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14 Portfolio Composition and Pension Wealth: An Econometric Study

Louis-David L. Dicks-Mireaux and Mervyn A. King

14.1 Introduction

Much empirical research has been devoted to examining the effects of social security and private pension wealth on household savings. In contrast there has been very little study of the consequences of pension wealth for the *composition* of household portfolios. Given that the two types of pension wealth are not perfect substitutes for other assets, it is likely that they would affect optimum portfolio choices among other assets. This microeconomic impact has macroeconomic implications. Because the financial structure of the private sector's net worth is an important determinant of both real decisions (corporate investment, for example) and financial variables (such as interest rates and their term structure), any effect of pension wealth on the portfolio composition of households' nonpension wealth will have macroeconomic consequences. In this chapter we estimate the portfolio effect of pension wealth using individual data for 10,118 Canadian households. Throughout the chapter we regard pension wealth as an exogenous variable beyond the control of an individual household. Although this is clearly true of social security wealth, it is possible to alter private pension wealth by choosing an occupation which offers more or less attractive retirement compensation. We shall ignore this possible source of endogeneity.

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To model asset demands satisfactorily, our specification must allow for the empirical observation that most households do not own all of the assets which we are able to distinguish. For each of the 12 assets in our study there is a significant number of households with zero holdings, and only two households own all 12 assets. We construct below a model of the probability of owning a particular combination of assets. In the estimation of individual asset demand equations, the failure of households to hold complete portfolios leads to two problems. First, the demand for an asset depends on the particular combination of other assets in the portfolio. Second, estimates of demand equations which use data only for those households with positive holdings will be subject to sample selection bias. We discuss, and attempt to resolve, these econometric difficulties in section 14.3.

Because our sample consists of a single cross section of households, we cannot examine the effects on portfolio behavior of variables which are uniform across households. These are variables which, although they may vary over time, are identical for all households at the date of interview. The most important of such variables are the relative prices of different assets, including the inflation rate.[1] One exception is that part of the price which reflects households' marginal tax rates. The data on net worth are, however, both comprehensive and of good quality, and we are able to compute estimates of both social security and private pension wealth. There is also substantial variance of pension wealth among the population, which allows us to identify the effects of pension wealth on the dependent variables. The sample and the construction of estimates of tax rates, pension wealth, and permanent income for each household in the sample are described in sections 14.2 and 14.4. In section 14.3 we discuss alternative approaches to modeling the mixed discrete-continuous portfolio choice problem facing households and explain our preferred method. Estimates of the model are contained in section 14.5, and simulations of the effects of changing the levels of both social security and private pension wealth on portfolio composition are presented in section 14.6. This section also contains estimates of the effect of the two types of pension wealth on total household savings.

14.2 The Sample

The data used in this study refer to 12,734 Canadian families in 1977 and come from the Statistics Canada micro-data tape, Income (1976), Assets and Debts (1977) of Economic Families and Unattached Individuals, which contains data collected as a supplement to the 1977 Survey of Consumer Finances.[2] Unless otherwise stated, all tables are derived from this tape and money figures are expressed in Canadian dollars. The survey covers a stratified random sample of the noninstitutional population and provides a particularly rich source of information on household ownership of assets and liabilities, incomes, and other individual and household characteristics. A family or household will be defined here as a group sharing a common dwelling and related by blood or marriage. The data refer to market values in May 1977 and the income data to the calendar year 1976. For the econometric analysis 2,616 households were excluded. These included 139 "special family units," primarily those with high incomes, for whom data on age and other characteristics were not recorded on the tape to protect their identity. Because our main interest is in estimating equations in which the dependent variables are relative shares of assets in household portfolios, neither this omission nor the stratification of the sample leads us to suspect sample selection bias. In addition, of the total value of assets and debts held by the complete sample (computed using population weights), these "special family units" only held 7.3% and 2.4%, respectively. The sample was further reduced to 10,118 households by deleting households headed by a woman, for reasons explained below in the construction of permanent income.

The data on net worth are given for 15 categories of assets and liabilities. These were aggregated into 12 classes for the portfolio composition analysis by defining equity in owner-occupied housing to be net of any mortgage liability and equity in own businesses to be net of loans specifically for this purpose, and by aggregating two forms of consumer debt into a single category of personal debt. The 12 assets are: cash, deposits, bonds, stocks and shares, registered home ownership savings plans (RHOSP), registered retirement savings plans (RRSP), other nonliquid financial assets (ONLFA), passenger cars, equity in owner-occupied housing, equity in other real estate, equity in a business or farm, and personal debt. Market values of assets are recorded (for cars and equity in real estate and own businesses these are the respondents' own estimates) except for bonds, which are given at face value. In all the tables, and in the presentation of the empirical results presented, debt is measured as a positive variable. The survey data exclude social security and pension wealth (which we discuss below), consumer durables other than cars, equity in life insurance, and other assets such as the expected value of future inheritances and support from relatives and children. The percentage composition of wealth by asset is given in table 14.1. Column 1 gives the share of assets in the total wealth of the sample of 12,734 households using population weights. These weights were not used in calculating the shares in columns 2 and 3. In the second column are the shares of assets in the total wealth of the sample used for our empirical work. The third column shows the average of the asset shares of individual households in the same sample as column 2. This is in contrast to columns 1 and 2, which are the asset shares of the aggregate portfolios of

Table 14.1 Percentage Composition of Wealth by Asset, 1977 (Shares Are Defined with Respect to Total Assets)

Assets	Canada[a] (1)	Sample[b] (2)	Average of Individual Household Asset Shares[b] (3)
Total deposits	11.0	9.4	16.0
Total bonds	3.3	2.6	2.7
Cash	0.2	0.2	1.6
Stocks and shares	1.9	1.3	0.7
RHOSP	0.2	0.2	0.6
RRSP	1.8	1.8	1.5
Other nonliquid financial assets	4.2	2.1	1.1
Passenger cars	4.8	4.8	16.6
Home equity	41.6	38.3	44.0
Real estate equity	9.4	9.8	5.9
Business equity	21.6	29.5	9.3
Personal debt	4.8	5.3	56.0
Mean total assets ($)	48,600	58,474	58,474
Mean net worth ($)	40,391	55,357	55,357
Mean social security wealth ($)[c]	na	72,799	72,799
Mean private pension wealth ($)[c]	na	26,940	26,940
Mean permanent income ($)[c]	na	22,598	22,598

[a]Calculated over all 12,734 households using population weights.
[b]Calculated over sample of 9,788 households, with *no* weights applied.
[c]Authors' estimates.

their respective samples. In effect, the shares in the second column are a weighted estimate of those in column 3, where the weights are individual household wealth.

As the focus of this study is portfolio composition, any variation across assets in the accuracy of the data will be critical. Detailed evaluations of the data can be found in Statistics Canada (1979) and Oja (1981), and the ensuing discussion draws heavily on these sources. To assess the quality of the data involves a comparison with outside estimates of the wealth components, and these in turn are unlikely to be free of all error. If we ignore this, then discrepancies between the two may be attributed to sampling error, incomplete response rates, and underreporting in the survey data. As we employ the data in unweighted form and do not address issues of wealth distribution or of the level of national wealth, the first source of error is not of concern to us. The overall response rate was 79.7%, and where imputations of items of wealth were made, they were generally no greater than 10% in magnitude. Oja (1981) concludes that neither of these sources of error in the data is a major concern.

This suggests that underreporting is the main source of error. Davies (1979), in a study of a similar survey in 1970, concluded that the major source of underreporting is nonreporting of assets at the household level. This may affect both the probit and share demand parameter estimates. However, compared to previous surveys some improvements were introduced in the 1977 survey. Real assets, which account for about 80% of nonpension wealth, appear to be accurately recorded in the 1977 survey. The grossed-up value of each of the financial assets and debt varies from 20–30% to 90–100% of outside estimates. It should be noted, however, that these figures refer to a comparison of aggregate values of wealth items and therefore include all three sources of error.

14.3 An Econometric Model

In our data set we are able to distinguish between 12 assets (to be precise, 11 assets and one category of debt). Most models of portfolio behavior predict that, in the absence of restrictions, individuals would choose to hold nonzero quantities of all assets. Table 14.2 shows the distribution of households by the number of assets held and illustrates that such a prediction is only accurate for two households in our sample. To ignore this feature of household behavior would be not only to produce biased estimates of the parameters of the demand functions for assets but also to ignore a misspecification in that the demand for an asset depends on the set of other assets held by an investor. It is clear, therefore, that the principal econometric difficulty we face is to estimate

Table 14.2 Distribution of Household Portfolios by Number of Assets Held, 1977

Number of Assets Held	Frequency	%
0	81	0.8
1	213	2.1
2	547	5.4
3	1,166	11.5
4	2,071	20.5
5	2,532	25.0
6	1,842	18.2
7	988	9.8
8	433	4.3
9	174	1.7
10	55	0.5
11	14	0.1
12	2	0.0
Total	10,118	100

jointly the decisions of how many and which assets to hold and the quantity of each asset which is held conditional on its ownership. This raises a number of interesting econometric issues (discussed more fully in King [1982]) which have been ignored in previous studies. In one of the few published econometric studies of portfolio composition, Feldstein (1976) simply excluded households that did not have positive holdings of any assets.

The theoretical considerations which suggest that individuals may hold incomplete portfolios are of two kinds. First, there are partial equilibrium factors such as transactions costs, which may be interpreted in a broad sense to include the costs of monitoring and managing a portfolio. Economies of scale may imply that it is optimal to select a portfolio with only a limited number of assets. Second, there are general equilibrium effects. Auerbach and King (1982) show that in a world of distortionary taxes, no equilibrium can exist without constraints on individual portfolios. Constraints on short sales are the most obvious example, and these lead to an equilibrium in which investors have specialized portfolios. The asset (or assets) in which an investor specializes is determined by his marginal tax rate. Auerbach and King (1982) model explicitly the case of three assets: corporate equity, corporate bonds, and municipal bonds. But similar considerations apply to a world with many assets. Complete specialization in a single asset (the most favored for tax purposes) results only if it is possible to achieve the constrained optimal allocation of consumption over states of the world by owning only the assets in question. If, as will be the case in practice, this is impossible, the particular combination of assets owned by an individual will reflect the trade-off between considerations of tax savings and aversion to risk.

In principle, therefore, we need to construct a joint discrete and continuous choice model. We cannot simply estimate an asset demand system using observations of those with positive holdings for two reasons. First, not all households own each asset, and to omit the sample of nonholders would lead to sample selection bias. This problem is familiar. The second difficulty is less familiar and more serious. The proportion of an individual's wealth which is invested in a particular asset depends on the combination of assets in the portfolio. Suppose, for example, that an individual holds only one other asset in addition to asset j. Then the proportion of his wealth invested in asset j will clearly differ from that which he would invest if he owned all 12 assets given values for observable characteristics. The discrete and continuous aspects of the problem are obviously inseparable.

Suppose that households maximize expected utility as a function of the 12 asset holdings subject to both a budget constraint and a set of short sales constraints on each of the assets. The resulting set of first-order conditions may be inverted to give asset demand functions only if we know which constraints are binding, that is, if we know which combination of assets the household owns. The first-order conditions do not tell us this. It is for this reason that a multivariate tobit specification, although a seemingly natural way to model the problem, is an inappropriate specification. The multivariate tobit model (see Amemiya 1974; Lee 1981) embodies the essential feature of a tobit model that a single index for each asset determines both the discrete and continuous outcomes. But this is not the correct representation of the behavior of an optimizing investor subject to short sales constraints (this is demonstrated formally and discussed further in King [1982]). The solution to the investor's optimization problem is twofold: that combination of assets is chosen which leads to the highest level of expected utility, and, given this optimal combination, the corresponding set of first-order conditions may be inverted to determine asset demands. The discrete choice amounts to selecting from a very large number of mutually exclusive alternatives. In fact, with J assets the number of distinct combinations of assets is equal to 2^J.[3] For 12 assets this means we have 4,096 mutually exclusive alternatives. Optimal asset demands are given by a switching regressions model in which the demand system depends on the particular combination of assets owned. Again the number of regimes is equal to the number of possible combinations.

To estimate individual equations for the probability of owning each of these 2^J alternatives would almost certainly involve more parameters than we have observations, even with a sample of 10,118 households. Moreover, with the same number of regimes we cannot estimate distinct demand equations for each regime. The only feasible approach is to compute the implied probabilities of all mutually exclusive combinations containing the asset in question. Suppose that alternative i is chosen if the following linear index is positive, if

$$(1) \qquad X\beta_i + u_i > 0, \qquad i = 1, \ldots 2^J,$$

where X is a $(1 \times N)$ row vector of N observable characteristics and β_i is an $(N \times 1)$ column vector of associated parameters.

The u_i are assumed to be identically and independently distributed, with a distribution function denoted by F. Let d_i denote a vector of dummy variables with the i^{th} element equal to unity if the investor owns combination i and all other elements equal to zero. The probability of holding asset j may then be written as

$$(2) \qquad p(j) = \sum_{i \epsilon s} \int_{-\infty}^{X\beta d_i} dF; \; S \,|\, \text{all } i \text{ containing } j,$$

where β is an $(N \times I)$ matrix of parameters.

The determinants of the probability of owning asset j can be represented as interaction terms between observable characteristics and dummy variables for the combinations of other assets owned by the individual. Again this involves an excessively large number of parameters. To reduce the number of parameters to a feasible magnitude, we must assume some independence between combinations. If we assume that the effects of observable characteristics on the probability of choosing asset j are independent of the particular combination, then the probability is a function of characteristics and dummy variables with no interaction terms. This still implies a very large number of parameters, because there are as many dummy variables as there are combinations of assets containing asset j. (The precise number is 2^{J-1}, which in our case is 2,048.)[4] But if we are prepared to assume independence over observable characteristics, we might as well assume independence over unobservable characteristics. This assumption implies that the probability of choosing asset j is a function of observable characteristics and independent of the other assets owned (an alternative derivation of this specification is given in King [1982]). There are no cross-equation constraints because the probabilities of owning each asset do not sum to unity. Hence we shall estimate independent probit equations for each asset in turn.

The continuous choice open to a household is its demand for assets given the combination of assets which forms its optimal portfolio. The functional form of the demand for a given asset depends on the other assets owned, and there is a discrete jump in the demand function as the combination of assets owned changes. If households face short-selling constraints, these jumps embody the "spill-over" effects of the constraints on asset demands. As the dependent variable we take the logistic transformation of the proportion of wealth invested in each asset. We use this transformation to justify our assumptions about parameter restrictions below and to reduce heteroscedasticity. The demand function for asset j is:

$$\ln\left(\frac{p_j}{1-p_j}\right) = C_{ij} + Z\theta_{ij} + u_j, \qquad j = 1, \ldots, J \quad i = 1, \ldots, 2^{J-1}, \tag{3}$$

where p_j is the proportion of wealth invested in asset j, C_{ij} is the constant term, and Z is a vector of observable characteristics. All parameters, as written, are indexed by the combination of assets in the portfolio denoted by i which runs from $i = 1, \ldots, 2^J$. In this general form there are again too many parameters. We shall consider a simple case of the shift effect of different assets combinations in which $\theta_{ij} = \theta_j$ for all i and

$$C_{ij} = \sum_{k=1}^{J-1} C_{kj} d_{ki} \tag{4}$$

for all i,j.

In other words, the constant term for a particular combination is equal to the sum of fixed coefficients for each asset contained in the combination (where d_{ki} is unity if combination i contains asset K, and zero otherwise). These assumptions imply that the effect of adding an additional asset, or of a change in one of the exogenous variables, on the demand for an asset is independent of the other variables or assets owned, except insofar as it affects the value of p, the proportion of the portfolio invested in the asset. The absence of interaction terms is rendered more plausible by the logistic specification of the dependent variable. With these assumptions the explanatory variables in (3) are the vector Z and the 11 dummy variables corresponding to all assets other than j. The equations we shall estimate are

$$\text{(5)} \qquad \ln\left(\frac{p_j}{1-p_j}\right) = \sum_{k \neq j} C_{kj} d_{ki} + Z\theta_j + u_j, \qquad j = 1, \ldots, J.$$

We shall be particularly interested in those variables relating to social security and private pension wealth. Because of the logistic transformation, the system of J equations given by (5) does not satisfy the aggregation condition that

$$\text{(6)} \qquad \sum_{j=1}^{J} p_j = 1.$$

We judged it better to sacrifice the imposition of the adding-up constraint to obtain the benefits described above. Although we report below the results of estimating equation (5) for all 12 assets, when simulating the model to examine the effects of change in pension wealth or portfolio composition we shall drop one of the equations. This is described further in section 14.6.

Equations (5) were estimated using observations for those with positive holdings of the asset in the dependent variable. To correct for sample selection bias we included the inverse of Mills's ratio from the estimated probit equations as an additional regressor (Heckman 1979). For a discussion of the assumption of the joint normality of u_j and the error term in the probit equation, see King (1982). This procedure does not give consistent standard errors, but we computed a consistent estimate of the covariance matrix using the results of Greene (1981). These adjustments deal with those people who do not own the asset in question. Less significant is the issue of how to deal with those households which report that they own only one asset. It would be possible to deal with this by including an additional inverse Mills's ratio in the regression using a bivariate probit analysis, but there are strong reasons for supposing that in these cases the data are misrecorded, and so we have chosen to omit the observations with portfolios consisting only of one asset. In any event, the numbers involved are very small. For five assets the number of such cases is zero and in three further cases it is three or less. For deposits it is 69, for cash 141, for passenger cars 63, and for home ownership 50.

14.4 The Construction of Data

In this section we explain how we computed estimates of pension wealth and tax rates. The method employed to construct estimates of permanent income for each individual in the sample is described in the appendix and is a summary of that given in King and Dicks-Mireaux (1982).

The most important component of wealth for which we do not have direct observations is the value of the right to future private pensions and old age social security payments. Social security wealth is defined as that accruing from the public retirement income system. It comes from five sources: Old Age Security (OAS), the Guaranteed Income Supplement (GIS), the Spouses' Allowance (SPA), and the Canada and Quebec Pension Plans (CQPP). The OAS provides flat-rate benefits which are taxable, and were equal to $1,634.34 in 1976 to those aged 65 and over. Eligibility for GIS is based on receipt of OAS, and those who have no income other than OAS receive the maximum benefit of $1,146.30 and $2,035.80 (in 1976), for single and two-pensioner families, respectively. The SPA is payable to a pensioner's spouse, provided he or she is 60–64 years old and would, except for age, qualify for OAS and the GIS at the two-pensioner family rate. Both these benefits are reduced, at different rates, if income is received from sources other than OAS. These benefits have been fully indexed to increases in the consumer price index (CPI) since 1972 and are all financed from general tax revenue.

The Canada and Quebec pension plans, which are virtually identical with automatic transferability of benefit credits, were established in 1965 and cover almost the entire labor force. Both plans are contributory and earnings related. Contributions are paid by individuals aged 18–70 years and not receiving plan benefits, at a rate of 3.6% shared equally by employers and employees and paid in full by the self-employed, on earnings between a lower and upper bound. Both plans provide three types of benefits: retirement pensions, survivors' benefits, and disability benefits.

Since 1976 the eligible age for receipt of retirement benefits has been 65. The benefit level is calculated as 25% of adjusted career average earnings (ACAE), multiplied by the average value of the yearly maximum pensionable earnings (YMPE) in the final 3 working years. The ACAE is the mean value of the ratio (with a maximum value of one) of earnings to YMPE in the best 85% of earning years. The intent of the system appears to be to index the YMPE to the average wage and salary index, although in practice it has on occasion failed to achieve this. Benefit payments are indexed to the CPI. Survivors' benefits include death benefits, surviving spouses' pensions, disabled widowers' pensions, and orphans' benefits. The surviving spouses' pensions (the one of most concern to us) are 60% of that which would have been paid to the deceased contributor if the spouse is 65 years or older, plus a flat-rate component if aged 45–65. For those less than 45 years old, the pension level is determined by age, the number of dependent children, and disability.

The plan is a recent one and transitional arrangements were used to introduce it, which created further variation in the value of pension rights across individuals. Persons aged 55 and less in 1966 were to be eligible for full pensions at age 65; in effect, the closer an individual was to age 55 in 1966 the greater the "bonus" or net benefit received. Those who were 56 or more years old would contribute for less than 10 years and receive a prorated pension.

For each individual in the sample we constructed an estimate of the present value of social security wealth, using estimated age-earnings profiles (for the CQPP component), and the relevant survival probabilities.[5] For the present value calculation the nominal discount rate was chosen to be equal to the rate of change of the wage and salary index. In other words, for the pension plans, the real discount factor for the years up to the age of retirement is one. The rate of inflation was assumed to be 5%, so that for the postretirement years the real discount rate is 2.5%, which is the growth rate of productivity (or the difference in the growth rates of the wage and salary and consumer price indexes). For wives allowance was made for nonparticipation in the labor force at various stages of the life cycle by adjusting the level of the age-earnings profile in a fashion identical to that used in estimating permanent income. In addition to the retirement pension, only the surviving spouse's pension, for those over 45, was included in the calculation. In computing the flat-rate components of social security wealth, we assumed that everyone of at least 65 years of age receives OAS. We made no allowance for SPA because the age-earnings profile implicitly assumes that spouses effectively work until they are 65. Current and future eligibility for the GIS was determined using the appropriate needs test.

In estimating the present value of private pension wealth, actual receipts were used for retirees, and an expected pension was imputed for those in pension plans who were below retirement age (assumed to be 65). The imputation was based on a regression for pension receipts of retirees in terms of permanent income, age, and occupation. To allow for sample selection bias the inverse Mills's ratio, computed from a probit model of positive pension receipts for retirees, was included as an explanatory variable. To convert these benefit levels into a present value it is necessary to make some assumption about current and future pre- and postretirement indexation. Indexation provisions vary widely across pension plans, and any assumption (although we do take notice of what evidence is available) applied uniformly across households will be only an approximation.[6] The heterogeneity of the pension plans across occupations will be captured to some extent in the imputation of pension receipts. We assume that prior to retirement, benefits are effectively indexed to the rate of growth of wages and salaries. Postretirement we assume the level of indexation is 60% of the CPI, which, given the rate of inflation of 5%, yields a real discount rate for postretirement years of 4.5%. With the information available, it was difficult to incorporate survivors' pensions. The procedure used assumes that any living spouse will be entitled to one-half of the household's pension income, regardless of whether he or she is widowed.

A more detailed description of the Canadian retirement income system and of the construction of the wealth estimates is presented in Dicks-Mireaux (1981).[7] Mean values of wealth in these various forms in the sample of 10,118 households were the following: for net worth recorded in the survey, $53,611; social security wealth, $72,455; and for the 4,381 households with private pension wealth, $60,587.

In this final section we briefly examine how personal saving is treated for tax purposes and describe how the marginal tax rate was computed for each household. Both are done with respect to the 1976 tax law, to which the recorded income data relate. The first $1,000 of interest and dividend income, as of 1974 and 1975, respectively (with capital gains included in 1977), are tax exempt. Unlike the United States, Canada has no exemption for state and local bond interest income. Since 1972 realized capital gains have been taxed with a 50% exclusion provision and no distinction between short- and long-run gains. Associated outlays and expenses may be excluded, but there is no adjustment for inflation when calculating taxable gains.[8]

The Canadian Registered Home Ownership Savings Plan (RHOSP) originated in 1974. It permits tax deductions for contributions of up to $1,000 per year, with a lifetime maximum total of $10,000 excluding interest earned and accumulated in the plan, for up to 20 years. Withdrawn funds are not taxed insofar as they are used to acquire an owner-occupied home. In addition, when this wealth is transformed into a house its imputed income is untaxed. Canada differs from the United States in that mortgage interest and local property taxes are *not* deductible.

The tax treatment of private pension plans, since 1972, is like that of an expenditure tax. Contributions are exempt, and receipts less $1,000 for those over 65 are taxed. All federal pension receipts are taxed, unlike United States social security. Registered Retirement Savings Plans (RRSP) were introduced in 1957 and are available to everyone.[9] Their tax treatment is the same as that for private pension plans except that there is a maximum deduction on contributions: ($3,500), $5,500 or 20% of earned income, whichever is less, if (were) not covered by a private pension plan. Furthermore, interest on money borrowed by an individual to pay premiums into his own RRSP is also tax deductible. It is worth noting that contribution limits were very low at first and were raised substantially in 1971 and 1976.

In Canada husbands and wives are assessed separately for tax purposes. For the econometric analysis of household portfolio composition, the relevant marginal tax rate was taken to be that of the male household head. In married households some account should be made for wives purchasing or holding assets. One would expect, however, that in general, rational cooperative behavior would allocate the legal pattern of ownership and purchases so that tax savings were maximized, which would equalize the marginal tax rates faced by husbands and wives.[10] In this case the husband's tax rate is indeed appropriate for our purposes.

The calculated marginal tax rate is potentially endogenous with respect to portfolio composition. Only total earnings and total income of the husband are recorded in the survey, and therefore taxable income had to be estimated. This was done as follows.[11] Total income was calculated as net employment income plus unearned income. Of the deductions which can be applied to this to derive net total income, allowance was made for those relating to Canada and Quebec and employer-sponsored pension plan contributions, unemployment insurance premiums, and registered home ownership plans. In addition to the basic exemption, those related to age, marriage, and wholly dependent children were applied to net income to give taxable income. In the absence of any information on expenditures and the different kinds of unearned income, it was not possible to take into account any other exemptions or deductions. The tax rate was then computed and incorporates the provincial tax laws which consist of a tax rate applied to the basic federal tax payable.[12] Table 14.3 shows the mean values of the constructed variables and asset shares, for each subsample with positive holdings of each asset.

14.5 Empirical Results

In this section the empirical estimates of the discrete and continuous choice models of asset demands are presented. Table 14.4 shows the maximum likelihood estimates of the probit model for positive holdings of each asset.[13] A priori, it is not clear what effect on the probability of holding each asset one should expect of the three components of wealth. For example, both social security and private pension wealth may be thought of as real illiquid assets; though less so, in both respects, for the latter. Consequently, one might expect their presence to reduce the likelihood of holding assets with similar characteristics. On the other hand, some illiquid assets may not be perceived by households to be part of retirement saving—for example, cars—while liquid financial assets such as bonds may be. As shown by the coefficients on the three wealth-

Table 14.3 **Wealth, Portfolio, Income, and Tax Characteristics for Subsamples with Positive Holdings of Each Asset (All Figures Are Calculated as Means of Individual Observations for Which $p_j \neq 1$)**

		Assets											
Variable[a]	Total Sample	Deposits (1)	Bonds (2)	Cash (3)	Stocks and Shares (4)	RHOSP (5)	RRSP (6)	ONLFA (7)	Cars (8)	Home Equity (9)	Real Estate Equity (10)	Business Equity (11)	Debt (12)
Share of asset in total assets (p_j), %	. . .	17.7	10.1	1.8	7.8	12.0	9.0	14.0	19.4	60.8	30.1	48.1	157.3
SSW/W	1.3	14.4	2.2	15.7	2.2	1.0	8.5	2.5	6.6	2.6	2.0	0.5	6.1
PPW/W	0.5	3.4	2.1	3.3	0.9	3.3	9.4	0.3	2.8	0.9	0.8	0.1	3.5
W/Y	2.4	2.9	3.7	2.8	5.0	2.2	4.5	6.0	2.8	3.6	4.8	7.1	2.2
SSW/Y	3.2	3.5	3.4	3.6	3.2	2.8	3.2	3.6	3.6	3.8	3.7	4.1	3.5
PPW/Y	1.2	1.0	1.3	1.0	1.5	1.6	1.4	1.0	1.0	1.0	1.1	0.5	1.1
Permanent income (Y), $'s	22,598	21,367	22,683	21,084	24,734	27,785	25,087	21,437	21,860	20,776	21,669	20,446	22,849
Marginal tax rate of household head	30.3	31.1	33.9	30.7	37.6	36.3	38.4	33.6	31.9	31.1	34.0	31.0	32.4
No. of observations for which $p_j > 0$ and $p_j \neq 1$	9,788	8,789	2,592	8,676	895	447	1,630	751	8,295	6,960	1,906	1,876	6,327
No. of observations for which $p_j \equiv 1$	330	69	3	141	0	0	0	0	63	50	0	2	3

[a] W = net worth; SSW = social security wealth; PPW = private pension wealth.

to-permanent-income ratios, all three types of wealth do have significant effects on the choice of which asset to hold. The effect of the level of wealth differs between its three components. Except in the case of debt, the probability of holding each asset rises with the ratio of nonpension wealth *W* to permanent income. Private pension wealth has a significant positive influence on holdings for all assets except business equity and ONLFA, and is particularly strong for deposits, bonds, cars, and home equity. This form of wealth does not appear to be very different from nonpension wealth. In contrast, however, we observe that social security wealth has significant negative effects on positive holdings of deposits, bonds, home equity, and to a lesser extent stocks and shares. Both private pension and social security wealth have similar positive effects on the discrete choice to own an RRSP, the former being statistically more significant.

Clearly, as we argued earlier, the marginal tax rate has a significant influence on the discrete choice to hold particular assets, for example a positive one on stocks and shares and RRSPs.[14] Because of our inability to observe whether individuals have or have not exhausted the tax deductions or exemptions associated with a particular asset, the exact interpretation is not quite as clear-cut. In general, permanent income *Y* has a significant positive effect. The negative influence on home equity (in comparison to that on RHOSPs) is, perhaps, surprising. However, the positive effect on holding an RHOSP may be largely related to the tax savings it offers via income averaging, regardless of whether or not it is ultimately used to purchase a home. Also, unlike the United States, the tax advantage of home ownership versus renting is limited to the nontaxation of imputed income from the former. Its insignificance in the cash equation attests to the transactions role of cash. Low household earnings, which may reflect transitory shocks or the position on the age-earnings profile, in contrast tend to have a negative influence. Either asset holdings have been run down or, simply, little or no saving is possible. The apparently contradictory positive effect on holdings of bonds, stocks and shares, and other nonliquid financial assets may reflect that households with these assets may receive most of their total income from them.

Of the remaining explanatory variables, low age has a negative effect except on business equity (youthful entrepreneurship) and debt. Education when significant has a positive influence; its insignificant role in cash and home equity is understandable, but with regard to business equity it is perhaps surprising. Marriage has mixed effects: a strong role in owning a home, and a negative role in holding an RHOSP or RRSP.

Estimates of relative asset share demand equations are given in table 14.5, at the end of which is a detailed description of the explanatory variables used. These equations model the continuous choice of how much to hold of each asset given the choice of which assets are held.

Table 14.4 Probit Model for Positive Asset Holdings (Standard Errors in Parentheses)

	Assets				
Explanatory Variable[a]	Deposits (1)	Bonds (2)	Cash (3)	Stocks and Shares (4)	RHOSP (5)
Constant	−2.531 (0.909)	−2.300 (0.807)	0.012 (0.860)	−6.897 (1.148)	−12.691 (1.801)
Marginal tax rate	0.783 (0.180)	1.066 (0.159)	0.622 (0.170)	1.607 (0.228)	−0.345 (0.307)
Ln Y	0.372 (0.095)	0.127 (0.084)	0.095 (0.090)	0.511 (0.119)	1.100 (0.181)
W/Y	0.104 (0.008)	0.021 (0.003)	0.017 (0.004)	0.031 (0.003)	0.004 (0.004)
SSW/Y	−0.095 (0.016)	−0.064 (0.015)	−0.017 (0.015)	−0.033 (0.023)	0.121 (0.042)
PPW/Y	0.097 (0.018)	0.090 (0.011)	0.052 (0.015)	0.042 (0.014)	0.032 (0.016)
Married	0.069 (0.080)	0.274 (0.073)	0.108 (0.076)	−0.058 (0.102)	−0.572 (0.141)
Education: secondary or above	0.297 (0.048)	0.241 (0.034)	−0.004 (0.041)	0.304 (0.044)	0.293 (0.052)
Age < 40	−0.350 (0.046)	−0.457 (0.037)	−0.164 (0.042)	−0.502 (0.049)	0.083 (0.064)
Household earnings < $6,000	−0.273 (0.054)	0.490 (0.048)	−0.181 (0.052)	0.154 (0.068)	−0.743 (0.130)
Nos. above limit	8,789	2,592	8,676	895	447
Nos. below limit	1,260	7,523	1,301	9,223	9,671
$\chi^2(9)$	1,064.6	814.0	219.2	713.9	382.7
The probability P of positive asset holdings evaluated at the sample means	0.912	0.241	0.876	0.068	0.027
The change in P for:					
25% increase in $\frac{SSW}{Y}$	−0.015	−0.018	−0.003	−0.004	0.008
25% increase in $\frac{PPW}{Y}$	0.004	0.007	0.003	0.001	0.004

Assets						
RRSP (6)	ONLFA (7)	Cars (8)	Home Equity (9)	Real Estate Equity (10)	Business Equity (11)	Debt (12)
−10.200	−5.112	−3.401	6.091	−1.483	−11.129	−7.494
(1.109)	(1.076)	(0.809)	(0.833)	(0.869)	(0.984)	(0.768)
2.060	1.093	1.384	1.240	1.540	−0.273	0.450
(0.212)	(0.214)	(0.161)	(0.168)	(0.171)	(0.183)	(0.145)
0.875	0.335	0.346	−0.754	−0.028	0.925	0.726
(0.114)	(0.112)	(0.085)	(0.087)	(0.091)	(0.101)	(0.080)
0.039	0.036	0.029	0.220	0.044	0.198	−0.014
(0.003)	(0.030)	(0.004)	(0.009)	(0.003)	(0.006)	(0.002)
0.037	0.022	0.036	−0.035	−0.002	0.216	0.147
(0.023)	(0.020)	(0.014)	(0.016)	(0.016)	(0.019)	(0.014)
0.036	−0.027	0.107	0.120	0.002	−0.189	0.030
(0.012)	(0.016)	(0.016)	(0.013)	(0.012)	(0.015)	(0.012)
−0.358	−0.189	0.469	1.524	0.398	−0.258	−0.200
(0.094)	(0.096)	(0.070)	(0.076)	(0.082)	(0.091)	(0.067)
0.243	0.137	0.118	−0.031	0.147	−0.003	0.052
(0.038)	(0.047)	(0.042)	(0.037)	(0.037)	(0.041)	(0.034)
−0.552	−0.263	−0.067	−0.182	−0.302	0.396	0.522
(0.044)	(0.050)	(0.042)	(0.039)	(0.039)	(0.044)	(0.034)
−0.337)	0.202	−0.433	−0.161	−0.026	−0.349	−0.507
(0.065)	(0.063)	(0.048)	(0.052)	(0.051)	(0.056)	(0.043)
1,630	751	8,295	6,960	1,906	1,876	6,327
8,488	9,367	1,760	3,108	8,212	8,240	3,788
1,426.8	319.8	1,496.5	3,231.0	724.2	2,544.9	1,654.2
0.119	0.066	0.859	0.770	0.172	0.153	0.635
0.006	0.002	0.007	−0.010	−0.003	0.051	0.049
0.002	−0.001	0.006	0.008	0.002	−0.010	0.003

[a]Dummy variables take the value unity when the description applies to the household, zero otherwise. Individual variables refer to the head of a household.

Table 14.5 Asset Demand Equations (Standard Errors in Parentheses) Dependent Variable ln $(p_j/1 - p_j)$

	Assets				
Explanatory Variable	Deposits (1)	Bonds (2)	Cash (3)	Stocks and Shares (4)	RHOSP (5)
Marginal tax rate	1.268 (0.223)	1.181 (0.443)	1.596 (0.710)	2.839 (0.872)	−0.214 (0.701)
Ln *Y*	−0.008 (0.018)	−0.141 (0.065)	−0.541 (0.085)	−0.044 (0.109)	−0.150 (0.071)
W/Y	−0.024 (0.004)	−0.019 (0.007)	−0.051 (0.009)	−0.015 (0.008)	−0.113 (0.017)
SSW/Y	0.006 (0.024)	−0.057 (0.047)	−0.003 (0.052)	−0.026 (0.092)	0.052 (0.088)
PPW/Y	0.013 (0.016)	0.002 (0.032)	0.090 (0.044)	0.023 (0.039)	−0.005 (0.031)
SSW/W	0.00007 (0.00007)	−0.001 (0.001)	0.0003 (0.0001)	0.003 (0.004)	0.002 (0.001)
PPW/W	−0.00005 (0.00013)	0.001 (0.001)	−0.003 (0.002)	0.001 (0.006)	−0.002 (0.001)
No. of persons with life insurance	0.102 (0.020)	−0.023 (0.032)	0.029 (0.040)	−0.094 (0.060)	−0.046 (0.050)
Farm family dummy	−0.097 (0.102)	−0.410 (0.177)	0.294 (0.201)	−1.152 (0.305)	0.278 (0.375)
Married dummy	−0.070 (0.074)	0.109 (0.173)	0.538 (0.231)	−0.263 (0.281)	0.171 (0.190)
Self-employed dummy	0.187 (0.084)	0.408 (0.146)	−0.007 (0.165)	0.114 (0.225)	0.101 (0.271)
Unemployed or not in labor force dummy	−0.006 (0.062)	0.295 (0.112)	0.178 (0.121)	0.246 (0.235)	0.018 (0.166)
No. of children < 18 years	−0.113 (0.018)	−0.084 (0.032)	−0.018 (0.034)	0.022 (0.059)	−0.083 (0.050)
No. of children aged 18–24 in full-time schooling	0.111 (0.062)	−0.054 (0.093)	0.162 (0.120)	0.007 (0.160)	0.030 (0.154)
D1	— (—)	−0.318 (0.173)	−0.136 (0.134)	−0.775 (0.380)	0.071 (0.315)
D2	−0.031 (0.042)	— (—)	−0.157 (0.084)	−0.224 (0.122)	−0.053 (0.094)
D3	0.165 (0.061)	−0.155 (0.100)	— (—)	−0.546 (0.213)	−0.030 (0.175)
D4	−0.017 (0.064)	0.014 (0.084)	−0.106 (0.126)	— (—)	−0.228 (0.129)

Assets						
RRSP (6)	ONLFA (7)	Cars (8)	Home Equity (9)	Real Estate Equity (10)	Business Equity (11)	Debt (12)
0.753 (0.534)	0.595 (1.119)	0.881 (0.256)	−0.512 (0.197)	−0.870 (0.501)	−1.268 (0.471)	0.008 (0.337)
−0.171 (0.058)	−0.008 (0.166)	0.100 (0.025)	0.123 (0.029)	0.139 (0.081)	0.453 (0.060)	0.009 (0.029)
−0.025 (0.005)	−0.012 (0.012)	−0.041 (0.004)	−0.028 (0.004)	0.009 (0.006)	0.005 (0.006)	−0.093 (0.006)
−0.155 (0.054)	−0.005 (0.088)	0.122 (0.018)	−0.009 (0.017)	−0.031 (0.034)	−0.006 (0.043)	0.142 (0.028)
0.026 (0.021)	−0.025 (0.065)	0.008 (0.015)	0.018 (0.014)	−0.018 (0.024)	0.127 (0.046)	−0.003 (0.020)
−0.0004 (0.0018)	−0.001 (0.001)	0.0004 (0.0001)	−0.0002 (0.0004)	−0.001 (0.003)	−0.002 (0.002)	0.0009 (0.0001)
0.0002 (0.0016)	0.004 (0.011)	−0.0003 (0.0001)	−0.003 (0.002)	−0.002 (0.006)	0.003 (0.005)	−0.0001 (0.0002)
−0.091 (0.032)	−0.108 (0.093)	0.049 (0.017)	−0.022 (0.017)	−0.026 (0.032)	0.012 (0.051)	0.041 (0.027)
−0.600 (0.155)	−1.165 (0.398)	−0.506 (0.087)	−1.305 (0.081)	−0.098 (0.169)	0.955 (0.127)	0.245 (0.146)
−0.061 (0.146)	−0.098 (0.339)	−0.088 (0.109)	0.204 (0.097)	−0.349 (0.187)	−0.189 (0.213)	−0.080 (0.116)
0.188 (0.121)	0.034 (0.312)	−0.053 (0.073)	−0.197 (0.069)	−0.093 (0.110)	0.078 (0.110)	0.069 (0.114)
0.015 (0.125)	0.503 (0.285)	−0.022 (0.054)	−0.009 (0.055)	−0.145 (0.115)	−0.059 (0.217)	−0.015 (0.084)
−0.043 (0.029)	−0.148 (0.088)	0.025 (0.015)	0.032 (0.015)	0.001 (0.029)	0.026 (0.040)	0.094 (0.022)
0.080 (0.082)	0.178 (0.266)	0.099 (0.052)	0.011 (0.050)	0.030 (0.086)	−0.246 (0.147)	0.207 (0.080)
−0.130 (0.207)	0.240 (0.577)	−0.691 (0.058)	−0.934 (0.058)	0.019 (0.146)	−0.119 (0.170)	−0.291 (0.082)
−0.155 (0.063)	−0.025 (0.191)	−0.217 (0.036)	−0.209 (0.037)	−0.263 (0.069)	−0.387 (0.112)	−0.357 (0.059)
−0.146 (0.119)	0.237 (0.322)	0.160 (0.051)	0.058 (0.051)	−0.309 (0.106)	−0.060 (0.152)	−0.097 (0.079)
0.035 (0.073)	−0.314 (0.226)	−0.170 (0.055)	−0.084 (0.054)	−0.158 (0.091)	−0.376 (0.147)	−0.061 (0.087)

Table 14.5 (continued)

	Assets				
Explanatory Variable	Deposits (1)	Bonds (2)	Cash (3)	Stocks and Shares (4)	RHOSP (5)
D5	−0.040	0.019	−0.305	0.072	—
	(0.086)	(0.122)	(0.170)	(0.207)	(—)
D6	0.121	0.058	−0.145	0.290	−0.187
	(0.051)	(0.073)	(0.101)	(0.128)	(0.107)
D7	−0.116	0.048	−0.168	−0.173	−0.007
	(0.067)	(0.098)	(0.133)	(0.155)	(0.183)
D8	−0.909	−0.491	−0.538	−0.296	−0.476
	(0.056)	(0.109)	(0.108)	(0.219)	(0.169)
D9	−2.002	−1.632	−1.585	−1.303	−1.118
	(0.047)	(0.082)	(0.091)	(0.179)	(0.109)
D10	−0.398	−0.174	−0.262	−0.158	−0.465
	(0.047)	(0.073)	(0.092)	(0.131)	(0.126)
D11	−0.751	−0.736	−0.378	−0.339	−0.661
	(0.066)	(0.107)	(0.128)	(0.172)	(0.179)
D12	−0.713	−0.339	0.056	−0.018	0.065
	(0.041)	(0.070)	(0.082)	(0.139)	(0.102)
V1	−0.002	0.015	−0.066	−0.066	0.015
	(0.011)	(0.022)	(0.022)	(0.054)	(0.024)
V2	0.013	0.006	0.010	0.008	−0.058
	(0.009)	(0.016)	(0.018)	(0.029)	(0.022)
V3	0.023	0.010	0.010	0.039	−0.011
	(0.009)	(0.016)	(0.019)	(0.028)	(0.027)
V4	0.008	−0.003	−0.024	−0.024	0.016
	(0.011)	(0.044)	(0.020)	(0.029)	(0.030)
V5	0.086	0.152	0.022	0.187	0.025
	(0.029)	(0.003)	(0.057)	(0.089)	(0.128)
V6	−0.003	−0.008	−0.002	−0.010	0.002
	(0.002)	(0.265)	(0.004)	(0.007)	(0.012)
V7	0.055	0.234	0.143	0.112	−0.447
	(0.168)	(0.173)	(0.340)	(0.592)	(1.335)
Inverse of Mills's ratio	−0.180	0.138	3.386	−0.065	0.073
	(0.168)	(0.260)	(1.166)	(0.312)	(0.213)
SE of equation	1.674	1.504	2.722	1.700	0.915
Degrees of freedom	8,756	2,559	8,643	862	414
Mean p_j	0.087	0.042	0.003	0.027	0.065

Assets						
RRSP (6)	ONLFA (7)	Cars (8)	Home Equity (9)	Real Estate Equity (10)	Business Equity (11)	Debt (12)
−0.072 (0.106)	0.152 (0.419)	−0.614 (0.074)	−0.381 (0.101)	−0.196 (0.150)	−0.116 (0.250)	−0.505 (0.115)
— (—)	0.020 (0.209)	−0.196 (0.044)	−0.247 (0.044)	−0.159 (0.077)	−0.474 (0.122)	−0.317 (0.071)
−0.155 (0.087)	— (—)	−0.280 (0.059)	−0.365 (0.059)	−0.100 (0.096)	−0.206 (0.144)	−0.114 (0.095)
−0.364 (0.119)	−0.248 (0.274)	— (—)	−0.791 (0.052)	−0.184 (0.099)	−0.546 (0.135)	0.122 (0.080)
−1.046 (0.088)	−1.124 (0.242)	−2.219 (0.041)	— (—)	−1.490 (0.093)	−1.093 (0.150)	−1.605 (0.062)
−0.164 (0.068)	−0.145 (0.196)	−0.429 (0.040)	−1.018 (0.039)	— (—)	−0.880 (0.106)	−0.324 (0.066)
−0.295 (0.091)	−0.225 (0.257)	−0.696 (0.057)	−1.499 (0.056)	−0.739 (0.087)	— (—)	−0.148 (0.087)
0.073 (0.067)	−0.024 (0.197)	0.475 (0.036)	0.132 (0.036)	−0.146 (0.069)	0.212 (0.103)	— (—)
0.029 (0.028)	0.028 (0.060)	−0.095 (0.010)	0.094 (0.014)	0.031 (0.029)	−0.079 (0.036)	−0.078 (0.014)
0.021 (0.015)	0.044 (0.046)	−0.038 (0.007)	0.016 (0.008)	0.013 (0.016)	0.035 (0.021)	−0.074 (0.012)
0.007 (0.014)	−0.084 (0.045)	−0.002 (0.008)	0.009 (0.008)	0.004 (0.015)	−0.001 (0.021)	−0.040 (0.012)
0.034 (0.015)	0.074 (0.046)	−0.022 (0.009)	0.009 (0.009)	−0.017 (0.016)	−0.048 (0.025)	−0.038 (0.015)
0.051 (0.052)	−0.174 (0.125)	−0.040 (0.026)	−0.051 (0.024)	−0.024 (0.047)	−0.038 (0.077)	−0.110 (0.053)
−0.011 (0.005)	0.011 (0.010)	0.002 (0.002)	0.001 (0.002)	0.0005 (0.004)	0.006 (0.006)	0.006 (0.004)
0.890 (0.596)	−0.556 (0.777)	−0.192 (0.167)	−0.122 (0.142)	0.229 (0.297)	−0.864 (0.676)	−0.194 (0.461)
0.138 (0.162)	−0.974 (0.555)	0.452 (0.174)	0.327 (0.093)	−0.040 (0.254)	−1.075 (0.103)	0.560 (0.189)
1.187	2.120	1.374	1.297	1.326	1.782	1.884
1,597	718	8,262	6,927	1,873	1,843	6,294
0.050	0.056	0.104	0.644	0.241	0.456	0.085

Footnotes on the following page.

The explanatory variables in the vector Z of equation (5) relating to wealth on which we focus are the ratios of the three components of wealth to permanent income and the ratio of the two forms of pension wealth to net worth (nonpension wealth). The first set of variables captures the scale effects of wealth on asset demands, the second set the composition effect of wealth on portfolio behavior. Nonpension wealth has a significant depressing scale effect on the relative shares of all assets, apart from real estate and business equity. In contrast, the estimated coefficients on private pension and social security wealth are rarely significant and are of different size and sign. Statistically significant point estimates occur for RRSPs, cars, and debt for SSW and cash and business equity for PPW. The compositional influence of pension wealth is also very small, with significant coefficients found only for SSW/W in the demand for cars and debt. At a first glance it would appear that for the continuous choice decision the portfolio composition effects of pension wealth are small, and this is borne out in the simulations in section 14.5. This finding may in part be a result of the level of aggregation of assets. If we had chosen to group assets into a smaller number of categories, some of the significant discrete choice effects would instead have shown up in the continuous choice model estimates.

The dummy variables D1–D12 take the value unity when assets 1–12 are held, zero otherwise. These capture the effect of the particular portfolio combination the household holds on the relative share demand for each asset. The significant role of these asset ownership dummies (and also the number of persons with life insurance, which is a form of dummy for this type of wealth) evidently justifies their inclusion in the estimated equations. In most cases, the gross effect of the ownership of other assets

Footnotes for Table 14.5

Index of Explanatory Variables

D1–D12 are dummy variables which take the value unity if the household has positive holdings of assets 1–12, where the numeric index corresponds to the equation column numbers.

Dummy variables take the value unity when the description applies to the household, zero otherwise. Individual variables refer to the head of a household. A farm family is one which any member receives more than 50% of his income fom self-employment in farming. The labor force status dummies relate to the week in which the survey was undertaken.

V1–V7, a piecewise function of age, (A). Define the following dummies for household i: $b_{1i} = 1$ if $A_i < 30$, zero otherwise; $b_{2i} = 1$ if $30 < A_i < 40$, zero otherwise; $b_{3i} = 1$ if $40 < A_i < 50$, zero otherwise; $b_{4i} = 1$ if $50 < A_i < 60$, zero otherwise; $b_{5i} = 1$ if $60 < A_i < 75$, zero otherwise; $b_{6i} = 1$ if $75 < A_i$, zero otherwise.

Then V1–V7 correspond to: $V1_i = b_{1i}(A_i - 15) + 15\,\Sigma_{j=2}^{6} b_{ji}$; $V2_i = b_{2i}(A_i - 30) + 10\,\Sigma_{j=3}^{6} b_{ji}$; $V3_i = b_{3i}(A_i - 40) + 10\,\Sigma_{j=4}^{6} b_{ji}$; $V4_i = b_{4i}(A_i - 50) + 10)\,\Sigma_{j=5}^{6} b_{ji}$; $V5_i = b_{5i}(A_i - 60) + 15b_{6i}$; $V6_i = b_{5i}(A_i - 60) + 225b_{6i}$; $V7_i = b_{6i}$, which is a linear piecewise function of age with a quadratic form between the ages of 60 and 75.

is to reduce the relative share held in a particular asset, and most of the positive dummy coefficients are insignificant. An exception to this is the increase in demand for deposits contingent on ownership of cash or an RRSP, or life insurance. Although it is difficult to summarize these results, some features are worth noting. Home equity (D9), primarily because of its large share in homeowner household portfolios, has a very strong negative effect on the demand for all other assets. In contrast to ownership of nonfinancial assets, the holding of financial assets appears to have an insignificant effect on the relative shares of financial assets held (except for stocks and shares). The demand for other nonliquid financial assets is virtually unaffected by other asset ownership, presumably because of its residual nature.

Relative share demand has a negative income elasticity for financial assets and a positive elasticity for nonfinancial assets. Households with lower permanent income are less willing or unable to tie up their wealth in what in effect are less liquid assets. More so than in the discrete choice model, the interpretation of the role of the tax rate is hampered by the nonlinearities embodied in the exemption and deduction rules. The parameter estimates are accordingly mixed; given the initial deductions the positive effect on deposits, bonds, and stocks and shares is understandable, but the insignificant influence on RHOSPs and RRSPs which have potentially large tax breaks is surprising. The insignificant effect on home and real estate equity may be attributed to the absence of mortgage interest deductibility for tax purposes. The imputed income from home ownership is untaxed.

The remaining explanatory variables are intended to cover socioeconomic characteristics of the household which might affect asset demands, transitorily or otherwise, such as labor force or marital status and the number of dependent children. To capture any life-cycle features of these demands we include a piecewise function of the household head's age, using variables V1–V7 which allow us in a linear regression to incorporate a nonlinear function of age (these variables are discussed further in King and Dicks-Mireaux [1982]). Neither marriage or the number of children aged 18–24 in full-time schooling appear to influence portfolio composition significantly. In the former case, notable exceptions are the understandable positive influence on cash holdings and home equity and the less obvious negative one on real estate equity. In the latter case, this may reflect the relatively complete government funding of university education. In contrast young children have reduced the demand for financial assets, with no significant effects on nonfinancial assets other than to increase the demand for home equity. Neither labor force dummies (in contrast to low household earnings in discrete choice behavior) influence portfolio composition. Up to the age bracket 60–75 years the age terms V1–V7 suggest, in general, a cumulative rise in relative asset share demands. For both cars and debt the opposite is true. The terms V5 and V6 imply that between the age of 60 and 75 the age effect on the demand for financial assets reaches a maximum, while for other assets it continues to rise. This possibly reflects a greater initial role, in providing for retirement income, of decumulating financial assets.

The inverse of Mills's ratio clearly indicates that in its absence sample selection bias will occur in estimating equations of the form (5) for nonfinancial assets and cash. The former are available to most households in relatively less divisible units than financial assets, while zero holdings of cash are clearly due to rather special factors.

14.6 The Effect of Pension Wealth on Portfolio Composition

In this section we use the empirical estimates in simulations to examine the effect of changes in pension wealth on household portfolio composition. To do so correctly we must take into account two factors. First, changes in pension wealth may affect asset demands directly, as in the estimated equations, and indirectly, via their effect on the level of nonpension wealth. Second, because individual households hold very different combinations of assets it is important to compute the response for each household and then to aggregate over households to discover the overall effect.

In the simulations we consider separately the effects on portfolio composition of a 25% increase in the ratio of social security and private pension wealth to income. This particular choice of effect to simulate is suggested by the substantial earnings-related elements of both forms of wealth. In these exercises some assumptions had to be made. The effect of these wealth changes on the discrete choice of which assets to hold is excluded, that is, the combination of assets each household owns is taken as given. This was done because within the present model specification we have been unable to devise a computationally simple way of incorporating these effects. The estimates for all 12 demand equations were presented in section 14.5, but to impose the adding-up constraint for asset shares we drop the home equity equation.[15] Note that because the shares p_j are defined with respect to total assets this constraint only applies to the 11 assets and not to debt. Finally, the approach is a partial equilibrium one in that we take no account of how the increase in either type of pension is to be paid for or funded; and we assume the supply elasticity of the assets to be infinite.

We incorporate in the simulations the possible adjustment in the level of nonpension wealth by households in the face of changes in pension wealth. This response is modeled as follows: given an exogenous change in pension wealth an individual may choose to hold less nonpension wealth. Having made this choice, he or she then decides how to allocate this wealth among assets. Formally this offsetting behavior may be interpreted in terms of the coefficients of the wealth terms in the estimated equations. We can write the asset demand equations as

$$\text{(7)} \qquad \ln\left(\frac{p_j}{1-p_j}\right) = \alpha_1 \frac{TW}{Y} + \alpha_2 \frac{SSW}{W} + \alpha_3 \frac{PPW}{W} + S\varnothing_j + u_j, \qquad j = 1, \ldots, J,$$

where S is the vector of all nonwealth explanatory variables, $\varnothing$ is its associated parameter vector, and TW is "effective" total wealth. It is defined by

$$\text{(8)} \qquad TW = W + \delta_s SSW + \delta_p PPW,$$

where δ_s and δ_p reflect the extent to which social security and private pension wealth, respectively, are regarded as equivalent to nonpension wealth. Equation (7) can, therefore, be written as

$$\text{(9)} \qquad \ln\left(\frac{p_j}{1-p_j}\right) = \alpha_1 \frac{W}{Y} + \alpha_1 \, \delta_s \frac{SSW}{Y} + \alpha_1 \, \delta_p \frac{PPW}{Y} + \alpha_2 \frac{SSW}{W} + \alpha_3 \frac{PPW}{W} + S\varnothing_j + u_j, \qquad j = 1, \ldots, J.$$

It is clear that, unless pension and nonpension wealth are considered as equivalent (i.e., $\delta_s = \delta_p = 1$), there is no reason to expect the estimated coefficients on the three wealth-to-income ratios to be the same. Indeed, they are not (see table 14.5), and for a given change in pension wealth, if households adjust their holdings of other wealth, they will do so by a value of δ_s or δ_p. In fact the nature of the offset as implied by the individual demand equations differs as between private pension and social security wealth and the estimates differ also across assets. The range of values is in fact quite wide: a $-\$6.2$ to $+\$3.6$ change in W/Y with respect to a one-dollar rise in SSW/Y, and $-\$23.3$ to $+\$2.0$ for PPW/Y. This lack of conformity in the estimated offsets across equations is perhaps understandable in the absence of cross-equation constraints.[16] If we regard the offsets implied by the individual demand equations as appropriate, changes in the ratio of pension wealth to permanent income will only affect asset demands via the composition effects α_2 and α_3. For example, any change in SSW/Y has an effect of $\alpha_1\delta_s\Delta(SSW/Y)$ on asset demand. This is simultaneously matched by a change of $-\delta_s\Delta(SSW/Y)$ in W/Y, resulting in a change in asset demand equivalent to $-\alpha_1\delta_s\Delta(SSW/Y)$. The combined effect is therefore zero. The changes in SSW and W do, however, affect asset demands by changing the value of the ratios SSW/W and PPW/W. If an alternative single value for the offset of δ_0 is imposed on all the equations, the net scale effect on asset share demands becomes $\alpha_1(\delta_s - \delta_0)\Delta(SSW/Y)$.

The effects of pension wealth on portfolio composition are examined for three different assumptions about the response of nonpension wealth to changes in pension wealth. The three assumptions are that the offsets are (*a*) zero; (*b*) the weighted average of the offsets implied by the estimated demand equations, the weights being the aggregate shares of each asset in the sample; and (*c*) an estimate derived from an econometric model of total household savings in nonpension wealth.

The values of the offsets (for a one-dollar increase in pension wealth) used were $0.56 and −$6.03 for the weighted average of the demand equation estimates, and −$0.27 and −$0.23 for the aggregate estimate of social security and private pension wealth, respectively. The zero offset can be interpreted as the short-run behavioral response to a change in pension wealth. Households smooth their adjustment of wealth via changes in savings but reallocate their portfolio immediately. The two nonzero offsets can be thought of as different steady states in which the complete desired adjustment of the level of nonpension wealth has also been made.

Before describing the simulation exercises we turn to the specification of the model of total household savings. The model presented is one which is developed in more detail in King and Dicks-Mireaux (1982). Wealth holdings (excluding pensions) over the life cycle are modeled as a nonlinear function of age (using the piecewise function adopted in the estimation of [5]), household socioeconomic characteristics, and the size of private and social security wealth. To control for differences in permanent income, all the wealth variables are deflated by it. The life-cycle model has been criticized on the grounds that one can observe a large number of households owning amounts of wealth which appear incompatible with the need to finance that part of retirement consumption not financed by pensions or social security. Indeed, in the Canadian sample we found this to be true. Nevertheless, the behavior of the majority of households is consistent with the predictions of the life-cycle model (King and Dicks-Mireaux 1982). Consequently, in estimating the model we exclude households with net worth of less than $2,500. Table 14.6 shows the results of estimating a probit model for holding low net worth. This was used to compute the inverse of Mills's ratio, which was included in the net worth regression, presented in table 14.7, to allow for sample selection bias induced by truncating the dependent variable.

In table 14.6 we see that low educational attainment and household earnings are correlated with small wealth holdings. This suggests an explanation for why such households may not act as predicted by the life-cycle model, namely, that they do not plan for the future or are unable to manage their own financial affairs, or may receive such low earnings that the optimal life-cycle consumption plan implies that retire-

Table 14.6 Probit Model for Small Wealth Holdings (Standard Errors in Parentheses)

Variable[a]	$W < \$2,500$
Constant	4.209
	(0.752)
Ln Y	−0.475
	(0.080)
Household earnings < \$6,000	0.353
	(0.052)
No. of persons unemployed	0.229
	(0.030)
Age < 40	0.884
	(0.052)
Self-employed	−0.067
	(0.117)
Home owner	1.899
	(0.042)
Farm family[b]	−0.406
	(0.202)
Married	0.018
	(0.064)
Education: secondary or above	−0.361
	(0.047)
Nos. below limit	1,839
Nos. above limit	8,279
$\chi^2(9)$	4,116.2

[a]Dummy variables take the value unity when the description applies to the household, zero otherwise. Individual variables refer to the head of a household.

[b]A family in which any member receives more than 50% of his income from self-employment in farming.

ment consumption is less than or equal to the expected value of old age social security payments.

Estimates of the model,

$$\left(\frac{W}{Y}\right)_i = \alpha_0 + \sum_{j=1}^{7} a_j v_{ji} - \delta_s \left(\frac{SSW}{Y}\right)_i - \delta_p D_1 \left(\frac{PPW}{Y}\right)_i + u_i \tag{10}$$

are shown in table 14.7.

The variables are defined as earlier. In addition, D_1 equals one if household i is eligible for a private pension plan, zero otherwise, and δ_s and δ_p are the implied offsets given by the definition of total wealth in (8).

As the life-cycle model predicts, asset holdings rise (apart from a small dip at ages 50–60) up to the age bracket 60–75 and then fall. The implied offset to nonpension wealth from an additional dollar of social security or private pension wealth is 27 and 23 cents, respectively; the larger effect of

Table 14.7 **Net Worth (*W*) Regression: Truncated Sample *W* > $2,500 (Standard Errors in Parentheses) Dependent Variable *W*/*Y***

Constant	11.825 (2.764)
V1	0.071 (0.043)
V2	0.084 (0.027)
V3	0.177 (0.028)
V4	−0.002 (0.032)
V5	0.049 (0.086)
V6	−0.009 (0.007)
V7	−0.094 (0.512)
Farm family dummy	7.376 (0.257)
No. of persons unemployed	−0.361 (0.105)
No. of adults in household	0.145 (0.076)
No. of persons with life insurance	0.115 (0.064)
Ln *Y*	−1.013 (0.256)
SSW/*Y*	−0.269 (0.061)
PPW/*Y*	−0.227 (0.047)
Inverse of Mills's ratio	−1.379 (0.175)
S.E. of equation	5.182
R^2	0.182
Degrees of freedom	8,263

the former possibly due to its being indexed. The macroeconomic effects of introducing a public pension plan using a hypothetical but broadly realistic simulation model of the economic-demographic system of Canada in the mid-seventies is examined by Denton and Spencer (1981). Among several experiments they consider the effect of different savings offset assumptions with respect to contributions.

Additional explanatory variables were introduced. A test for homothetic preferences is possible by including permanent income. The sign of the coefficient implies that the higher is permanent income, the lower is the ratio of wealth to permanent income. The elasticity evaluated at the mean value of Y/W is -0.31. Farm families possess greater wealth than is predicted by the simple model which may reflect the importance of land prices to the value of such families' net worth. Unemployment has a depressing effect on wealth, and household size appears to have little significant influence on wealth holding. Measured wealth does not include the value of life insurance policies, and we know only the number of persons in each household covered by life insurance. We might expect that, ceteris paribus, the more members covered the less would be the level of household wealth invested in other assets. But in fact the coefficient on the life insurance variable is positive, suggesting rather that purchase of life assurance is correlated with a greater than average preference to save (resulting perhaps from a higher than average degree of risk aversion).

The simulation exercises are now described. The purpose of the first simulation is to illustrate how the effect of a change in pension wealth differs between two households which differ with regard to the number of assets held. This is done for a 25% increase in SSW/Y using the wealth offset from the aggregate savings model reported above. The two portfolios we consider are the "modal" portfolio, which consists of deposits, cash, cars, home equity, and personal debt, and a "complete" portfolio in which all assets are held. As shown in table 14.2 portfolios of five assets are the most popular, and almost half of these consist of the modal portfolio (1,022 households). In each case the predicted portfolios (columns 1 and 2 in table 14.8) are calculated using the mean characteristics of those holding the modal portfolio. These were permanent income of \$24,098, nonpension wealth of \$29,286, social security wealth of \$77,684, and private pension wealth of \$32,311. The household head is 41 years old, and the dummies imply high probabilities of being married and employed but not of being a farm family. The mean number of adults with life insurance and of dependent children above and below 18 years of age is 0.75, 1.59, and 0.07, respectively.

The two predicted portfolios obviously differ, with the proportion of assets held in nonfinancial form being less in the complete portfolio.[17] Columns 3 and 4 of table 14.8 give the changes in asset shares following the increase in SSW/Y. In both cases the effects are small. With more

Table 14.8 **Predicted Portfolio of the "Average" Individual with the Modal Portfolio and a Complete Portfolio Following a 25% Increase in *SSW/Y***

	Initial Portfolio %		Change in Portfolio (Percentage Points)	
Assets	Hold 5 Assets	Hold All Assets	Hold 5 Assets	Hold All Assets
Total deposits	4.51	1.36	0.04	0.01
Total bonds	—	1.99	—	−0.08
Cash	0.13	0.03	0.001	0.00
Liquid financial assets	4.64	3.38	0.04	−0.07
Stocks and shares	—	1.11	—	−0.02
RHOSP	—	0.74	—	0.05
RRSP	—	2.41	—	−0.27
Other nonliquid financial assets	—	3.93	—	−0.01
Nonliquid financial assets	—	8.19	—	−0.25
Total financial assets	4.64	11.57	0.04	−0.32
Passenger cars	8.05	0.65	0.83	0.07
Home equity	87.31	74.77	−0.87	0.48
Real estate equity	—	7.34	—	−0.19
Business equity	—	5.67	—	−0.04
Total nonfinancial assets	95.36	88.43	−0.05	0.32
Personal debt	4.30	0.72	−0.59	0.10

assets being held, the absolute changes in the modal five assets are reduced. In the modal portfolio the shares of financial and nonfinancial assets rise and fall, respectively, while in the complete portfolio the opposite occurs.

In tables 14.9 and 14.10 we have simulated the effect of changes in pension wealth on portfolio composition for a single representative household which holds the mean portfolio of the sample of 9,788 households. Both tables 14.9 and 14.10 indicate that neither change in both types of pension wealth has a large effect absolutely or proportionately on portfolio composition. Comparing the two tables we observe that the effects on portfolio composition of changes in both types of pension wealth are similar for the zero wealth offset assumption. For the nonzero offsets the changes in nonfinancial assets are negative in both tables but larger for changes in private pension wealth. The direction of change in financial asset holdings is different for the two increases in pension wealth. For example, social security in contrast to private pension wealth has a negative effect on the portfolio share of RRSPs held.

The final simulations presented in tables 14.11 and 14.12 show the effect of the two changes in pension wealth on the aggregate portfolio of the sample. The method employed was to calculate the change in the

Table 14.9 Change in the Mean Portfolio of the Sample for a 25% Increase in *SSW/Y*, Given for Different Offsets in Nonpension Wealth with Respect to Social Security Wealth

		Change in Asset Share (Percentage Points) Offset to Wealth		
Assets	Initial Asset Share (%)	Zero	Average of Demand Equation Estimates	Aggregate Estimate
Total deposits	9.44	0.004	−0.004	0.08
Total bonds	2.58	−0.12	−0.03	−0.11
Cash	0.23	0.00	−0.01	0.00
Liquid financial assets	12.25	−0.08	−0.08	−0.03
Stocks and shares	1.27	0.38	0.37	0.38
RHOSP	0.16	0.00	0.00	0.01
RRSP	1.79	−0.18	−0.20	−0.18
Other nonliquid financial assets	2.07	0.19	0.15	0.21
Nonliquid financial assets	5.29	0.19	0.15	0.21
Total financial assets	17.54	0.11	0.07	0.18
Passenger cars	4.86	0.42	0.34	0.46
Home equity	38.28	−0.23	−0.28	−0.30
Real estate equity	9.77	−0.20	−0.16	−0.21
Business equity	29.54	−0.10	−0.04	−0.13
Total nonfinancial assets	82.45	−0.11	−0.07	−0.18
Personal debt	5.33	0.53	0.03	0.63

value of wealth held in each asset for each household and then to compute the new economy-wide portfolio. Since households own different combinations of assets, it would be incorrect to simulate this effect by using a representative household assumed to hold the intitial mean sample portfolio. A comparison of tables 14.9–14.10 and 14.11–14.12 reveals the aggregation biases inherent in doing this. In converting shares to absolute values and in calculating the new level of total assets (net worth plus debt), the relevant offsets to net worth and the change in personal debt as predicted by our equation estimates were used.

The magnitude of the predicted changes in portfolio shares reported in tables 14.11 and 14.12 are small, and consequently we refrain from making strong statements about the differences in these changes as between assets or between the two types of pension wealth increase. The results reported in table 14.12 for the weighted average offset are clearly an exception. The large changes are a result of the high value of the offset to nonpension wealth. For several assets this led to negative predicted asset shares, which makes little sense in our framework.[18] For these

Table 14.10 **Change in the Mean Portfolio of the Sample for a 25% Increase in *PPW/Y*, Given for Different Offsets in Nonpension Wealth with Respect to Private Pension Wealth**

		Change in Asset Share (Percentage Points) Offset to Wealth		
Assets	Initial Asset Share (%)	Zero	Average of Demand Equation Estimates	Aggregate Estimate
Total deposits	9.44	0.03	1.00	0.04
Total bonds	2.58	−0.02	0.06	−0.02
Cash	0.23	0.01	0.03	0.01
Liquid financial assets	12.25	0.02	1.09	0.03
Stocks and shares	1.27	0.41	0.48	0.42
RHOSP	0.16	0.00	0.03	0.00
RRSP	1.79	0.01	0.08	0.01
Other nonliquid financial assets	2.07	−0.01	0.03	−0.01
Nonliquid financial assets	5.29	0.41	0.62	0.42
Total financial assets	17.54	0.43	1.71	0.45
Passenger cars	4.86	0.01	0.33	0.02
Home equity	38.28	−1.11	−2.28	−1.12
Real estate equity	9.77	−0.04	−0.26	−0.05
Business equity	29.54	0.71	0.50	0.70
Total nonfinancial assets	82.45	−0.43	−1.71	−0.45
Personal debt	5.33	0.00	0.81	0.01

reasons we exclude these results from the discussion below. Negative shares were also predicted, when using the aggregate model offset, for cash in both tables. For the zero offset assumption the predicted asset share changes are similar in both tables, and apart from home equity are negative. When the aggregate offset is used almost half of the predicted changes in shares are positive. The signs of these changes are similar for the two increases in pension wealth but larger in absolute size for the increase in social security wealth.

The simulations appear to suggest rather small effects on portfolio composition of changes in pension wealth. However, before jumping to such a conclusion one should take account of the exclusion of the influence of pension wealth on the choice of which assets to hold. The estimates of the discrete choice model of asset demands reported in table 14.4 indicate that such an influence exists. At the bottom of this table the change in the probability, evaluated at the sample means and assuming a zero offset to nonpension wealth, of holding an asset is given for the two increases in pension wealth employed in the simulations. In addition, it is

Table 14.11 Aggregate Portfolio of the Sample, and Its Change after a 25% Increase in *SSW/Y*

		Change in Asset Share (Percentage Points) Offset to Net Worth		
Assets	Initial Asset Share (%)	Zero	Average of Demand Equation Estimates	Aggregate Estimate
Total deposits	9.44	−0.22	0.94	−0.91
Total bonds	2.58	−0.14	−0.12	−0.11
Cash	0.23	−0.10	−1.41	−0.38
Liquid financial assets	12.25	−0.46	−1.41	−0.38
Stocks and shares	1.27	−0.03	−0.16	0.07
RHOSP	0.16	−0.003	0.09	−0.07
RRSP	1.79	−0.18	−0.26	−0.10
Other nonliquid financial assets	2.07	−0.01	−0.23	0.18
Nonliquid financial assets	5.29	−0.22	−0.56	0.08
Total financial assets	17.54	−0.68	−1.15	−1.32
Passenger cars	4.86	−0.13	3.68	−2.80
Home equity	38.28	0.98	2.28	0.45
Real estate equity	9.77	−0.16	−0.97	0.55
Business equity	29.54	−0.01	−3.84	3.12
Total nonfinancial assets	82.45	0.68	1.15	1.32
Personal debt	5.33	−0.15	4.17	−3.28

clear from table 14.8 that a change in the number and type of assets held will affect the nature of the portfolio composition adjustment.

14.7 Conclusion

The major result of our study is that, whereas there seems to be an identifiable effect of pension wealth on total private saving, the effect on portfolio composition is less significant. Moreover, within the area of portfolio composition the main effect is in terms of the particular number and combination of assets held rather than the amount of any given asset as a proportion of total wealth.

We have also demonstrated the need for, and the difficulties of constructing, a joint discrete and continuous choice model of asset demands. The empirical results suggest that to ignore the joint nature of the decision process would be an incorrect specification of household portfolio behavior.

Table 14.12 **Aggregate Portfolio of the Sample, and its Change after a 25% Increase in *PPW/Y***

		Change in Asset Share (Percentage Points) Offset to Net Worth		
Assets	Initial Asset Share (%)	Zero	Average of Demand Equation Estimates	Aggregate Estimate
Total deposits	9.44	−0.27	−0.46	−0.55
Total bonds	2.58	−0.05	−1.17	−0.03
Cash	0.23	−0.10	−1.57	−0.26
Liquid finiancial assets	12.25	−0.42	−3.20	−0.84
Stocks and shares	1.27	−0.01	−0.48	0.03
RHOSP	0.16	−0.01	−2.62	−0.07
RRSP	1.79	−0.01	−2.31	0.03
Other nonliquid financial assets	2.07	−0.02	1.75	0.10
Nonliquid financial assets	5.29	−0.05	−3.66	0.09
Total financial assets	17.54	−0.47	−6.86	−0.75
Passenger cars	4.86	−0.61	−14.41	−2.34
Home equity	38.28	1.11	−29.78	0.93
Real estate equity	9.77	−0.08	4.73	0.40
Business equity	29.54	0.05	39.46	2.12
Total nonfinancial assets	82.45	0.47	6.86	0.75
Personal debt	5.33	−0.71	−16.01	−4.75

Appendix: The Construction of Estimates of Individual Permanent Income

The model for permanent income (defined as normal age-adjusted manual earnings) is[19]

$$\text{(A1)} \qquad \ln Y_i = Z_i\gamma + s_i - c(A_i),$$

where Z_i is a vector of observable characteristics for individual i, γ is the associated parameter vector, and s_i is an unobservable variable measuring characteristics, such as skill or drive, which is constructed such that its mean value is zero and has variance σ_s^2. The term $c(A_i)$ is a cohort effect which reflects that, for given Z, younger generations are better off than their elders because of technical progress and capital accumulation.

Current earnings differ from permanent income because there exists an age-earnings profile over the life cycle, and a transitory component. Earnings in year t are therefore given by

$$\text{(A2)} \qquad \ln E_{it} = \ln Y_i + h(A_{it} - \bar{A}) + u_{it}.$$

The function h measures the age-earnings profile (assumed constant across the population), and A is a "standard" age with respect to which permanent income is defined. The transitory component of earnings, u_{it}, is assumed to have zero mean and variance σ_u^2, and to be uncorrelated with s_i. Combining (A1) and (A2) gives the earnings equation

$$\text{(A3)} \qquad \ln E_{it} = Z_i\gamma + g(A_{it}) + s_i + u_{it},$$

where $g(A_{it}) = h(A_{it} - \bar{A}) - c(A_{it})$. The error term $s_i + u_{it}$ has zero mean and variance $\sigma_s^2 + \sigma_u^2$. Estimation of (A3) provides consistent estimates of γ and the function g. By imposing a cohort effect using outside information, both h and c could be identified. The minimum variance estimator of s_i, the unobservable individual-specific effect, is given by

$$\text{(A4)} \qquad \hat{s} = \alpha(s_i + u_{it}),$$

where

$$\text{(A5)} \qquad \alpha = \frac{\sigma_s^2}{\sigma_s^2 + \sigma_u^2}.$$

Therefore, given values for σ_u^2 and σ_s^2, $\hat{\gamma}$ and c, permanent income may be constructed for each individual. With observations on earnings for only one year, it is not possible to obtain estimates of σ_s^2 and σ_u^2 as well as γ from (A3). A value of 0.5 for α was therefore assumed. This value was based on the results of studies which used longitudinal data to estimate the relative magnitudes of σ_s^2 and σ_u^2.[20]

The earnings equation (A3) was estimated for male household heads and for wives separately. Female-headed households were deleted from the sample because a substantial fraction of these were headed by elderly women, probably widows, and for them permanent income is determined primarily by the lifetime earnings of the deceased husband, for which no information was available.

Equation (A3) implicitly assumes individuals are in "full-time" employment and does not allow for systematic changes in labor supply resulting from spells of unemployment during part of the year. Hence the equation was estimated for all individuals whose annual earnings were greater than \$2,000. The sample selection bias induced by this truncation of the dependent variable was corrected for using the two-stage procedure proposed by Heckman (1979). Equation (A3) was estimated by OLS, with the inverse of Mills's ratio computed from a probit model of earnings greater or less than \$2,000 included as an additional explanatory variable, to give consistent estimates of γ and the g function. A discussion of the estimates can be found in King and Dicks-Mireaux (1982), and details of them are available on request.

For individuals included in the earnings regressions, permanent income is equal to the age-adjusted structural component of earnings given by observable variables, plus one-half of the residual in the earnings equation. For the excluded 1,873 male household heads, permanent income was predicted by the structural component alone. The same procedure was adopted for wives but with an explicit adjustment (based on educational attainment and the presence of dependent children) for nonparticipation in the labor force at various stages of the life cycle. By this method, the estimate of the permanent income of wives is independent of that of their husbands, and vice versa. In neither the probit nor earnings regressions of husbands or wives do explanatory variables pertaining to the spouse enter. It is not entirely obvious which characteristics of a spouse should affect the labor participation or earnings choice of the other. To the extent that some do, there is the more general problem of how to model this. Does the wife make her decision conditional on that of her husband, or vice versa? We choose to assume that these decisions are made independently.

Household permanent income is the sum of the estimates for husbands and wives. Mean estimated permanent income of men is $15,928 and of wives $7,451.

Notes

1. Strictly speaking, the relevant variables are the expected relative prices and inflation rate, which will in general differ across individuals. This source of variation is allowed for insofar as it can be explained by the observable individual characteristics included in the demand equations.

2. All computations on this data base were carried out by the authors and should not be attributed to Statistics Canada. Further details of the data base may be found in Statistics Canada (1979).

3. This is because

$$\sum_{j=0}^{J} {}_{J}C_{j} = \sum_{j=0}^{J} J!/[J!(J-j)!] = 2^{J},$$

which includes the combination owning zero assets.

4. In the context of a logistic distribution as applied to the ownership of consumer durables, Amemiya (1975) examines a three-good case and Billowes (1982) presents estimates for a model with six durables. In the latter case the number of dummy variables was too great to allow estimation of the model.

5. The estimated age-earnings profiles are those estimated for the purpose of constructing our measure of permanent income.

6. A brief summary of the evidence on pension plan indexation in Canada, and relevant references, can be found in Dicks-Mireaux (1981).

7. Other sources of information about the retirement income arrangements in Canada are Statistics Canada (1978) and Wolfson (1979).

8. This calculation differs as between three types of asset. For personal use property, such as personal and household effects, cars, boats, or cottages, gains are reported only if the proceeds of sale were more than $1,000. A gain on own homes is not taxed if the house was a principal residence. Listed personal property (works of art, jewelry, and collectors'

items) is similarly treated except that losses may be offset against gains where the original adjusted cost is greater than $1,000. All gains and losses on other capital properties must be reported. If the loss exceeds $1,000, the excess may be used to reduce taxable capital gains and other income in 1975, 1977, and future years. For business, farm, or professional equity and real estate (other than owner-occupied homes), capital cost or depreciation allowances are available. Rates for commonly held assets are 5% and 10% for buildings of brick and wood, respectively, 20% on machinery and equipment, and 30% on vehicles.

9. The American IRA and Keogh plans, before the 1981 change in the tax law, were only available to self-employed persons or those without company-sponsored plans.

10. Certain features of the tax law facilitate this optimizing behavior. Spouses may contribute to each others' RHOSP and RRSP, and unused portions of eligible deductions for interest and dividend income are transferable. This suggests that when deductions are not fully exhausted, and a husband's marginal tax rate is greater than or equal to his wife's, our procedure is appropriate.

11. A more detailed account is available on request from the authors.

12. In the case of Quebec the procedure is different, and allowance was made for this.

13. To compute a consistent estimate of the covariance matrix of the demand equations, we required the same sample to be used in both the probit and second stage of the estimation procedures. Consequently, households for which the asset share equaled unity were excluded from the probit model for that asset.

14. The insignificant negative effect of the tax rate on the probability of owning an RHOSP may partly be a problem of endogeneity, as the RHOSP deduction was incorporated in the calculation of the tax rate.

15. Home equity was chosen because of its large share in household portfolios. Consequently, any proportional errors in forecasting changes in its share due to its residual role will be reduced. Bonds, which are the most susceptible to measurement error in the survey, were not used because of their small share. In any event, as most of the predicted changes were of small magnitude, any errors are also small. Indeed, the difference between the change in the portfolio share of home equity predicted by the estimated equation and that calculated as a residual was typically no larger than ∓ 0.5 percentage points.

16. One may also ask whether, if the offsets were constrained to be similar across equations, the remaining parameter estimates would change significantly.

17. A disturbing factor in this exercise is that without imposing the adding-up constraint on the predicted portfolio of all assets, the share of home equity was only 9.3%. With only five assets the difference between the predicted and imposed share of home equity was only −5.2%.

18. The possibility of predicting negative aggregate portfolio shares of assets arises for the following reason. In predicting the new level of total assets at the level of the individual household, nothing in the model precludes negative holdings. This is more likely the larger the offset employed in the simulation. Consequently, although the predicted asset shares by construction must be positive, when they are multiplied by total household assets to get the value of each asset held negative values can arise. In the simulation performed the aggregate value of net worth and total assets after summing over households was always positive. However, the aggregate value of the decline in holdings of particular assets was in several cases greater than the initial value, and hence the predicted aggregate shares are negative.

19. This definition excludes the annuity value of receipts of gifts and inheritances, on which no data are available in our sample, and also "supernormal" profits (and losses).

20. These studies, which used United States data, were Lillard (1977), Lillard and Willis (1978), and Lillard and Weiss (1979). See King and Dicks-Mireaux (1982) for further discussion of this point.

Comment Alan J. Auerbach

In this chapter, Dicks-Mireaux and King have made an ambitious attempt to deal with a number of difficult empirical problems. For this, they are to be commended. Not surprisingly, perhaps, the ultimate findings are somewhat inconclusive. Nevertheless, many interesting issues arise along the way.

To estimate the effects of pension wealth on portfolio allocation, Dicks-Mireaux and King estimate both probit equations, to determine whether individuals hold particular assets, and share equations, given that they do. Before doing this, they must calculate many of the key explanatory variables, such as permanent income, pension wealth, social security wealth, and marginal tax rate. In each case, they demonstrate great attention to detail, doing an admirable job in light of the limitations in the raw data. However, many of these limitations are rather severe. It is unlikely that one could improve greatly on the accuracy of the calculations that Dicks-Mireaux and King perform, but it is also unlikely that some of their constructed variables are very accurate. For example, pension wealth of the working population is based on the pensions being received by current retirees with the same characteristics. Given the changes that have occurred over time in the coverage and nature of private pensions (the raison d'etre of this study, after all), this may be a problem. Likewise, the permanent income of women is adjusted for the fact that women in general do not work full-time over their lifetimes. However, the adjustment ignores the possibility of unobservable differences in participation among women with the same observable characteristics but different current participation behavior: two otherwise observationally equivalent women, one who works and one who doesn't, have the same predicted pattern of lifetime labor force participation. Presumably, variables relating to the husband's characteristics might be included here, although this would raise additional questions with which the authors, quite justifiably, prefer not to deal.

The arrival at the estimable equation (5) is preceded by a journey through combinatorics. Section 14.3 of the chapter shows just how difficult a task Dicks-Mireaux and King have undertaken. I would take issue with their ultimate estimation procedure for a couple of reasons. First, it is not clear why the logistic transformation is appropriate. The asset shares are bounded above and below by one and zero, as are probabilities, but the zero bound represents a constraint rather than a natural limit. Since we observe a truncated version of the underlying error distribution (for which the authors correct by inclusion of the inverse

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Mills's ratio from the relevant probit equation), why should the symmetry of the logistic distribution hold for the observed errors?

Perhaps a more serious problem with equation (5) is the inclusion of dummy variables for other positive asset holdings. To evaluate this procedure, we must know first how the error terms u_j are generated. If they come from allocation mistakes, or from individual-specific differences, one would expect them to be correlated across equations: if I buy more housing, I will buy less of all other assets. This means that the probability of holding other assets, and hence the dummy variables for such assets, may be correlated with the error term in (5). This would lead to inconsistent estimates of the coefficients C_{kj}.

Turning to the empirical findings, I find it somewhat difficult to interpret the separate effects of the different wealth income and wealth composition terms. According to equations (7)–(9), we should think of the coefficients of *SSW/Y* and *PPW/Y* as telling us the extent to which these two types of pension wealth are perceived as net household wealth in the sense analyzed by Barro. Meanwhile, the coefficients of *SSW/W* and *PPW/W* are intended to indicate the effects of wealth composition. However, this seems like an artificial distinction. For example, social security wealth, being less liquid, may not count fully as "real" wealth, but this would be the same reason for its effect on portfolio shares. Moreover, given the potential errors in calculating permanent income, wealth may be almost as good a measure of permanent income as the value used. As a result, it is not surprising that the implied wealth offsets from the equations are rather unbelievable.

The pension variables do appear to help in explaining whether individuals hold certain assets (table 14.4), but in the asset demand equations neither social security wealth nor pension wealth (divided by income or wealth) has a very significant effect. This is difficult to interpret, as are the coefficients for these wealth variables from specific equations.

Except for those simulations that use the wealth offset inferred from the asset demand equations using (9), the estimated effects of changes in pension wealth or social security wealth on portfolio composition are remarkably small. However, this outcome merely reflects the poor performance of these variables in the asset demand equations.

Perhaps the most valuable contribution of this chapter is its attention to modeling the portfolio behavior of typical investors, who often hold a small number of the assets available. While I have expressed reservations about some of the techniques used in this chapter, further work along these lines should be encouraged.

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