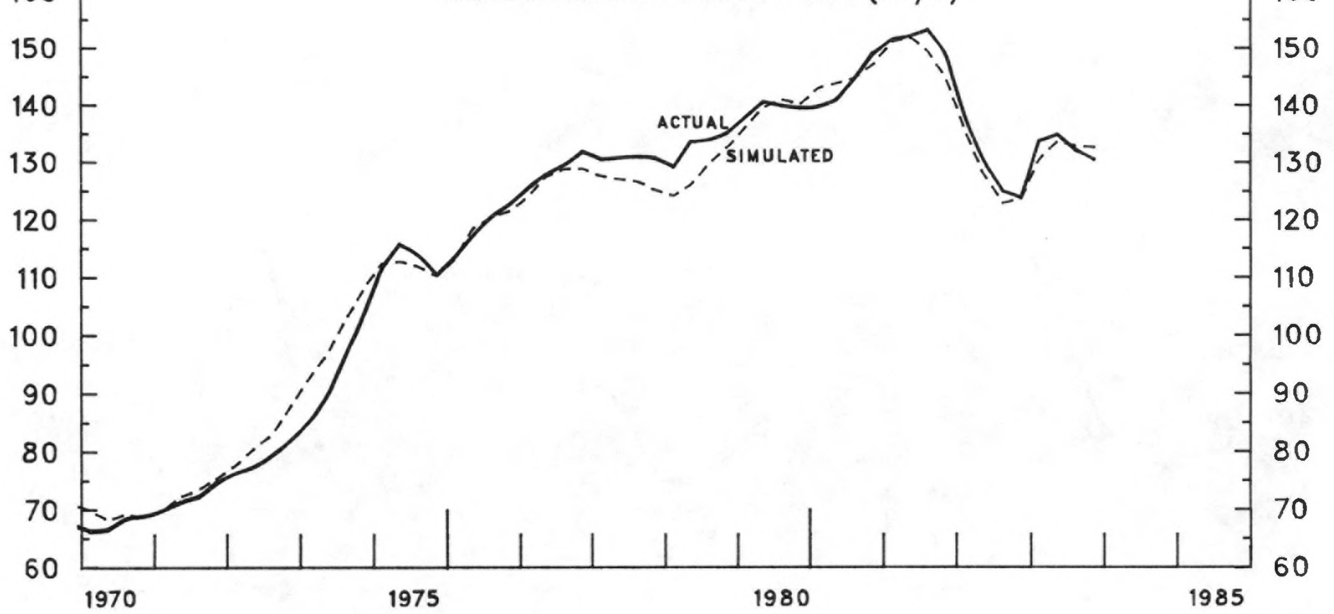


Figure 4
REAL HOLDINGS OF CURRENCY AND DEPOSITS (CD/P)

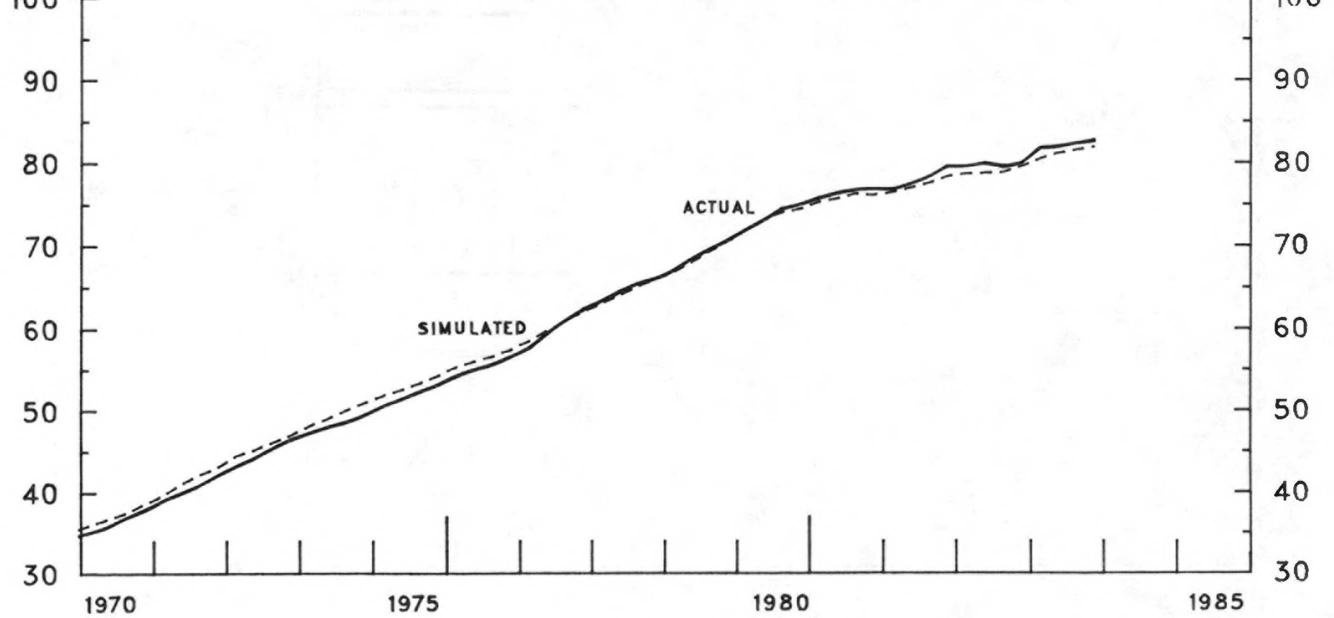


Figure 5
REAL EQUITY HOLDINGS (EQ/P)

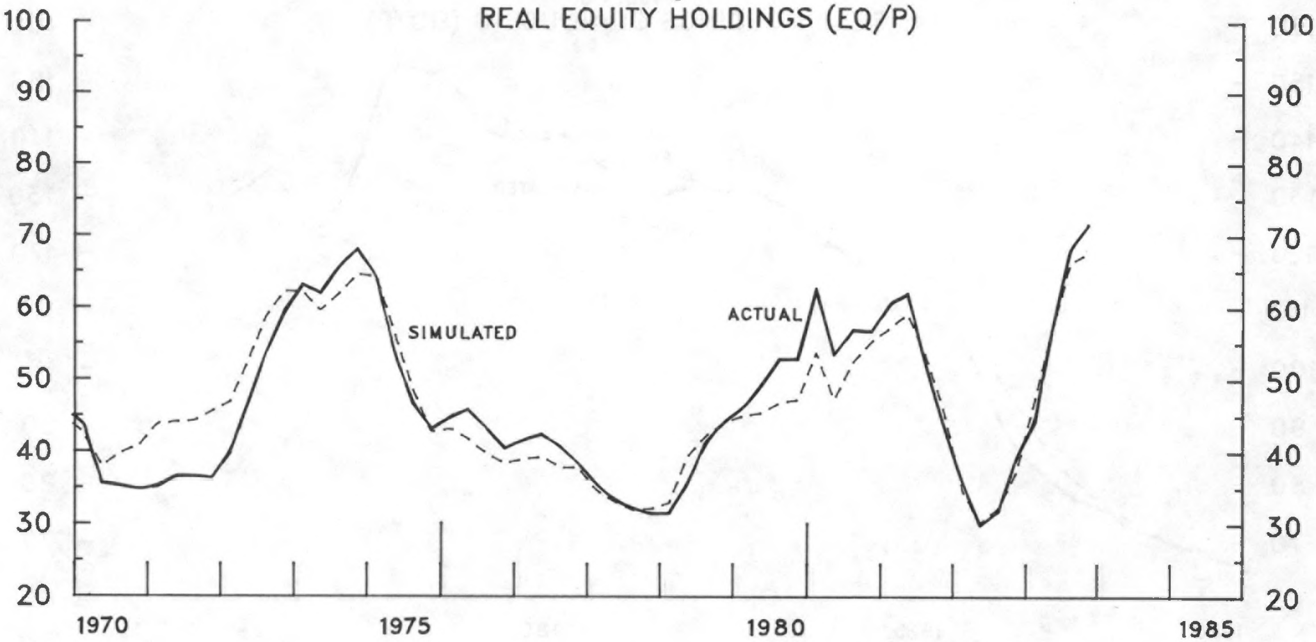


Figure 6
REAL HOLDINGS OF BONDS AND SHORT-TERM PAPER (BO/P)

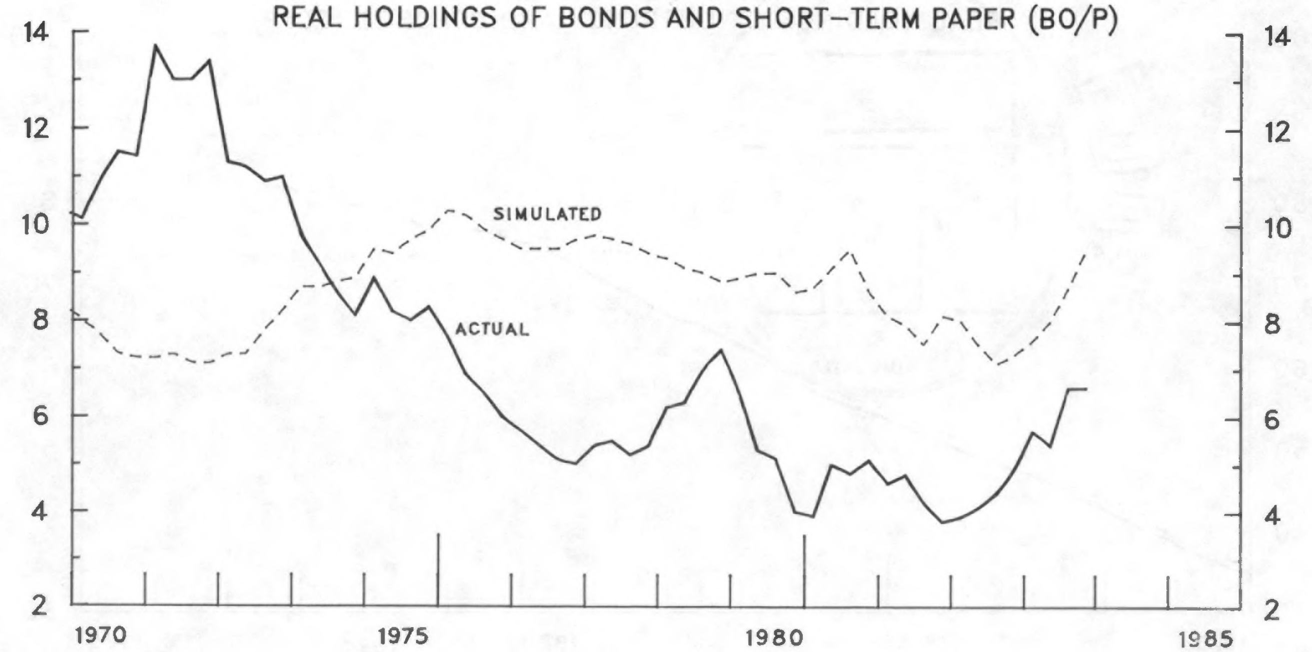


Figure 7
REAL HOLDINGS OF LIFE INSURANCE AND PENSIONS (LP/P)

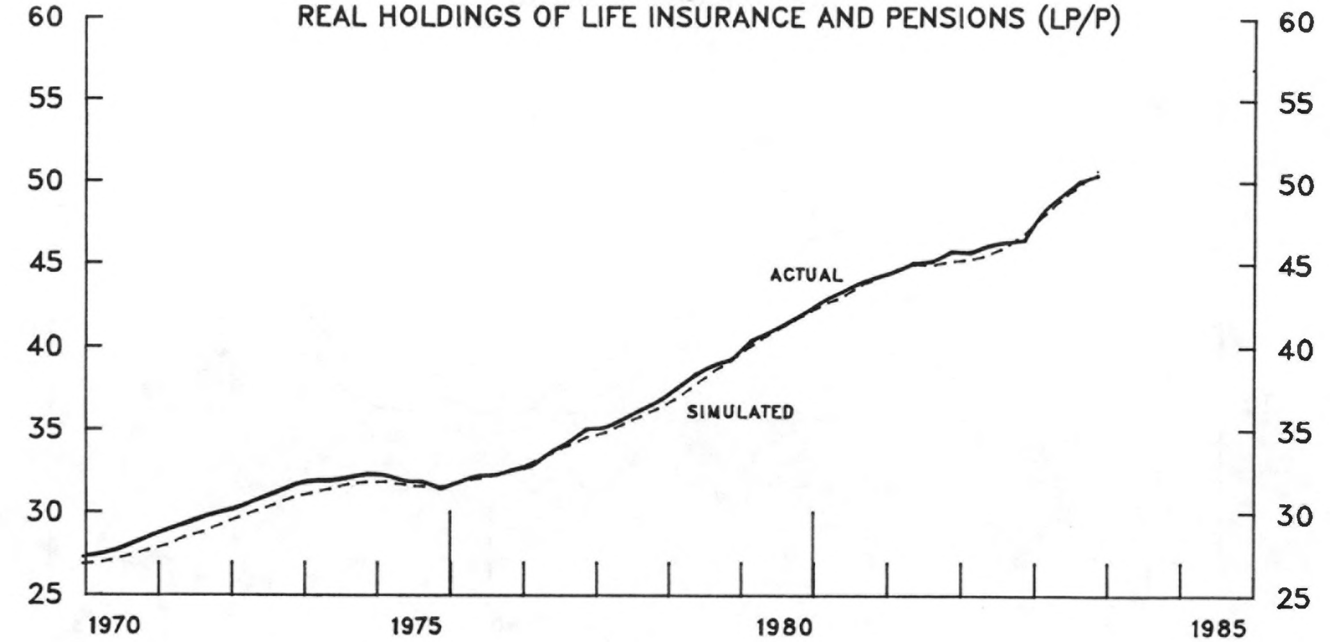


Figure 8
REAL MORTGAGE HOLDINGS (MO/P)

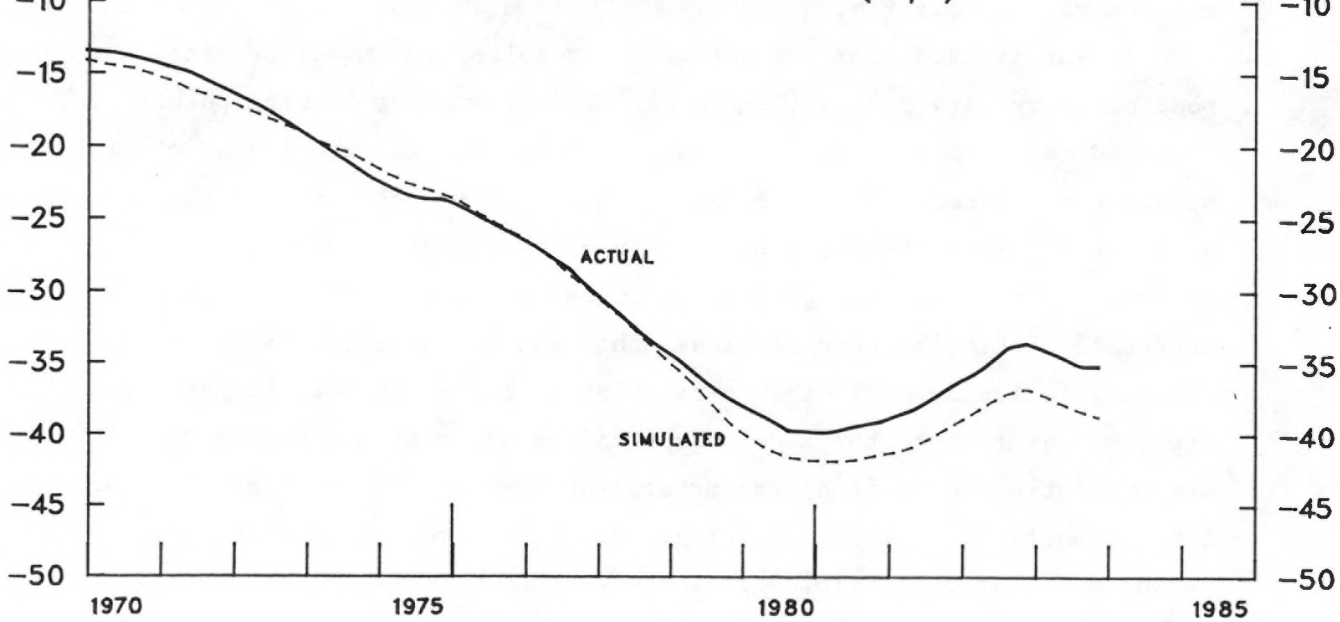
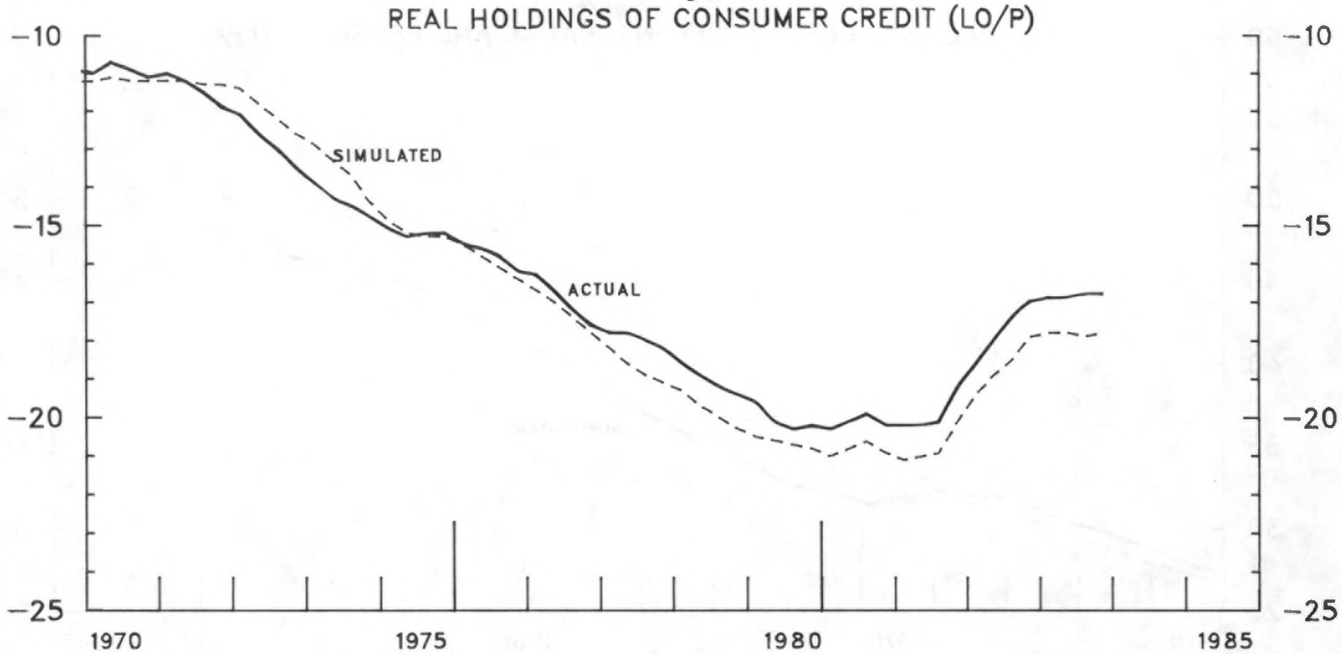


Figure 9

REAL HOLDINGS OF CONSUMER CREDIT (LO/P)



steep decline and steeper rebound that followed are, however, captured very well. These big movements in one of the largest categories of the portfolio, undoubtedly caused similar movements in unexpected income which, by implication, may be primarily responsible for the tracking ability of the equation.

As anticipated from the estimation results, the model predicts the bond category very poorly (Figure 6). The only major turning point captured is the most recent one late in 1981, but the model predicts the upturn two quarters after the fact. This performance can probably be attributed largely to the poor quality of the original series. Fortunately the bond category constitutes only a very minor share of the household portfolio. Nevertheless, this simulation performance may be responsible for several other persistent errors -- notice, in particular, that the point where the model stops underpredicting and begins overpredicting bonds is approximately the same crossover point observed for consumption, durables, housing, equity, and mortgages. Thus, for some purposes it may be sensible to exogenize this category in the course of future work.

Like the currency and deposits category, life insurance and pensions (Figure 7) are very smooth and are therefore quite well explained by the model. There is a persistent underprediction during the first five years but the remainder of the sample fits extremely well. The model predicts the two liability categories, mortgage holdings and consumer credit, quite well, but in both cases the system begins to overpredict (in absolute value) towards the end of the sample (Figures 8 and 9). Although the error pattern at the end of the sample is consistent with other evidence that suggests that households have responded to the high and variable interest rates of the 1980s by attempting to reduce debt burdens more than might have been expected on the basis of past relationships, the overpredictions begin somewhat earlier than expected. An interesting implication, however, is that the additional contraction in liabilities beyond what the model can explain was evidently financed through a reduction in durables expenditures and, if the results can be believed, bond holdings, since these are the only two equations that have significant offsetting simulation errors at the end of the sample.

2.5 Simulation Results: Shock Minus Control

In this section we consider the results of a limited number of comparative dynamics experiments that better illustrate the properties of the model. Table 5 lists the per cent shock-minus-control results at impact and at the end of each subsequent year for five years. Each shock is assumed to be permanent.

Before turning to the simulation results it is worth reconsidering briefly the underlying theoretical model as given in equations (1.1) to (1.4). From these it is clear that any permanent exogenous shock that leaves income unchanged will give rise to a permanent reallocation of wealth and, possibly, a permanent change in the desired wealth/income ratio, financed through a temporary change in consumption expenditures. Thus, it is possible to judge one aspect of the speed of adjustment to shocks by examining the path of consumption expenditures. On the other hand, permanent shocks to income will eventually have unit-elastic effects on consumption and on the asset stocks since homogeneity with respect to trend income has been imposed in estimation.

The first shock is a 1 per cent increase in the expected rate of inflation with all other variables held constant. This shock leads to extensive reshuffling of the portfolio, with increases in all three classes of real expenditure and increased borrowing in the form of both mortgages and consumer credit. It is particularly interesting to note the increase in outstanding loans, for which the impact effect of this shock is zero. This effect therefore arises through the adjustment matrix. The other major effects of this shock are declines in bond and equity holdings.

The second shock is an increase of 100 basis points in all nominal interest rates in the model, with expected inflation held constant. In effect, the average level of real interest rates is increased. Notice also that the variable ΔR90 will equal unity in the first period and zero elsewhere. As may be seen in Table 5, the household sector responds by reducing all three types of real expenditure, especially that on durables, and by paying down mortgages and loans. These adjustments agree with expectations. The new equilibrium will see a portfolio with less currency and deposits, less life insurance and pensions, and more equity and bonds.

Shock 3 is a linear combination of shocks 1 and 2, increasing all nominal interest rates and expected inflation by 100 basis points, and the results of this shock may be obtained simply by summing those of the previous two shocks. Here the results are mixed, with some responses changing sign partway through the simulation. Evidently the new equilibrium will be characterized by increased real expenditure in all three categories, despite a reduction at impact in spending on both consumption and durables. This new expenditure is financed through reductions in the four asset categories and a small increase in liabilities. Mortgages, in fact, are reduced during the first four years but begin to grow again in the longer term.

It was noted previously that the impact coefficients on the rate of return on housing, RHO, were generally perverse. Shock 4 examines the dynamic effects of isolated changes in this rate. As was the case for

Table 5

COMPARATIVE DYNAMICS EXPERIMENTS
Percent Shock Minus Control

	CON	DU	HO	CD	EQ	BO	LP	-MO	-LO
Shock 1: 1 per cent increase in expected inflation									
Impact	0.00	0.15	0.86	0.00	-2.14	0.00	0.00	-0.30	0.00
Year 1	0.86	1.31	3.01	0.06	-9.01	-3.16	0.00	-1.68	-1.01
Year 2	1.80	2.95	3.78	0.19	-13.15	-12.72	0.00	-3.96	-3.18
Year 3	1.92	3.99	3.71	0.28	-15.93	-19.51	0.01	-6.29	-5.00
Year 4	1.48	4.66	4.22	0.35	-12.90	-18.69	0.02	-8.62	-5.85
Year 5	1.05	5.24	4.36	0.44	-10.65	-42.81	0.03	-10.99	-6.75
Shock 2: 1 per cent increase in all interest rates, expected inflation held constant									
Impact	-0.52	-0.28	-0.29	-0.15	1.36	-1.56	-0.07	0.51	-0.02
Year 1	-1.73	-1.59	-1.29	-0.35	5.62	1.11	-0.40	2.73	1.65
Year 2	-1.96	-2.94	-1.47	-0.52	8.02	8.99	-0.79	5.55	3.45
Year 3	-1.44	-3.54	-1.26	-0.58	9.19	15.17	-1.12	7.56	4.42
Year 4	-1.09	-3.99	-1.51	-0.67	7.12	15.56	-1.46	9.34	4.75
Year 5	-0.34	-4.29	-1.60	-0.76	5.56	37.46	-1.76	10.96	5.02
Shock 3: 1 per cent increase in all interest rates and expected inflation									
Impact	-0.52	-0.13	0.57	-0.15	-0.79	-1.56	-0.07	0.21	-0.02
Year 1	-0.87	-0.28	1.73	-0.29	-3.38	-2.05	-0.50	1.05	0.64
Year 2	-0.16	0.01	2.32	-0.33	-5.13	-3.73	-0.79	1.59	0.27
Year 3	0.48	0.45	2.44	-0.30	-6.74	-4.34	-1.11	1.28	-0.58
Year 4	0.39	0.67	2.71	-0.32	-5.78	-3.13	-1.44	0.72	-1.10
Year 5	0.71	0.95	2.75	-0.32	-5.09	-5.35	-1.73	-0.03	-1.73
Shock 4: 1 per cent increase in rate of return on housing									
Impact	0.00	0.00	-0.15	-0.08	0.49	0.00	-0.08	0.07	0.00
Year 1	-0.02	-0.07	-0.45	-0.38	2.19	0.82	-0.42	0.24	-0.03
Year 2	-0.03	-0.13	-0.44	-0.64	3.24	3.56	-0.83	0.20	-0.15
Year 3	0.06	-0.04	-0.28	-0.76	3.56	6.06	-1.17	-0.11	-0.47
Year 4	0.19	0.16	-0.25	-0.88	2.94	6.60	-1.53	-0.58	-0.93
Year 5	0.28	0.40	-0.14	-0.95	2.64	17.31	-1.85	-1.31	-1.52
Shock 5: 1 per cent increase in interest rate on currency and deposits									
Impact	-0.35	0.00	-0.09	0.27	0.00	0.00	0.00	0.00	0.00
Year 1	-0.25	-0.16	-0.45	1.32	0.00	0.84	0.02	0.02	0.09
Year 2	-0.31	-0.63	-0.88	2.21	0.06	4.25	0.07	0.26	0.56
Year 3	-0.50	-1.21	-1.26	2.67	0.19	7.89	0.14	0.81	1.31
Year 4	-0.72	-1.77	-1.61	3.12	0.17	8.78	0.22	1.61	2.05
Year 5	-0.67	-2.33	-1.92	3.40	0.09	22.35	0.30	2.66	2.84
Shock 6: 1 per cent increase in rate of return on equity									
Impact	0.00	0.00	0.00	-0.03	0.06	0.00	0.00	0.00	-0.05
Year 1	-0.03	0.01	0.03	-0.16	0.21	-0.02	0.00	-0.02	-0.15
Year 2	-0.03	0.07	0.09	-0.26	0.29	-0.19	-0.01	-0.07	-0.22
Year 3	0.01	0.14	0.16	-0.30	0.35	-0.44	-0.02	-0.15	-0.30
Year 4	0.03	0.22	0.20	-0.35	0.29	-0.54	-0.02	-0.26	-0.42
Year 5	0.04	0.30	0.25	-0.37	0.26	-1.43	-0.03	-0.41	-0.53
Shock 7: 1 per cent increase in mortgage rate									
Impact	0.00	0.00	-1.11	-0.36	3.21	0.00	-0.09	0.21	0.00
Year 1	-0.89	-0.62	-3.59	-1.82	13.55	4.02	-0.50	0.99	0.55
Year 2	-1.73	-1.50	-3.94	-3.12	19.83	15.75	-1.02	2.01	1.59
Year 3	-1.56	-1.62	-3.14	-3.77	24.19	23.79	-1.50	2.68	1.82
Year 4	-0.86	-1.15	-3.23	-4.35	19.97	22.87	-2.00	2.90	1.03
Year 5	-0.31	-0.58	-2.77	-4.73	17.14	53.85	-2.46	2.46	-0.05
Shock 8: 1 per cent increase in expected income									
Impact	0.01	0.01	0.07	0.01	0.20	0.07	-0.00	-0.02	0.01
Year 1	0.13	0.07	0.31	0.04	0.66	0.28	-0.00	-0.10	-0.08
Year 2	0.35	0.25	0.57	0.15	0.87	1.17	0.02	-0.26	-0.32
Year 3	0.62	0.49	0.78	0.29	1.06	2.03	0.05	-0.54	-0.67
Year 4	0.79	0.71	0.88	0.42	0.77	2.11	0.09	-0.89	-1.00
Year 5	0.86	0.87	0.92	0.52	0.74	5.05	0.13	-1.26	-1.27
Year 6	0.85	1.01	0.91	0.59	0.81	5.02	0.15	-1.70	-1.50
Year 7	0.82	1.12	0.95	0.65	1.26	8.01	0.16	-2.26	-1.76
Year 8	0.88	1.31	1.21	0.75	1.39	7.92	0.19	-2.96	-2.16
Year 9	0.85	1.43	1.13	0.82	0.94	7.01	0.23	-3.37	-2.44

shock 3, there are some sign reversals in the responses to this shock. In particular, expenditures on both non-durables and durables are reduced temporarily, but increase in the long run. The reaction of housing expenditure remains negative until year seven. Mortgages are at first reduced in absolute value, but in the longer run more mortgage debt is taken on. Thus, although these results are by no means ideal, they do contain elements that fit our priors.

In the fifth shock the rate of interest on currency and deposits increases by 100 basis points. The results are essentially what one would expect: all three categories of real expenditure are reduced, especially that for durables, both categories of debt are reduced in absolute value, and the allocation to currency and deposits is increased. Only minor effects are observed for equity and life insurance and pensions, and the large response of bonds should probably be discounted.

In shock 6 the rate of return on equity increases by 100 basis points. On average the responses are much smaller than those observed for shock 5. The new equilibrium will be characterized by increased holdings of durables, housing, and equity, increased debt, and reduced bonds and currency and deposits. Other effects are very minor.

The seventh shock increases the mortgage rate by 100 basis points, and the results meet expectations quite well. All three categories of real expenditure are reduced, especially that on housing. Holdings of bonds and equity increase, which is difficult to interpret, but the contractions of currency and deposits and life insurance and pensions seem reasonable, given that holdings of mortgages and, in the early years, loans, are both reduced in absolute value.

In shock 8 the implications of a permanent increase in expected income of 1 per cent are examined. This shock is intended principally as a check on the average speed of adjustment of the model. Since most of the categories remain in motion after five years, the simulation was extended to nine years. It is evident, first of all, that the speed of convergence of the model is very slow. This observation is not unique to this study but is common in financial models. The individual results indicate that, after nine years, consumption, housing, currency and deposits, and equity have responded to the income shock with approximately unit elasticity. The other categories, however, remain some distance from their steady-state solutions.

Finally, the model was simulated from 1983-84 outwards to 1999 with the exogenous variables held constant in order to calculate the steady-state wealth/expected income ratio implied by the model. The sample average net wealth/expected income ratio is 15 (3.75 for income measured at annual rates) and after 1983 the model follows one large 15-year cycle with a peak of 17.2 and a trough of 16 (4.3 and 4.0, respectively, with income measured at annual rates). Thus, the model seems to possess reasonable global steady-state properties.

On balance, this comparative dynamics exercise casts the model in a more favourable light than did the examination of the individual parameter estimates. Although the impact coefficients are of mixed quality, the model seems to exhibit many of the expected broad empirical regularities. Principal among these is the observed tendency to reduce both sides of the balance sheet, using assets to pay down mortgages and loans, in the face of general increases in interest rates. In addition, the consistent responses of mortgages and housing on the one hand and of loans and durables on the other seem reasonable. It is also encouraging to find that of the three expenditure categories durables are most sensitive to general interest rate increases. Finally, it is interesting to note the substantial differences between the observed responses to general increases in real as opposed to nominal interest rates.

3 SUMMARY AND CONCLUSIONS

In this study an attempt was made to resolve a limited number of issues pertaining to the data, and some relatively broad inferences were drawn concerning the portfolio behaviour of the Canadian household sector. Although it is difficult to measure the overall success of the model developed here, the analysis has a number of positive aspects that bear repeating.

First is the data set. In each case data were taken from what was judged to be the most reliable source available. In addition, where appropriate, asset holdings were measured in market-value terms. By itself the resulting data set provides a convenient framework for analysis of broad trends in the portfolio of the Canadian personal sector.

Next is the choice of a theoretical model in which the consumption-savings and portfolio-balance decisions were integrated. This had the result of casting the portfolio model in flow terms and adding a real expenditure block of equations whose parameters then became part of the adding-up conditions. The sum of the flows to be explained, which was to be the scale variable of the system, therefore became income, rather than the more familiar scale variable, wealth. Estimation and testing of the model revealed solid empirical support for integration, from the point of view of modelling both real expenditures and portfolio allocations. Testing also found empirically signficant cross-equation linkages, but most of these effects came from the dynamic adjustment matrix rather than from the rates of return themselves.

As is the case for most portfolio models estimated using traditional methods, multicollinearity rendered a large number of explanatory variables statistically insignificant in the theoretically specified equations. Accordingly, the variables that contributed least to the explanatory power of the model were gradually eliminated, thereby isolating the most important cross-equation linkages. During this stage the equations were estimated jointly while retaining the cross-equation adding-up conditions. The final parameter estimates revealed complementary relationships between durables expenditures and consumer credit on the one hand, and between housing expenditures and mortgages on the other. The analysis also disclosed pervasive effects from expected inflation and expectations of future interest rate changes throughout the portfolio. Many important linkages were also found in the adjustment matrix. It was therefore decided to supplement the analysis with some selected comparative dynamics experiments.

First, however the system was subjected to a full dynamic simulation, and actual series were compared to predicted. Generally speaking, these results were reasonable. The major exception was the bond equation, which, fortunately, represents only a minor part of the overall portfolio. The only other notable simulation errors were found in the two liability categories, both of which overpredicted in absolute-value terms during the 1980s. This finding, however, was consistent with the observed recent trend in the household sector towards more conservative balance sheets.

The results of the shock-minus-control experiments agreed with our priors, on balance, although some of the more counterfactual shocks produced mixed results. Of particular interest were the experiments where all the rates of return in the model were shocked simultaneously. When only real interest rates were increased, the responses were much larger than when nominal rates were increased together with the expected rate of inflation. Furthermore, the general increase in real rates predicted the sort of behaviour that has been observed during the 1980s, namely, a tendency to reduce both sides of the balance sheet by cutting back asset accumulation (especially durable goods) to reduce indebtedness. An increase in expected inflation alone led to the opposite strategy; real expenditures increased, financed by an increased debt load. The shocks to individual interest rates tended to yield less intuitive results, mainly because they arise principally from individual parameter estimates which, as noted, were judged to be somewhat unreliable.

This judgement regarding the quality of the individual parameter estimates was based on the observation that the coefficients and the related hypothesis tests were rather sample sensitive. Although it is reassuring to note that the results seemed to approximate our priors more closely as the data set was extended, it must be recognized that these priors were not very precise. Sample sensitivity of the estimation results could reflect any number of problems, including incorrect functional form, structural change, omitted variables, and simultaneous-equations bias.

It is hoped that this model will serve as a useful point of departure for subsequent research. Such work might focus on the construction of meaningful rates of return, which should be adjusted both for differences in maturity and for differential tax treatment. Another important element, not considered here, is the possible influence of changes in perceived risk in the portfolio-allocation decision. An assessment of more elaborate specifications of the dynamic adjustment process might also prove interesting.

APPENDIX

Introduction

The financial-flow accounts published quarterly by Statistics Canada provide data in considerable detail on the flows of assets and liabilities for several sectors of the economy including "Persons and Unincorporated Businesses." It was therefore a natural source of data for this type of model. Annual data on outstanding stocks of assets and liabilities are also given. Unfortunately, many of the elements of the flow-of-funds matrix are estimated on the basis of limited surveys, and virtually the entire household sector column is derived residually. For this reason, all errors made in constructing the remainder of the matrix fall into the numbers for the personal sector. Moreover, the annual stock and quarterly flow data are themselves inconsistent with one another. This situation arises for several reasons, including problems of valuation and differences in survey coverage when constructing the two sets of numbers.

For these reasons alternatives to the financial-flow accounts have been used for several of the asset categories. In instances where the financial-flow accounts were used, an attempt was made to reconcile the (more reliable) annual stock data with the additional information contained in the quarterly flows. This reconciliation was accomplished as follows:

(a) The annual stocks were interpolated linearly to quarterly, and first differences were then calculated to give flows consistent with the stocks but constant for the four quarters of each calendar year.

(b) The quarterly flows, as reported, were used to generate an interpolator by taking the difference between these flows and a four-quarter moving average of the same. This difference was then added to the stock-consistent flow series generated in (a).

(c) To construct the final quarterly stock series the flows generated in (b) were added to the one-quarter lag of the interpolated stock series constructed in (a).

This procedure generates a stock series from which a flow series can be constructed using first differences. Each series incorporates both the annual stock data and the quarterly flows.

Exact data sources are given in Table A.1. Each asset category was treated individually, with the intention of obtaining the most meaningful data possible. Each category is now discussed in turn.

The Real Expenditure Block

The real expenditure block constitutes the first three equations of the system: consumption of non-durables, consumption of durables, and housing expenditure. For the most part the data are available from the national accounts, and the relevant CANSIM numbers are given in Table A.1. For the remainder, the stocks of durables and housing are both taken from the RDXF database at the Bank of Canada, and the flows are simply first differences of these stocks. The stock of durables is found by summing the stocks of household durables, motor vehicles, and miscellaneous durables. Each of these variables has been constructed by cumulating flows from the 1952 stock while applying a specific rate of depreciation (see Bank of Canada, 1980a, pp. 10-11 for details). The stock of housing is derived in a similar fashion (ibid, 20). Notice, however, that depreciation of the housing stock appears as a positive component of non-durables consumption in the national accounts, in the form of imputed rent. In contrast, durables are treated like ordinary consumption in the accounts. To correct this asymmetry the depreciation of the stock of durables outstanding in the previous period has been added to the national accounts estimate of consumption of non-durables in the current period.

The market price of durables is taken to be the implicit price deflator for durables from the national accounts; that for housing is that provided by the Multiple Listing Service. The common price index used to deflate all components of the model is the implicit total consumption expenditure deflator of the national accounts. Throughout the model, all price indices have been normalized (where necessary) to equal unity for the year 1971.

Table A.1

DATA SOURCES

Series	Stock	Flow	Price	Rate
1. Non-durable consumption	-	C	C	C
(a) semi-durables	-	D40596	D40628	-
(b) non-durables	-	D40597	D40629	-
(c) services	-	D40598	D40630	-
(d) depreciation on durables	-	RDXF	-	-
2. Consumer durables	RDXF	C	D40627	C
3. Housing	RDXF	C	RDXF	C
(a) total rents	-	-	-	RDXF
4. Currency and Deposits	C	C	-	C
(a) currency (proportion estimated)	B2001	-	-	0
(b) personal chequing (B)	B676	-	-	0
(c) chequable savings (B)	B452	-	-	B14035
(d) non-chequable savings (B)	B453	-	-	B14019
(e) fixed-term (B)	B454	-	-	B14045
(f) foreign currency (B) (0.14)	B496	-	-	BC
(i) forward premium	-	-	-	B14034
(g) savings (T)	B910+B911	-	-	BC
(h) term deposits - short (T)	B913+B917	-	-	BC
(i) term deposits - long (T)	B914+B918	-	-	BC
(j) Credit unions, Caisses populaires	B3917	-	-	BC
(k) Canada Savings Bonds	B2406	-	-	B14041
5. Equity	C	C	B4237	C
(a) undistributed profits	-	D31500	-	-
(b) dividends - non-residents	-	D31509	-	-
(c) dividends - residents	-	D31510	-	-
(d) stock dividend yield	-	-	-	B4245
(e) price/earnings ratio	B4246	-	-	-
6. Bonds and Short-term paper	C	C	C	C
(a) Canadas	D160019	D150062	RDXF	C
(b) Provincials	D160020	D150063	MYW	B14014
(c) Municipals	D160021	D150064	MYW	B14015
(d) Other (asset)	D160022	D150065	MYW	B14016
(e) Other (liability)	D160053	D150058	-	-
(f) Canadas 1-3 years	B2446	-	-	B14009
(g) Canadas 3-5 years	B2447	-	-	B14010
(h) Canadas 5-10 years	B2448	-	-	B14011
(i) Canadas over 10 years	B2449	-	-	B14013
(j) Treasury Bills	D160015	D150035	-	B14007
(k) Commercial paper (asset)	D160016	D150036	-	B14017
(l) Commercial paper (liability)	D160047	D150071	-	-
7. Life Insurance and Pensions	D160023	D150066	-	-
8. Mortgages	B980	C	-	B14024
9. Loans	B135	C	-	BC
10. Price Deflator	-	-	D40626	-

Notes: (1) All D- and B-numbers are from the CANSIM databank.
(2) "C" implies that the series was constructed as described elsewhere in this Appendix.
(3) The source "RDXF" is the RDXF Model database; see Bank of Canada (1980a,b) for details.
(4) "BC" implies that the data were obtained internally at the Bank of Canada.
(5) "MYW" implies that the data were obtained from various publications of the Economics Department of McLeod, Young, Weir Limited.
(6) "(B)" implies that the deposit is at a chartered bank.
(7) "(T)" implies that the deposit is at a trust or mortgage loan company.

Currency and Deposits

As indicated in Table A.1, the data for this category were all obtained at the Bank of Canada; most series are available on CANSIM. The aggregate stock of currency and deposit holdings was constructed by aggregating the 11 assets, most of which may be presumed to be held entirely by the household sector. The exceptions are currency holdings and foreign currency deposits, both of which are held in part by the corporate sector. Approximately 20 per cent of total currency is estimated to be held by households; the actual amount used here equals 10 per cent of total currency plus 1 per cent of consumption expenditure on non-durables excluding rent. In the case of foreign currency deposits, 14 per cent of such deposits at chartered banks have been allocated to households, based on an estimate of the retail/wholesale split of the series.

Most series used for this category are reported monthly on an average-of-Wednesdays basis. In some cases, however, the figures are month-end and, accordingly, month-end series were averaged with their own one-month lagged values prior to aggregation. The data for credit unions and caisses populaires are end-of-quarter; after averaging with the lagged quarter this series was interpolated to monthly. The aggregate monthly currency and deposits series was then collapsed to a quarterly periodicity for estimation.

Equity

The starting point for constructing the market value of equity was the price-earnings ratio of the TSE300 published by the Toronto Stock Exchange. This variable is calculated by dividing the current market price of a stock by the company's earnings per share in its latest fiscal year and then forming an aggregate average value by weighting individual stocks appropriately. This series was collapsed to quarterly periodicity and multiplied by a lagged, four-quarter moving average of quarterly total corporate earnings (retained earnings plus dividends paid to residents and non-residents at annual rates) as reported in the national accounts. The lagged four-quarter moving average of total earnings is used because the figures on quarterly earnings apply to the reported quarter only, whereas those in the denominator of the price-earnings ratio apply to the most recently completed fiscal year. This estimate of the total value of equity was then multiplied by the lagged four-quarter moving average of the ratio of dividends paid to residents to total dividends paid, so as to isolate the domestic portion of the series. This estimate of the market value of equity held by residents is assigned totally to the personal sector, which assumes that households own all equity directly. This estimate somewhat overstates household equity holdings because equity held by financial institutions has been ignored. The estimate is also biased to the extent that dividends paid to residents actually go to foreign-owned subsidiaries.

Bonds

Quantities for the bond category, which includes both bonds and short-term paper, were constructed from the financial-flow accounts as described in the introduction to this appendix. Because the financial-flow accounts bond series includes Canada Savings Bonds, an asset already included in the currency and deposits category, these were netted from the constructed bond series. To convert this book-value series to market value, a price index was needed. An appropriately weighted coupon series for outstanding Government of Canada bonds obtained from the RDXF database at the Bank of Canada was divided by a similarly weighted average of yields on the various maturities of Government of Canada bonds. The weights in each case were the lagged proportions of outstanding stocks of these bonds as reported in the Bank of Canada Review (Table 24), and which are available on CANSIM (see Table A.1). This yielded a market price that was applied to Canada bonds; the McLeod Young Weir 40-Bond Long-Term Indices were used for provincials, municipals and other bonds (assumed to be corporates). Aggregation of the four market-value series (after collapsing the various series to quarterly periodicity, where necessary) resulted in a series for the total market value of bonds held by the personal sector.

Life Insurance and Pensions

The quantities for this category were constructed as described in section 1.3 from the financial-flow accounts.

Mortgages and Consumer Credit

Data on mortgages and consumer credit were collected from eight classes of lending institutions by the Bank of Canada and are now available on CANSIM; see Table A.1.

Rates of Return

The various rates of return are adequately described in the text, and exact sources are given in Table A.1

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