HOUSEHOLD WEALTH ACCUMULATION:

IMPACT OF TENURE CHOICE AND HOME EQUITY LOANS

by

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Abstract

The existing literature on household wealth accumulation has hitherto recognized the life-cycle effects, household socio-economic characteristics, bequest motives, and intergenerational transfers as important factors affecting household net wealth. The two empirical essays in this thesis expand the literature by emphasizing the likely roles that a household's tenure choice and home equity borrowing decisions have in its wealth accumulation process.

The first essay, entitled "Homeownership and Household Wealth Accumulation", tests whether homeownership has placed the owner household on a more favorable wealth accumulation path, based on past observations that the values of owner-occupied housing have grown at a real rate greater than those of financial or other tangible assets. The premise is that, while the tenure choice decision is affected by a household's net wealth, the housing tenure chosen could place a household on different wealth accumulation paths over its life-cycle. Controlling for selection bias arising from tenure status, the results indicate that typical homeowners and renters have distinct wealth accumulation processes. While homeownership improves the wealth position of homeowners, the renter households are, however, better off in their existing tenure than otherwise. It appears that households self-select themselves into the appropriate tenure that optimizes their wealth accumulation paths.

The second essay on "Household Consumption/Investment Behavior and Home Equity Loans" investigates which behavioral model underpins the homeowners' consumption and investment decisions of home equity loan funds, and how these decisions impact portfolio decisions and wealth accumulation. It concludes that the 'life-cycle model' and the 'precautionary savings model' prevail over the 'bequest motive model' in motivating the household

consumption/investment decisions of home equity loans. Home equity loans alter the illiquid nature of housing investment through convenient tapping of housing equity, and reduce household preference to hold liquid assets to meet precautionary needs. Their presence encourages loan users to hold smaller shares of liquid cash and financial assets in total assets, and to diversify from housing asset to business, real estate and illiquid nonhousing assets. They generally reduce homeowners' net wealth, reflecting a tendency for borrowed funds to be consumed or invested in loss-incurring assets.

TABLE OF CONTENTS

Abstract ii

Table of Contents iv

List of Tables vi

List of Figures vii

List of Appendices viii

Acknowledgements x

CHAPTER ONE
OVERVIEW OF THESIS 1
1.1 MOTIVATIONS 2
1.2 LITERATURE REVIEW OF IMPORTANT STUDIES 6
1.3 OUTLINE OF ESSAYS 10
1.4 IMPLICATIONS OF THE THESIS 15
1.5 LIMITATIONS OF THE ANALYSES 16

CHAPTER TWO
HOMEOWNERSHIP AND NET WEALTH ACCUMULATION 18
2.1 INTRODUCTION 19
2.2 LITERATURE REVIEW 25
2.3 MODEL OF WEALTH ACCUMULATION STRATIFIED BY TENURE STATUS 33
2.3.1 Wealth Accumulation by Homeowner Households 34
2.3.2 Wealth Accumulation by Renter Households 41
2.4 EMPIRICAL ESTIMATION 43
2.4.1 Methodology 43
2.4.2 The Database 51
2.4.3 Empirical Implementation 53
2.5 EMPIRICAL RESULTS 62
2.6 CONCLUSIONS 72
2.7 BIBLIOGRAPHY 78

CHAPTER THREE
HOUSEHOLD CONSUMPTION/INVESTMENT BEHAVIOR AND HOME EQUITY LOANS 99
3.1 INTRODUCTION 100
3.1.1 Background 100
3.1.2 Focus of Study 102
3.2 CONTRIBUTIONS OF THE PAPER 106
3.3 HOME EQUITY LOANS AND HOUSEHOLD NET WEALTH 108
3.3.1 Literature Review 108
3.3.2 Methodology 110
3.3.3 Database 113
3.3.4 Empirical Implementation 116
3.3.5 Results 126
3.4 HOME EQUITY LOANS AND CONSUMPTION/INVESTMENT BEHAVIOR 131
3.4.1 Literature Review 131
3.4.2 Methodology 134
3.4.3 Database 138
3.4.4 Empirical Implementation 139
3.4.5 Results 142
3.5 HOME EQUITY LOANS AND HOUSEHOLD PORTFOLIO DECISIONS 144
3.5.1 Literature Review 144
3.5.2 Methodology 150
3.5.3 Database 152
3.5.4 Empirical Implementation 153
3.5.5 Results 156
3.6 CONCLUSIONS 161
3.7 BIBLIOGRAPHY. 172

LIST OF TABLES

TABLE 2.1
EFFECTS OF TENURE CHOICE DECISION ON HOUSEHOLD NET WEALTH 50

TABLE 2.2
HOMEOWNERSHIP RATES FOR THE UNITED STATES, BY AGE OF HOUSEHOLDER: 1982 TO 1989 73

TABLE 2.3
2ND-STAGE OLS REGRESSION OF HOUSEHOLD NETWORTH (FULL SAMPLE) 74

TABLE 2.4
2ND-STAGE OLS REGRESSION OF HOUSEHOLD NETWORTH (FULL SAMPLE:SPECIFICATION INCLUDES 2 ADDITIONAL INDEPENDENT VARIABLES, INVRE & BROKACC). 75

TABLE 2.5
COMPARISON OF OWNERS' AND RENTERS' NET WEALTH POSITIONS UNDER EXISTING & ALTERNATIVE TENURE 76

TABLE 2.6
2ND-STAGE OLS REGRESSION OF HOUSEHOLD NETWORTH (REDUCED SAMPLE) . . . 77

TABLE 3.1
SUMMARY STATISTICS ON PORTFOLIO SHARES AND DOLLAR AMOUNTS OF VARIOUS ASSET GROUPS IN HOUSEHOLD PORTFOLIO 164

TABLE 3.2
OLS REGRESSION OF HOUSEHOLD NETWORTH. 165

TABLE 3.3
MULTINOMIAL LOGIT ANALYSES OF HHOLD CONSUMPTION/INVESTMENT BEHAVIOR WITH RESPECT TO HELOC AND 2ND MORTGAGE 166

TABLE 3.4
2ND-STAGE OLS REGRESSION OF SHATA 167

TABLE 3.5
2ND-STAGE TOBIT REGRESSION OF SCASTA 168

TABLE 3.6
2ND-STAGE TOBIT REGRESSION OF SBZRETA 169

TABLE 3.7
2ND-STAGE TOBIT REGRESSION OF SSTKBTA 170

TABLE 3.8
2ND-STAGE TOBIT REGRESSION OF SILQNTA 171

LIST OF FIGURES

FIGURE 2.1: REAL HOUSE PRICE INDICES OF US AND CANADA 20

FIGURE 2.2: LIFE-CYCLE OF OWNER HOUSEHOLD 35

FIGURE 3.1: IMPACT OF HOUSEHOLD BORROWING DECISION 103

LIST OF APPENDICES

APPENDIX 2.1
VARIABLE DEFINITIONS 78

APPENDIX 2.2
SUMMARY STATISTICS 89

APPENDIX 2.3
OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD LABOR EARNINGS 91

APPENDIX 2.4
OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD TRANSFER INCOME 92

APPENDIX 2.5
1ST-STAGE REDUCED-FORM PROBIT ESTIMATION OF TENURE CHOICE EQUATION . . 93

APPENDIX 2.6
OLS REGRESSION OF HOUSEHOLD NETWORTH BASED ON EQUATION 38 WITH INTERACTION VARIABLES 94

APPENDIX 2.7
1ST-STAGE REDUCED-FORM PROBIT ESTIMATION OF TENURE CHOICE EQUATION (FULL SAMPLE: SPECIFICATION INCLUDES 2 ADDITIONAL INDEPENDENT VARIABLES, INVRE & BROKACC) 95

APPENDIX 2.8
1ST-STAGE REDUCED-FORM PROBIT ESTIMATION OF TENURE CHOICE EQUATION (REDUCED SAMPLE: SPECIFICATION INCLUDES 2 ADDITIONAL INDEPENDENT VARIABLES, INVRE & BROKACC) 96

APPENDIX 2.9
DERIVATION OF THE INVERSE MILLS RATIOS 97

APPENDIX 3.1
VARIABLE DEFINITIONS 178

APPENDIX 3.2
SUMMARY STATISTICS 183

APPENDIX 3.3
USES OF HOME EQUITY LINES OF CREDIT, BY ORDER OF USE, 1987 187

APPENDIX 3.4
USES OF LIQUIDATED HOUSING EQUITY, BY TYPE OF LOAN 188

APPENDIX 3.5
USES OF BORROWED FUNDS, BY TYPE OF CREDIT, 1993-94 189

APPENDIX 3.6
OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD LABOR EARNINGS 190

APPENDIX 3.7
OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD TRANSFER INCOME 191

APPENDIX 3.8
OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD NET WEALTH 192

APPENDIX 3.9 193

APPENDIX 3.10
1ST-STAGE REDUCED-FORM PROBIT ESTIMATION 195

APPENDIX 3.11
2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF FIRST MORTGAGE 196

APPENDIX 3.12
2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF REFINANCED MORTGAGE 197

APPENDIX 3.13
2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF SECOND MORTGAGE . . . 198

APPENDIX 3.14
2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF THIRD MORTGAGE 199

APPENDIX 3.15
2ND-STAGE OLS REGRESSION FOR INITIAL MAXIMUM CREDIT ALLOWED ON ALL HELOCS 200

APPENDIX 3.16
1ST-STAGE REDUCED-FORM PROBIT ESTIMATION 201

APPENDIX 3.17 202

APPENDIX 3.18
EFFECTS OF HEL USAGE DECISION ON SHATA PORTFOLIO SHARE 206

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"My heart sings out in praise to Him." Doreen Chze-Lin Thang

CHAPTER ONE

OVERVIEW OF THESIS

CHAPTER 1

1 OVERVIEW OF THE THESIS

1.1 MOTIVATIONS

The existing literature on household wealth accumulation has hitherto recognized the life-cycle effects, household socio-economic characteristics, bequest motives, and intergenerational transfers as important factors affecting household net wealth. This dissertation comprises two empirical essays that emphasize the likely roles that a household's tenure choice and home equity borrowing decisions have in its wealth accumulation process.

The impetus for the first essay comes from a number of studies which affirmed the important influence that asset appreciation, in particular housing capital gains, has had on the household sector wealth. Peek (1983, 1986) observes that, over the 1951-1985 period, housing and land, non-corporate and corporate equities are the asset categories that accrue real capital gains. Peek establishes that each additional dollar of expected net capital gains on owner-occupied housing, land and net financial assets leads to an increment of eighty-nine cents in nonhuman wealth inclusive of net investment in consumer durables.

Similarly, Case and Cook (1989) illustrate that the 1980-1988 Boston property boom has created an enormous gap in the economic status between homeowners who bought their property before the price boom and those who did not. Those who bought earlier were better off than new homeowners or renters, as their housing cost burdens were substantially less. They also enjoyed a substantial increase in housing equity. Moreover, Holloway (1991) confirms that, over the 30-year period from 1960 to 1989, the real growth rate in the market value of owner-occupied housing is 4.1%, which is higher than those for financial assets (3.3%) and other tangible assets

(3.3%).

These studies raise an interesting question: "If the possession of a housing asset has resulted in an increase in the homeowners' net wealth arising from capital gains, does the tenure choice decision of the household affect its wealth accumulation path?" With housing asset(s) as the major component of a household's wealth portfolio, housing price appreciation may have produced an increase in the net wealth of homeowners, to the extent that the housing windfalls are not consumed. In the light of the findings from the above studies, a logical progression of the above postulation is that the maximization of a household's wealth could be one other motivation behind its tenure choice decision. This is the subject of the inquiry in the first essay on "Homeownership and Net Wealth Accumulation". The central hypothesis is that, while the tenure choice decision is affected by a household's net wealth, homeownership puts the owner household on a more favorable wealth accumulation path. The essay tests whether such a simultaneous relationship exists between tenure choice and net wealth accumulation.[1]

The examination of this question has important economic implications. Previous studies

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[1] Suggestions have been made that one could distinguish between two major hypotheses: "unconstrained sorting model" versus "constrained sorting model". The standard "unconstrained tax-based user-cost model" postulates that unconstrained households sort themselves into the appropriate tenure based on tax benefits, perceived household permanence and mobility. Household tenure decision is driven primarily by the tax-adjusted price of housing services acquired through homeownership relative to that of tenancy. Under this hypothesis, renters should not benefit in terms of wealth accumulation by choosing to own, but have self-selected into the appropriate tenure that optimizes their wealth accumulation path. The alternative "constrained sorting model" emphasizes the role of obstacles like credit constraints or racial discrimination that block households from their desired tenure modes. Under this hypothesis, some renters might benefit from being able to choose homeownership. However, to effectively distinguish between these two models, one needs to construct variables that capture the likely impact of credit constraints and racial discrimination. The 1989 Survey of Consumer Finances database is not amenable to the construction of variables that reflect credit constraint strictly related to home mortgage debt. At this juncture, the empirical test has been structured to merely test the validity of the first model, i.e., whether a simultaneous relationship exists between the household tenure choice decision and its wealth accumulation. This study is seen as an initial step towards distinguishing the two models. It is recommended that future research effort could include the refinement of the empirical implementation stage to test the validity of the second model too.

of household wealth have noted the existence of a wealth gap between blacks and whites, as evidenced by the low black-to-white wealth ratio ranging from 0.08 to 0.19.[2] In 1984, blacks owned only 3.0 percent of accumulated wealth and 4.4 percent of the total home equity in the United States, although they comprised 11 percent of all households.[3] Terrell (1971) indicates that racial differences in income cannot adequately explain the observed racial wealth disparity. Concern over the black-white differential in economic well-being continues today. Most studies of economic well-being have focused solely on income, but if wealth differences are greater than expected, then these studies will underestimate racial inequality, and policies that seek to narrow income differences to close the wealth gap may not adequately address the problem.

Given that the proportions of homeowners among black and white households in 1986 are 0.632 and 0.785,[4] respectively, the fact that housing capital gains accrue only to homeowners may provide some clues to explaining the racial wealth gap puzzle. Indeed, Krumm and Kelly (1989) provide empirical evidence that homeownership has significant positive impact on the level of household savings, suggesting the important role that housing tenure might have in explaining the savings differences between homeowners and renters. If homeownership improves the wealth position of a household, then Blau & Graham's (1990) policy suggestion of removing obstacles to homeownership would be one effective measure for improving the

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[2] Terrell (1971), Soltow (1972), Kain and Quigley (1972), Birnbaum and Weston (1974), Smith (1975), Sobol (1979), Blau and Graham (1990).

[3] Brimmer (1988).

[4] 1986 Current Population Survey, U.S. Bureau of the Census, Annual Demographic File; the Statistical Abstract of the United States: 1989, U.S. Bureau of the Census.

economic well-being of the households.[5] Policy-makers may well be advised to close the racial wealth gap by promoting higher homeownership rate. This argument provides the underlying motivation for the first essay, which tests whether the wealth accumulation process of the household is affected by its tenure choice decision.

The second essay, entitled "Household Consumption/Investment Behavior and Home Equity Loans", examines how the presence of home equity loans has affected household consumption/investment and portfolio decisions, which ultimately impact wealth accumulation. In addition to providing homeowners with the benefit of any housing capital gains accrual, homeownership also confers upon them the privilege of borrowing against the housing windfalls through home equity loans. Innovative home equity lines of credit (HELOC),[6] introduced in the early 1980s, greatly enhanced the ability of homeowners to conveniently tap this housing windfalls. They reduce consumers' transaction costs by eliminating the need to apply for approval each time an extension of credit is desired. The ease of tapping housing equity alters considerably the illiquid nature of housing investment, and may reduce the need for households to hold more liquid assets to hedge against portfolio risks arising from a highly undiversified portfolio. The previously locked-up housing equity can be conveniently released for consumption/investment or portfolio balancing purposes. The borrowed funds, if profitably invested rather than consumed, could further enhance the homeowners' wealth position. The

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[5] Possible barriers to homeownership could arise, for example, from stringent credit market conditions or racial discrimination in the housing and credit markets. Kain and Quigley (1972) attribute the lower probability of black homeownership to housing market discrimination. They speculate that this impediment to homeownership may explain, in part, the lower levels of black wealth accumulation at every income level. McDonald (1974), Roistacher and Goodman (1976), Ladenson (1978), Silberman, Yochum and Ihlanfeldt (1982), Yinger (1986), Munnell *et al.* (1992), and Duca & Rosenthal (1993) demonstrate that racial discrimination exists in both the housing and credit markets.

[6] Introduced in 1982, home equity lines of credit (HELOC) are revolving credit lines that allow homeowners to borrow against their home equity, at their discretion, up to the maximum credit permitted.

fundamental questions are whether these home equity loan funds are invested or consumed, and how they affect household portfolio decisions which ultimately influence wealth accumulation.

The issue of whether housing wealth is liquidated for consumption/investment or portfolio balancing purposes has important implications for aggregate savings and resource allocation among the various sectors of the economy. With households providing well over 90 percent of the aggregate net saving in the United States since 1951,[7] household wealth plays a key role in influencing national capital formation and economic growth. The composition of household saving crucially affects the allocation of the U.S. capital stock among household capital and industrial capital. The low level of U.S. national saving in the 1980s and the small share channelled to industrial capital have been issues of concern, largely because of their negative implications for economic growth.[8] If the presence of new home equity loan instruments, such as home equity lines of credit, does facilitate household consumption/investment decision or asset allocation in portfolio decision through their lower transaction costs, this finding will provide a basis for designing capital market instruments to achieve better re-allocation of locked-up resources in the housing sector to the other sectors.

1.2 LITERATURE REVIEW OF IMPORTANT STUDIES

This section highlights the key studies of household wealth accumulation, on which the dissertation is built. It provides the context for the discussion in this overview. Other studies will be discussed later in the separate literature review sections of each essay.

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[7] Patric H. Hendershott (1985).

[8] Feldstein (1977, 1983); Boskin (1983).

Although many studies have been conducted on various aspects of household wealth accumulation, there is a paucity of research analyzing the impact of housing tenure status on household wealth accumulation. While Case and Cook (1989) use hypothetical cases to analyze the extent to which the economic status of households are affected by the Boston property boom, Krumm and Kelly (1989) perform the first empirical test of the impact of homeownership on household net wealth accumulation in a simultaneous framework. Controlling for age, sex, education level, race, income, marital status, and tenure status as indicated by a dummy variable, they find that the predicted net wealth of the homeowner is almost double that of the renter with mean sample characteristics. Homeownership exerts a positive influence on the household's net wealth. Krumm and Kelly's results are further affirmed by Holloway (1991).

However, Krumm and Kelly's study does not stratify the sample into homeowner and renter subsamples. The owner and renter net wealth equations are distinguished in a single net wealth equation only by a dummy variable for homeownership and its interactive term with housing value. In constraining the two equations to have the same coefficients in the remaining explanatory variables, their study implied that the underlying wealth accumulation processes are the same for the homeowners and renters. The first essay questions the validity of such an assumption, and refines the empirical estimation by distinguishing between the homeowner and renter wealth accumulation processes.

The second essay proceeds to examine the household wealth accumulation process in the presence of home equity loan market, which allows liquidation of housing equity by households for consumption or investment purposes. Housing asset appreciation, acting in concert with the tenure decision, could affect household consumption/investment behavior which, in turn, affects

household wealth accumulation. The introduction of HELOC allows the liquidation of housing equity for household consumption or investment purposes with lower transaction costs. If housing windfalls liquidated through home equity loans are profitably invested rather than consumed, the household net wealth could be further enhanced. Summers and Carroll (1987) contend, however, that the growth in mortgage debt since 1980 has spurred consumer spending and depressed private savings. This assertion is supported by Manchester & Poterba (1989), who ascertain that refinanced and second mortgages have negative impacts on homeowner's net worth. The negative relationships suggest that a portion of home equity liquidated under the two forms of home equity loans has been used for consumption rather than investment purposes. The greater negative effect of second mortgages relative to that of refinanced mortgages implies a greater tendency for second mortgages to be applied to consumption purposes (or invested in assets incurring capital losses). The M & P work is the only study that examines the effect of home equity borrowing on household wealth. The analysis, however, excludes innovative home equity lines of credit (HELOC), as the 1984/85 database used predates the sharp growth in HELOC after 1986.

A later study by Skinner (1993a) affirms that housing windfalls increase consumption among middle-aged homeowners, and reduce a household's need for precautionary savings. The study highlights three models that could govern the household consumption/investment behavior with respect to housing windfalls. These are the 'life-cycle model', 'bequest motive model', and

the 'precautionary saving model'.[9] He concludes that the 'precautionary savings model' reconciles the empirical observation that households spend part of their housing windfalls while young, but typically do not tap into housing windfalls to finance consumption when old.

One aspect that is closely related to the household consumption/investment decision of home equity borrowings is the household portfolio decision. While extensive literature exists on household portfolio composition and the extent of diversification, there is relatively little work on how the presence of home equity loan instruments has affected household portfolio decisions. The linkage between mortgage debt and household portfolio decisions have only been recently explored by Manchester and Poterba (1989), and Jones (1993b, 1994a). Manchester & Poterba find some evidence of a link between mortgage debt and small business financing. Their study observes that households with higher mortgage debts have *larger* net holdings of business equity and other real estate and Individual Retirement Accounts (IRAs),[10] but have *lower* financial assets such as corporate stock/mutual funds and interest-bearing assets.

Jones (1993b) estimates that about half the mortgage debt of young U.S. households and about three-quarters of the older cohort's are used to finance nonhousing asset positions. The same study also discloses the prevalence of nonhousing portfolio objectives in mortgage debt

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[9] The life-cycle model depicts young households as partly consuming housing windfalls in the early stages of their life-cycle, saving during the productive life-stages, and drawing down the remaining housing equity to finance retirement consumption. In an extended life-cycle model with perfect reverse annuity mortgage market or zero psychic moving costs, households are likely to consume part of the housing windfalls, and decumulate housing equity over the remaining life-span. However, in the presence of large moving costs and absence of reverse mortgage market, household would not be able to consume housing windfalls while young, or to extract housing equity when old. In the bequest motive model, households are motivated to refrain from consumption with little drawdown on housing windfalls, in order to pass it along to the next generation. The precautionary saving model views housing wealth as a form of insurance against retirement contingencies, and predicts that housing equity is only cashed out in bad states (e.g., widowhood, decline in health, or income downturn).

[10] These are accounts with tax incentives enacted in 1981 to encourage private saving in the U.S.

demand of Canadian households. A subsequent study by Jones (1994a) provides further evidence that the demand for mortgage debt is positively linked to household asset preferences for vacation homes, closely held businesses and investment real estate.

The second essay extends the above works of Manchester & Poterba, Skinner and Jones, by examining the impact that the new HELOC instrument, with its attendant lower transaction costs, might have on household consumption/investment behavior, portfolio decision as well as household net wealth accumulation.

1.3 OUTLINE OF ESSAYS

The foregoing section discusses the motivations for this study, and reviews some key literature. This section outlines the focus, methods of investigation, findings and contributions of each essay in the thesis.

Essay 1:

The first essay tests the hypothesis that homeownership has placed the owner household on a more favorable wealth accumulation path, based on past observations that the market values of owner-occupied housing have grown at a real rate greater than those of financial or other tangible assets over the 30-year period from 1960 to 1989. The premise is that, while the tenure choice decision is affected by a household's net wealth, the housing tenure chosen could place a household on different wealth accumulation paths over its life-cycle due to the greater growth potential of the housing asset in the past.

This essay adopts an approach different from Krumm and Kelly's (1989) in examining the effect of homeownership on household net wealth. Stratifying the sample by tenure status,

it employs Maddala and Nelson's (1975) switching regression model with endogenous switching to address this question in a simultaneous framework. This approach has several advantages. It accounts for possible simultaneity that may exist between wealth accumulation and tenure choice decision. It corrects for selectivity bias by incorporating Heckman's (1976, 1979) two-stage probit/ordinary-least-squares method in the switching regression model. In addition, the stratification of the sample by tenure status allows any differences in owner and renter saving behavior to be reflected in the slope coefficients.

The empirical results indicate that, on average, homeowners generally have higher net wealth than renters. Homeowners and renters have different wealth accumulation processes, as indicated by different slope coefficients in the owner and renter net wealth equations. The hypothesis that homeownership has an impact on household net wealth is partially supported. Controlling for household characteristics, the study shows that the possession of a housing asset could have contributed to the accumulation of higher net wealth for homeowning households, subject to their being able to access homeownership. Homeowners are put on a more favorable wealth accumulation path than if they had otherwise chosen to be renters. However, this is not the case with renters. By comparing the conditional expected net wealth of renters under the two tenures, the study reveals that renters are better off in their existing tenure than as owners. Renters currently have higher than average expected net wealth. The above-average renter position is attenuated, when the study controls for confounding effects arising from the possession of other assets by the renters. The possession of other forms of real estate and financial assets helps to partly explain why renters are better off renting than owning. The results reveal, interestingly, that households self-select themselves into the appropriate tenure in which their wealth accumulation paths are optimal.

The self-selection may be based on household specific attributes that affect mobility and the perceived permanence of the household. For instance, households that are highly mobile are likely to rent rather than own their homes. Renting avoids the negative effect of high moving costs on household net worth. These renters can still achieve the same portfolio options available to homeowners through the possession of other real estate and financial assets. Thus, policies to increase homeownership rates among renters to improve their economic well-being may be inappropriate if homeownership places the current renters on a lower wealth accumulation path.

Essay 2:

The second essay examines the impact of the rapid growth of home equity loans on household consumption and investment behavior, portfolio decisions, and net wealth accumulation. It broadens the scope of research on home equity loans. The essay focuses on three specific questions:

(1) Has the accessibility to home equity loans increased or decreased household savings?

(2) Is household consumption/investment behavior with respect to home equity borrowing governed by the life-cycle model, bequest motive model, or precautionary savings model?

(3) Have home equity loans affected household portfolio decisions?

The first question expands Manchester & Poterba's (1989) study by incorporating innovative capital market instruments such as HELOC. It fills the gap in the M&P analysis which excludes HELOC. It also controls for simultaneity between net worth and home equity loans, by incorporating loan proxies obtained from Heckman's (1976) two-stage probit/ols estimation method into the final ols estimation of net worth. The first-stage probit analyzes the household decision of whether to obtain any home equity loans, while the second-stage ols

regressions determine the loan amounts held by the households conditional on the decision to borrow. The loan proxies are then used in the final ols regression for household net wealth. Coefficients of the loan proxies measure the effect of home equity loans on household wealth accumulation.

In analyzing the second question, the study expands the existing literature that has hitherto examined the quantitative aspect of the household consumption decision. Using aggregate or household consumption outlays, the existing studies have analyzed the factors influencing the consumption decision. The second question focuses on the behavioral aspect of the household consumption decision. The study uses the multinomial logit (MNL) analysis to determine which of the three underlying behavioral models affects the household decision to use home equity borrowings for one of three mutually exclusive primary purposes: housing investment, nonhousing investment, or nonhousing consumption. The knowledge of the motivating forces behind household consumption and investment behavior at the micro level is fundamental to understanding aggregate consumption/investment behavior arising from the household sector. For instance, if the life-cycle model prevails in motivating household consumption/investment behavior, demographic shifts would presumably have a significant impact on the aggregate saving rate.

With the growing importance of HELOC, the analysis of the third question would contribute to a better understanding of how capital market innovations impact household portfolio decisions. To examine the third question, Maddala's (1983) two-stage probit/tobit estimation method is employed to evaluate the impact of home equity borrowing on the various portfolio asset shares in total assets. Predicted likelihood of using home equity loans, obtained from the

first-stage probit analysis of household decision of whether to borrow, are used in the second-stage tobit estimation of different asset shares. The paper examines the extent to which home equity loan users actively manage their portfolios, shifting part of real housing gains induced by house price changes to other asset forms, either to reduce portfolio risks through diversification, or to increase their expected wealth position.

The results of the second essay indicate that home equity loans reduce household net wealth, reflecting a tendency for the borrowed funds to be applied to consumption, or to investments generating net losses. In investigating which behavioral model motivates the household consumption/investment behavior with respect to home equity loans, this study concludes that the 'life-cycle model' provides the best description of the household behaviour. The 'precautionary saving model' is partially supported, but the 'bequest motive model' is not corroborated. The availability of home equity loan instruments does affect household portfolio decisions. As households are able to conveniently draw on their home equity lines of credit, their desire to hold liquid assets to hedge against portfolio risks arising from a highly undiversified portfolio is reduced, as reflected in lower shares of cash and financial assets. Home equity loan users do engage in active portfolio management, as they shift part of housing equity into other assets. Households reduce their housing share in total assets, and channel the home equity funds into business/other real estate assets and illiquid nonhousing assets. However, loan-holders appear to be cautious by not overextending themselves in borrowings to invest in financial investments. The tendency to channel home equity loans into business/other real estate rather than financial assets could also reflect the market preference of lenders to have their loans collaterized by tangible rather than paper assets.

1.4 IMPLICATIONS OF THE THESIS

The findings in the thesis have broader implications. While it is a noble goal of policy makers to promote higher homeownership rates with the objective of closing the wealth gap, it may have to be carefully evaluated against any private costs incurred by renters induced into homeownership. A policy to encourage renters to become homeowners may hurt such families if the current renters can accumulate more wealth in their current tenure status relative to homeownership. Presumably, unless government policies force families to own, families will choose the tenure that maximizes their utility. If homeownership places current renters on a lower wealth accumulation path, policies to promote movements of renters to homeownership would have to subsidize, or compensate, families for such a move.

There is evidence that home equity lines of credit facilitate portfolio balancing decisions of households. This implies that financial instruments could be designed to affect resource allocation and increase efficiency in the capital market by reducing transaction costs. The prevalence of the 'life-cycle model' as the behavioral model motivating household consumption/investment of home equity loans also implies that a demographic shift may be an important factor in determining aggregate saving, as life stages affect the likelihood that the borrowed funds are consumed or invested. Based on the results which indicate a negative impact of home equity loans on household wealth accumulation, the current trend towards the increased usage of home equity loans is likely to depress aggregate savings in the future, thus affecting economic growth.

1.5 LIMITATIONS OF THE ANALYSES

In the absence of variables that control for the effects of credit constraints and racial discrimination, the results for the first essay could not distinguish between the "unconstrained tax-based user-cost model" and the "constrained sorting model". The former depicts unconstrained households making tenure choice decision based on after-tax user costs, perceived household permanence and mobility, while the latter considers tenure sorting in the presence of credit constraints and racial discrimination. The results could possibly reflect a "second best" situation for renters who optimize their wealth accumulation path within the constraints existing in the housing and credit markets. To effectively distinguish between the two models, one needs to consider the wealth positions of the renters under the constrained and unconstrained scenarios. In the case where controls have been made for credit constraints and racial discrimination effects in tenure decision, and renters are still found to be better off in terms of wealth accumulation being renters than otherwise, the unconstrained sorting model is then corroborated. Consequently, credit constraints and racial discrimination issues are irrelevant in the tenure and wealth maximization decisions.

However, the 1989 SCF is not amenable to the construction of variables that reflect credit constraint strictly related to home mortgage debt. Although there were questions asked as to whether the respondents have been turned down or dissuaded from applying for credit over the last five years, these are in relation to credit in general, rather than to housing mortgage debt. Until such measures with respect to housing loans are available, we may have to be content with the main findings that a simultaneous relationship exists between tenure choice and net wealth accumulation, and that households have self-selected themselves into the appropriate tenure that maximizes their wealth accumulation paths.

The 1989 SCF also does not have information on the past tenure history of the family to permit a longitudinal analysis of the household wealth positions before and after a change in tenure status. A panel database would have been more appropriate for such analyses. Unfortunately, existing panel databases do not have comprehensive balance sheet information on household wealth as those provided in the 1989 SCF. This is also the case for essay two, wherein the effects of the *existence*, rather than the usage, of home equity loans could have been better analyzed with panel data that tracks household wealth and wealth portfolio composition before and after home equity lines of credit become popular as an additional capital market instrument for liquidating housing windfalls.

To preserve the anonymity of the survey participants, the 1989 SCF does not disclose information on the residence location of the household as earlier surverys did. As a result, it is not possible to construct location-specific constant-quality housing price variable as well as variables reflecting the marginal tax brackets of the household. While the omission of the price variable is not an issue in the first essay, the presence of tax variables to capture the full impact of federal and state tax laws impinging on the household borrowing and portfolio decisions would have been ideal. For the analysis on household portfolio decisions in the second essay, we have then to rely on King and Leape's (1984) evidence that marginal tax rates are a significant determinant of asset ownership, but *not* of the asset share.

CHAPTER TWO

HOMEOWNERSHIP
AND
NET WEALTH ACCUMULATION

CHAPTER 2

2.1 INTRODUCTION

The central hypothesis of this empirical paper is that a household's net wealth accumulation is influenced by its tenure choice decision. The premise is that, while the tenure choice decision is affected by a household's net wealth, the housing tenure chosen could place a household on different wealth accumulation paths over its life-cycle, based on past observations that the values of owner-occupied housing has grown at a real rate greater than those of financial or other tangible assets. Specifically, the paper tests in a simultaneous framework whether the access to homeownership has placed the owner household on a more favorable wealth accumulation path.

Recent empirical studies have recognized the causal link from net worth to tenure choice. Birnbaum and Weston (1974) reveal that net wealth and current income positively affect the probability of homeownership by blacks and whites.[11] Jones (1989, 1990, 1993a) demonstrates that, in the presence of capital market imperfections, the household's current nonhuman wealth (not lifetime wealth or permanent income) plays a dominant role in facilitating the transition from the renter to the homeowner status. Unless a household has accumulated enough savings for the required downpayment, it is discouraged from homeownership.

The causal flow from net worth to tenure choice is, however, only one perspective of the relationship between homeownership and net wealth accumulation. The causal flow could take

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[11] Birnbaum and Weston (1974) suggest that the exclusion of the wealth variable could have led to a doubtful conclusion by Kain and Quigley (1972) that the lower probability of homeownership by the blacks is evidence of housing market discrimination. Without wealth considerations, they found that whites do appear to have a higher probability of homeownership. When wealth effect is allowed for, it is possible that blacks may have a *higher* probability of owning a home than do "equivalent" whites.

place in the reverse direction. For many households, particularly the younger ones, the housing asset constitutes a major component of their wealth portfolio. Past unanticipated housing price appreciation, exceeding the returns on financial assets in some periods, accrues to existing homeowners and may enhance their level of net worth relative to that of renters. As shown in Figure 2.1 which depicts the movement of *real* house prices for both the United States and Canada between 1950-1989,[12] the U.S. trajectory peaks in early 1950s after the wars, as well as around 1980. It can be seen that the 1975-1980 period experienced the greatest growth in real house prices. The purchase of a housing asset prior to this peak growth period would result in an unexpected increase in the home equity, and hence, its current net worth.

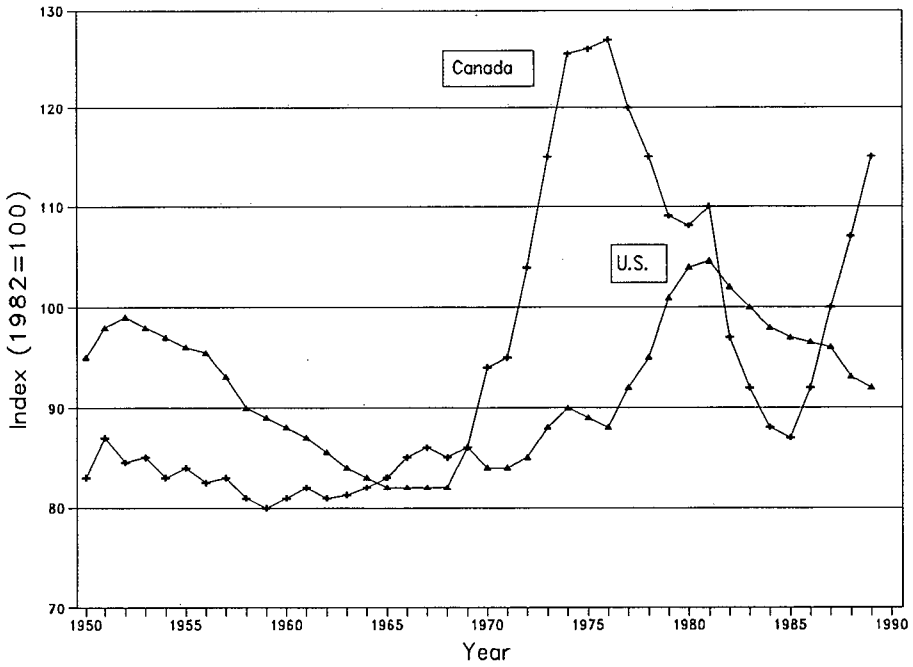

FIGURE 2.1: Real House Price Indices of US and Canada
Source: Engelhardt and Porteba (1991), Fig. 1, page 540.

[12] Engelhardt and Porteba (1991), Figure 1, page 540.

In a study exploring the distributional effects of housing price booms in Boston between 1980 to 1988, Case and Cook (1989) illustrate that the boom has created an enormous gap in the economic status between homeowners who bought their properties before the price boom and those who did not.[13] In another study using macro data from the Flow of Funds Accounts, Holloway (1991) confirms that the market value of owner-occupied housing in the household sector net worth increased more rapidly than other asset categories between 1960 to 1989. During this period, the *real* growth rate in the market value of owner-occupied real estate asset is 4.1%, which is higher than those for financial assets (3.3%) and other tangible assets (3.3%).[14] Growth was particularly rapid in the 1970-1980 subperiod, when the rate of increase was more than double those of financial and other tangible assets. Capital gains arising from home price appreciation account for much of the changes in home equity. In view of the rapid growth in the market value of housing asset relative to those of other assets, the pertinent question is whether households have been motivated to invest in housing asset on the basis that it would improve their wealth position? In other words, does household tenure choice decision have any impact on household savings process, thereby creating a simultaneous relationship between tenure decision and net wealth accumulation? This paper addresses this question, using the 1989 Survey of Consumer Finances database.

There is a paucity of research analyzing the impact of housing tenure status on a household's net wealth. Krumm and Kelly's (1989) research represents the first attempt at

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[13] The annual nominal increase in house prices in Boston averaged 13.3 percent, with the greatest growth rate of 40 percent between 1984 and 1985. Median housing prices doubled between the beginning of 1984 and mid 1987.

[14] Holloway (1991), Table 1, page 39. Over the 30-year period from 1960 to 1989, *net home equity* component grew at the same real annual compound growth rate of 3.2% as other remaining asset component of net worth. However, between 1970-80, net home equity component was growing at a greater compound rate of 7.3% compared to 2.7% for the remaining net wealth component.

examining the causal effects of homeownership on household wealth accumulation in a simultaneous equation framework. Controlling for age, sex, education level, race, income, marital status, and tenure status, they find that the predicted net wealth of the homeowner is 1.95 times that of the renter with mean sample characteristics. However, the study does not stratify the sample into homeowner and renter subsamples. In using a single net wealth equation, their study differentiates between the homeowner and renter net wealth equations only by the shift parameters of the dummy variable for homeownership, d_i, and of its interactive term with housing value, $d_i V_i$. Both equations are constrained to have the same coefficients in the remaining explanatory variables, thereby implying similar underlying savings processes for the homeowners and renters.

This paper adopts a different approach in investigating the effect of homeownership on a household's net worth. Using Maddala and Nelson's (1975) switching regression model with endogenous switching, it estimates the net worth of households stratified by tenure status, and examines the effect of the tenure decision on their net worth. The approach has several benefits. It accounts for possible simultaneity that may exist between wealth accumulation and tenure choice decision. It corrects for selectivity bias by incorporating Heckman's (1976, 1979) two-stage probit/ols method[15] into the switching regression model. In addition, the stratification of the sample by tenure status allows any differences in owner and renter saving behavior to be reflected in the slope coefficients. Based on past observations that net home equity has in some period grown at a rate greater than that of other net wealth components, and that owner-occupied

[15] The same procedure was suggested by Lee (1976), and applied in the estimation of housing demand by Lee and Trost (1978), Rosen (1979), and Goodman (1988).

housing asset has grown at a real rate greater than that of other assets between 1960-1989,[16] this paper tests the hypothesis that homeownership has a positive impact on the household's net wealth, even after controlling for household income, life-cycle effects, intergenerational transfers, and the bequest motive.

The empirical results indicate that the underlying wealth accumulation processes are inherently different for typical homeowner and renter households possessing net wealth in the range of minus $1 million to $5 million. The owner and renter net wealth equations have distinctly different slope coefficients. The actual mean and median net wealth of owners are much higher than those of renters. While homeownership may have contributed to a higher level of net wealth for homeowning households, it is not the case for renters. Based on comparison of their expected net wealth under the two tenures, this study reveals that the renters are better off in their existing tenure than otherwise. Renters currently have higher than average expected net wealth being renters rather than being homeowners. Controlling for possible confounding effects arising from ownership of other forms of real estate and financial assets, further analysis shows that the initial results of renters currently having higher than average expected net wealth is attenuated. Even then, these households are still better off being renters rather than as owners. They could in effect achieve similar portfolio options as homeowners to some extent[17] through

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[16] It is the relative rates of growth of different household wealth components that is relevant in analyzing if the possession of housing asset has favorably affected household wealth accumulation. The 7.3% real growth rate of *net home equity* in the 1970-80 period is much higher than the 2.7% growth rate of the remaining wealth component. It is also higher than its 30-year average rate of 3.2% over the 1960-89 period. The higher net home equity growth rate implies that the market value of the housing asset has increased at a greater rate than that of mortgage debt secured against it for consumption or investment purposes. The consumption of housing windfalls may, however, reduce its positive impact on household net wealth.

[17] It is noted that owner-occupied housing and other forms of real estate may not be perfect substitutes, as owner-occupied housing enjoys some tax advantages not accorded to the latter asset group. These tax advantages are capital gain tax deferment and non-taxation of imputed rents. Investment real estate has other tax advantages, e.g. tax deductibility of depreciation, and in the U.S., like-for-like exchanges.

the possession of other real estate and/or financial assets, while renting.

There are some suggestions for why some households are better off being renters rather than as owners. The socio-economic characteristics of some renters, e.g., high mobility, may have encouraged them to choose the renting tenure in which the wealth accumulation process is optimal for them. As homeowners have to pay legal and realtor fees, which renters do not incur at the time of their move, highly mobile families would prefer to rent than to own their homes. This is to avoid the negative impact on their net wealth due to the high costs of home sale upon each move. This explanation concurs with Rosenthal's (1988) findings that the tenure choice decision is influenced by a household's intended residence time. Families with longer residence times (i.e., more immobile families) have a greater propensity to own. It is argued that the decline in the discounted value of legal/realtor fees with length of residence reduces the relative cost of owning-to-renting in the tenure choice decision, thus encouraging homeownership.

While homeowners may have been motivated to improve their wealth position by investing in housing asset in response to the excessive capital gains derived from a greater growth rate of housing market values relative to other assets, it appears that renter households self-select into the renting tenure based on their socio and economic characteristics, so that they are better off in terms of net wealth accumulation in their respective tenure choices than otherwise. There are policy implications arising from the empirical results. While it is understandably a noble goal of policy-makers to encourage increased homeownership rate among renters, it may not be in the renters' best interest if homeownership places the current renters on a lower wealth accumulation path.

The rest of the paper is organized as follows. Section 2.2 reviews relevant research works on the life-cycle models of net wealth accumulation, and the role of homeownership on net wealth accumulation. Section 2.3 provides a conceptual framework that depicts the different wealth accumulation processes of the homeowner and renter households. Section 2.4 describes the database employed in this study, and discusses the methodology used in the empirical estimation of the homeowner's and renter's net wealth. Section 2.5 presents the estimation results, and Section 2.6 concludes. Section 2.7 contains the bibliography for this first essay.

2.2 LITERATURE REVIEW

Early macro studies focus on the distributions of net wealth,[18] and analyze the trend or changes in the household sector net wealth using aggregate data such as the national income or the flow of funds accounts.[19] Extensive research has been conducted on the life-cycle hypothesis of wealth accumulation.[20] With greater availability of micro databases, the scope broadens to include analyses of household wealth portfolio composition.[21] Recent research has identified intergenerational transfers and bequest motives as additional important factors influencing household savings.[22] The impact of capital gains on household sector wealth and

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[18] Atkinson and Harrison (1978), Wolff (1983), Cartwright and Friedland (1985), Smith (1975,1987), Greenwood (1987), McDdermed, Clark, and Allen (1989).

[19] Lansing and Sonquist (1969), Wolff (1989), Auerbach and Kotlikoff (1989).

[20] Modigliani and Brumberg (1954), Modigliani and Ando (1957,1960), Ando and Modigliani (1964), Landsberger (1970), Atkinson (1971), Deaton (1972), Modigliani (1975), Shorrocks (1975), Blinder, Gordon and Wise (1980), Wolff (1981), Kennickell (1984), Ando and Kennickell (1987), King and Leape (1987), Jianakoplos, Menchik, and Irvine (1989).

[21] Uhler and Cragg (1971), Pearl and Frankel (1981), Shorrocks (1982), King and Dicks-Mireaux (1982), Bhatia (1983), King and Leape (1984), Avery, Elliehausen, Canner and Gustafson (1984a, 1984b), Kane (1985), Avery and Elliehausen (1986), Avery, Elliehausen, and Kennickell (1988), Ioannides (1988, 1989), Curtin, Juster, and Morgan (1989), McNeil and Lamas (1989).

[22] Blinder, Gordon & Wise (1980), Kotlikoff and Summers (1981), Kotlikoff (1988), Horioka (1988), Hayashi, Ando and Ferris (1988), Hurd and Mundaca (1989).

aggregate personal savings behavior has also been highlighted by a number of studies.[23] In general, the literature has held that household income, life-cycle effects, intergenerational transfers, the bequest motive, and asset appreciation are factors that affect household net wealth accumulation. Only recently, Krumm and Miller (1986), Krumm and Kelly (1989), Case and Cook (1989), and Holloway (1991) focus on the role of homeownership on household net wealth. With this literature overview as the backdrop, the following discusses the relevant literature in greater detail.

A major strand of literature underpinning most wealth accumulation studies relates to the life-cycle theory of savings.[24] According to the theory, planned wealth accumulation arises from the desire of individuals to smooth their pattern of consumption over their lifetime. Wealth is accumulated during the productive working years to finance consumption during retirement. The key feature of life-cycle savings models is a "hump-shaped" pattern for the wealth-age profile, which increases during the working lifetime but declines in later years. Other than retirement needs, households may have a precautionary motive to hold a nonzero stock of nonhuman wealth to hedge against unexpected fluctuations in their income and obligations.

Empirical findings on the life-cycle hypothesis of savings are mixed. Earlier surveys of household behavior have generally confirmed the existence of the hump pattern.[25] Shorrocks

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[23] Bhatia (1970), Budd and Seiders (1971), Jianakoplos (1983), Wolff (1979), Peek (1983,1986), and Hendershott & Peek (1985a, 1985b), Skinner (1989) and Kopcke, Munnell, and Cook (1991).

[24] Modigliani & Brumberg (1954), and Modigliani & Ando (1957) are the first two papers that formulated the life-cycle theory of savings.

[25] Modigliani and Ando (1957).

(1975) provides some U.K. evidence that the pattern for lifetime ownership of assets is hump-shaped, but this is apparent only after making adjustments for differential mortality rate of the rich.

Other studies have rejected the hump-shaped wealth-age profile. Atkinson (1971), and Atkinson and Harrison (1978) have found no tendency for wealth to decline with age in the United Kingdom. Kennickell (1984) as well as Ando and Kennickell (1987) examine US evidence from 1960 to 1983. They conclude that there appears to be very little dissaving after retirement, if net worth is defined to exclude social security program and private pension wealth. The latter study shows that the life cycle theory is only partially supported by evidence in the United States (depending on the definition of net worth), and even less so in Japan.

King and Dicks-Mireaux (1982) have attributed the contrasting conclusions of earlier studies to the effect of differences in permanent income. Controlling for differences in permanent income, they observe that the ratio of wealth to permanent income *declines* after retirement.[26] The ratio attains a maximum value of 4.56 in the age bracket 60-64. However, the rate at which wealth declines after retirement is less than that predicted by a basic life-cycle model with neither bequests nor uncertainty about date of death.[27] The life-cycle model could account for only 50% of the variations in the wealth-permanent income ratio. It may not apply to certain groups of people in the population, in particular, those with negative and low (but positive)

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[26] Blinder *et al.* (1980), and Diamond and Hausman (1980) controlled for the effects of permanent income, but found results which were not supportive of the life-cycle model of wealth accumulation.

[27] This 'elementary' form in Modigliani, F. (1975) is based on the assumptions of the absence of bequest motive, and subjective certainty about future labor income, rate of return on assets and length of life.

levels of net worth. The observed levels of wealth, which exclude pension or social security wealth, do not correspond with the life-cycle view of a rational behavior of providing adequate resources for retirement.[28] King and Dicks-Mireaux suggest that bequest motive or uncertainty about date of death is likely to have some role in explaining the remaining variations in wealth holding.

Hayashi, Ito and Slemrod (1988) and Horioka (1988) concur with King and Dicks-Mireaux (1982) on the potential importance of the bequest motive on saving behavior. Their studies suggest that the large gap between the aggregate private saving rates of the United States and Japan could be attributed to the strong bequest motive of Japanese households.

The most recent evidence of wealth decumulation by the aged is presented by Hayashi, Ando and Ferris (1988) in a study of U.S. and Japanese households.[29] Affirming the life-cycle theory, their results indicate that U.S. households after retirement *dissave* about one-third of their peak wealth by the time of their death, leaving the rest mainly in the form of housing equity as bequests. Wealth declines with age after age 65 or so. Contrasting results arise in the case of the Japanese households. The study finds that the elderly Japanese continue to save toward the end of their life.

Other than life-cycle factors and bequest motive, the social characteristics of a household could influence its wealth position. Terrell (1971), Soltow (1972), Kain and Quigley (1972),

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[28] Allowing for social security and pension wealth result in higher decumulation rate after retirement.

[29] They employ a more reliable micro-level database from the 1983 Survey of Consumer Finance for the United States, and the 1984 National Survey of Family Income and Expenditure for Japan.

Smith (1975), Sobol (1979), and Blau and Graham (1990) examine the differences in the wealth position of black and white Americans. These studies report that on average, black households have less wealth than the whites. The ratio of black-to-white wealth ranges from 0.08 to 0.19. Terrell's (1971) study indicates that racial differences in income cannot explain sufficiently the observed wealth disparity.

The disparity could be attributed to the different set of investment opportunities that are available to the household, as indicated by Birnbaum and Weston (B & W, 1974). The B & W study discovers that blacks and whites have different investment behavior. Blacks consistently invest more in housing, than do whites at every income or wealth level. The proportion of home equity in total wealth held by homeowning blacks is about 1.5 to 2.8 times the proportion held by the whites over various income ranges.[30] When the households are classified by wealth and race categories, the results again indicate that the housing component in the black homeowners' portfolios is 1.2 to 1.5 times that of the whites at every wealth level. Indeed, 72 percent of black homeowners' wealth is held in home equity, while whites invest only 35 percent of their wealth in housing. This is the case, despite the fact that whites in the sample are more likely to own their homes (59 percent as against 39 percent for blacks), and that whites hold about 2.4 to 4.5 times the wealth of blacks as of 1966/67. Birnbaum and Weston attribute the investment differences to a smaller set of investment opportunities for blacks owing to limited information flow from reduced social and business contacts arising from racial discrimination.

The 1966 black-white wealth situation seems to carry over through the 1970s. Blau and

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[30] Birnbaum and Weston (1974) found an inverted U-shaped relationship between the percentage of wealth held in home equity and income in their data.

Graham (1990) concur with Birnbaum and Weston (1974) that while young black families, on average, hold only about 18 percent of the wealth of young white families, they hold a *higher* proportion of their wealth in car and home equity, and a *lower* proportion in net liquid and net business assets. Home equity is 62.5 percent of household wealth for blacks as against 47.4 percent for whites. The study reckons that, although income difference is the largest single factor explaining racial differences in wealth, as much as three quarters of the wealth gap still remains unexplained, even after controlling for other demographic and locational characteristics.[31]

Blau and Graham speculate that racial differences in intergenerational transfers and, to a lesser extent, possibility of barriers to the accumulation of business and housing wealth among blacks are likely to play a role in influencing household wealth holding. The likely role of differences in intergenerational transfers is affirmed by the estate records for deceased persons in 1967 in Washington, D.C., which show that the mean net worth for deceased black males was less than one sixth of white male net worth [Smith (1975)]. The younger black generation is less likely to have inherited an equivalent amount received by the whites, thus affecting their wealth holding. The importance of intergenerational transfers in the process of wealth accumulation is highlighted in Kotlikoff and Summers (1981), and Kotlikoff (1988). Both studies consider intergenerational transfers to be the major factor determining wealth accumulation in the United States.

The life-cycle theory, bequest motive, socio-economic and demographic characteristics of the household, differences in investment opportunities and intergenerational transfers only

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[31] There is, however, no control for tenure status.

explain part of the wealth accumulation story. Household wealth is also influenced by its portfolio composition through changes in the real value of assets held by the household [Peek (1983, 1986)]. These changes can be categorized into:

(1) capital gains (or losses) on assets, and

(2) net acquisitions of assets (sales and new purchases net of depreciation, less changes in liabilities).

The importance of net capital gains component in the consumption/saving behavior is affirmed by Peek (1983). He demonstrates that, while the omission of net capital gains effect is not critical for studies of the consumption/saving behavior before the mid-1960s, net capital gains do have significant effects on personal saving in the later period till 1977. Each additional dollar of expected net capital gains on owner-occupied housing, land, and net financial assets leads to an increment of eighty-nine cents in nonhuman wealth inclusive of net investment in consumer durables.

Peek (1986) indicates that in 21 of the 35 years from 1951 to 1985, household sector net capital gains were positive. In 11 of those years, total capital gains exceeded personal savings. In examining the changes in the real values of eight asset and liability categories over the 1951-1985 period, Peek verifies that housing and land, non-corporate and corporate equities tend to accrue real capital gains. Durables, life insurance and pension fund reserves, deposits, credit market instruments, and financial liabilities show consistent real capital losses.[32] Thus,

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[32] Peek (1986), Table 1, page 28. Non-corporate equity includes both equity in non-corporate business (partnerships and small proprietors) and nonprofit plant and equipment. Credit market instruments included U.S. government securities, state and local obligations, corporate and foreign bonds, open-market paper, mortgages, security credit, and miscellaneous assets.

differences in the household investment behavior as identified earlier in Birnbaum & Weston (1974) and Blau & Graham (1990) could result in different wealth portfolio composition, influencing its wealth accumulation process.

In view of past real capital gains accrued on housing as identified by Peek (1983, 1986), the possession of housing asset could have placed the household on a more favorable wealth accumulation path.[33] Krumm and Kelly's (1989) research represents the first attempt at examining specifically the causal effects of homeownership on household's total and nonhousing net wealth in a simultaneous framework. They employ Heckman's (1978) simultaneous equations system method to obtain consistent parameter estimates for their net wealth regression equations. Their wealth equations include a dummy variable for homeownership (d_i), and an interactive variable between d_i and home value V_i denoted as $d_i V_i$.[34] The coefficients of d_i in both nonhousing and total net wealth equations are found to be significantly *negative*, while those of $d_i V_i$ are significantly *positive*. Taken on its own, the negative coefficient of d_i would imply an adverse effect of homeownership on net wealth, if not for the counteracting positive effects of $d_i V_i$. Based on a specification that includes both d_i and $d_i V_i$, the predicted total net wealth of homeowner relative to renter with mean sample characteristics is 1.95 times that of the renter. The overall effect of homeownership, despite the counteracting forces, is still a positive influence on the household's net wealth. Krumm and Kelly's results are affirmed by Case and

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[33] Hendershott & Peek (1985a) find that, while many of the observed portfolio shifts are consistent with the passive acceptance of specific asset capital gains, households have in some instances chosen to actively respond to such portfolio shocks. In such cases, the household net wealth position would reflect the net effect of any active portfolio management.

[34] In model specifications which assume feedback from tenure decision to net wealth, predicted values from reduced-form estimation of d_i and $d_i V_i$ are used in place of observed values in wealth regressions to deal with the simultaneity problem.

Cook (1989) and Holloway (1991), who highlight the positive effect of home price appreciation on household wealth.

To summarize, the existing literature has held that life-cycle effects, bequest motives, household socio-economic characteristics, past inheritances, and differential rates of returns from various assets (including accruals of capital gain or losses) are factors that influence household wealth accumulation. This paper postulates that, in addition to the factors discussed above, the tenure choice decision could influence the household wealth accumulation process. It analyzes household wealth holdings stratified by tenure status.

2.3 MODEL OF WEALTH ACCUMULATION STRATIFIED BY TENURE STATUS

This section provides the conceptual framework for examining the wealth accumulation processes of the owner and renter households. Since the principal contribution of this paper is empirical in nature, the theoretical discussion here is meant to better motivate the empirical section, rather than make a theoretical innovation. It merely highlights how the possession of a housing asset impacts the household wealth accumulation process through, principally, the user cost and the housing capital gain components. Where the housing asset return exceeds those of nonhousing assets in some periods and the relative user costs of owning-to-renting is lower arising from tax advantages accorded to owner-occupied housing, the homeowners' wealth accumulation process, relative to that in tenancy, could be favorably affected by the tenure decision, *ceteris paribus*.

The framework considers a separate life-cycle wealth accumulation model for the owner and renter households. These models assume that the household maximizes its expected lifetime utility. It is also assumed that both households start with some initial nonhousing wealth, A_0, and have the same socio-economic characteristics, except with respect to the tenure decision. Consider, first, the model for the owner household.

2.3.1 Wealth Accumulation by Homeowner Households

The owner household is assumed to pass through two distinct segments in its lifetime T — the rental and the homeownership phases (see Figure 2.2). Between time 0 to t_1, it rents h_τ^R units of rental housing services at a rental of R_τ per unit. At time t_1, the renter household enters into the homeownership phase by purchasing a house yielding $h_{t_1}^O$ units of housing services. It then holds the housing asset for the rest of its lifetime from time t_1 onwards, with a view to bequeathing the estate to the later generation. The homeowner maintains the quality of its house through maintenance expenditures to sufficiently offset the deterioration of its housing stock H. It is assumed that the housing stock H yields a constant proportion of housing services h, i.e., $h = \alpha H$. The maintenance effort of the household thus ensures a constant stream of housing services, in which case, $h_t^O = h^O$ for $t_1 \leq t \leq T$.

The purchase price is $P_{t_1} H$, where P_{t_1} represents the price of one standardized (constant-quality) unit of housing at time t_1. This is financed with a downpayment of $k P_{t_1} H$ drawn from the savings of the household, and a mortgage of size $M = (1 - k) P_{t_1} H$, which is to be repaid by t_2. The mortgage has a term of $(t_2 - t_1)$, and is repaid with a fixed payment of K at the end of each period t throughout the term. The fixed mortgage instalment K, comprising principal and interest, is such that

$$M = (1 - k) P_{t_1} H = \int_{t_1}^{t_2} K\, e^{-i(t - t_1)}\, dt = \frac{K}{i}\left[1 - e^{-i(t_2 - t_1)}\right], \qquad (1)$$

where i is the nominal interest rate charged on the mortgage loan.

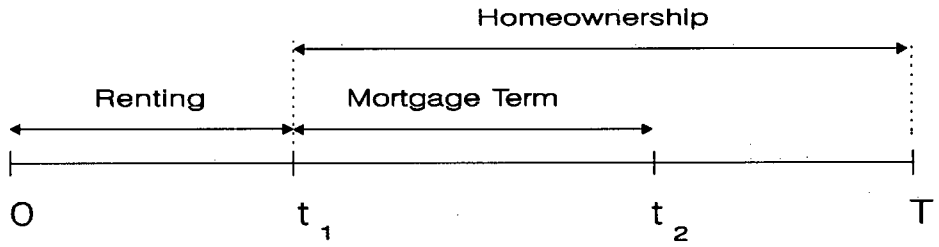

FIGURE 2.2: Life-Cycle of Owner Household

The household has an initial endowment of nonhousing wealth A_0 at time 0. At any time t, the household invests in either the nonhousing assets, housing asset, or both, accumulating a terminal wealth W_T at the end of its lifetime T. At the time of the home purchase t_1, its asset composition changes from a portfolio of nonhousing assets prior to home purchase, to that comprising a combination of nonhousing and housing assets after the purchase. A_τ is the value of *nonhousing* assets held in the portfolio of the household, and W_τ is the total wealth of the household for the period τ. If the mortgage is paid up by time T, $W_T \geq P_T H$.

Rental Phase (period 0 to t_1)

At any time t before the home purchase, the total household wealth W_t is the same as A_t, which is given by

$$A_t = A_0 \prod_{\tau=1}^{t} \left[1 + g_\tau(1 - m_\tau)\right] + \int_{\tau=1}^{t} \left[(1 - m_\tau) Y_\tau - c_\tau^R - R_\tau h_\tau^R\right]\left[1 + g_\tau(1 - m_\tau)\right]^{t+1-\tau} d\tau, \quad \text{for } 0 < t \leq t_1, \qquad (2)$$

where A_0 = the initial nonhousing wealth of household at time 0,

g_τ = the gross annual return from nonhousing assets, comprising not only asset income, but also upward or downward revaluation of the assets at time τ,

m_τ = the marginal income tax rate of the household in period τ,

Y_τ = the current labor income and any transfer income for the period τ,

c_τ^R = the consumption of numeraire nonhousing goods in period τ during the rental phase, with numeraire price of one.

R_τ = the rental rate per unit of housing service for the period τ.

The above formulation assumes that nonhousing assets accumulate at an annual compound rate of g_τ, inclusive of capital gains or losses.[35] For convenience, it is assumed that capital gains on nonhousing assets (realized and unrealized) are taxed at the same marginal income tax rate m_τ that asset income is subject to. The after-tax net value of nonhousing assets, which are subject to the appropriate tax rate at their disposal time t, can be calculated easily. The net proceeds may again be invested, earning another net-of-tax return as of that time. Net savings from net disposable income less nonhousing consumption and rental expenditures are assumed to be invested in similar portfolios held by the household, yielding a gross annual compound rate of return inclusive of capital gains but net of tax, $g_\tau(1 - m_\tau)$, right from the first period. All variables could change over time.

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[35] In distinguishing between the renter and homeowner households' wealth accumulation processes, the crucial assumption is that both households have exactly the same socio-economic characteristics, except with respect to the tenure decision, which affects the user cost and asset return components in the net wealth equation. As the theoretical model is intended only to illustrate where the differences in wealth accumulation could arise, it does not matter if the variables are known with certainty or not, so long as both households are subject to the same vagaries that impinge on the wealth accumulation process.

At Time of Home Purchase (t_1)

The nonhousing wealth of the household immediately prior to the house purchase, A_{t_1-}, is given by

$$A_{t_1-} = A_0 \prod_{\tau=1}^{t_1} [1 + g_\tau(1 - m_\tau)] + \int_{\tau=1}^{t_1} \left[(1 - m_\tau) Y_\tau - c_\tau^R - R_\tau h_\tau^R\right] [1 + g_\tau(1 - m_\tau)]^{t_1+1-\tau} d\tau, \quad (3)$$

where t_1- = time immediately prior to the time of home purchase at t_1.

In an imperfect capital market, wherein a household must have the minimum amount of wealth to pay for the downpayment and transaction costs related to the house purchase, the following condition holds:

$$A_{t_1-} \geq (k + \alpha) P_{t_1} H, \quad (4)$$

where k = the ratio of downpayment to the purchase price of the housing asset,

α = the transaction costs as a percentage of the purchase price,

P_{t_1} = the purchase price of the housing asset at time t_1.

Immediately after the house purchase, the nonhousing wealth of the household, A_{t_1+}, is

$$A_{t_1+} = A_{t_1-} - kP_{t_1}H - \alpha P_{t_1}H, \quad (5)$$

and the total net wealth of the household, W_{t_1+}, is

$$W_{t_1+} = A_{t_1+} + kP_{t_1}H. \quad (6)$$

As a result of the housing purchase, the nonhousing wealth is reduced by the amount of the downpayment ($kP_{t_1}H$), and the transaction costs ($\alpha P_{t_1}H$). The net wealth portfolio of the household now comprises reduced nonhousing wealth, but an increase in the housing equity component.

Mortgage Repayment Period of The Homeownership Phase (period t_1 to t_2)

Between the time t_1 and t_2, the homeowner's equity in the housing asset is built up through the repayment of the principal component of the annuity payment. At any time τ within the mortgage term (i.e. $t_1 \leq \tau \leq t_2$), the owner's home equity build-up E_τ, including changes in the price of the housing asset, is given by the difference between the market value of the property $P_\tau H$ and the outstanding mortgage loan M_τ as follows:

$$E_\tau = P_\tau H - M_\tau , \tag{7}$$

where the outstanding mortgage loan M_τ at time τ can be derived using

$$M_\tau = \int_\tau^{t_2} K e^{-i(t-\tau)} dt . \tag{8}$$

During the mortgage term of the homeownership phase, the total net wealth of the household W_t consists of the nonhousing assets and the owner's home equity component:

$$W_t = A_t + \left[P_{t_1} H(1+G)^{t-t_1} - \int_t^{t_2} K e^{-i(\tau-t)} d\tau \right], \qquad for \quad t_1 \leq t \leq t_2 , \tag{9}$$

where G = the average annual compound rate of appreciation in housing prices.

The terms within the brackets reflect the owner's equity component of the housing asset, inclusive of any capital appreciation over and above its purchase price P_{t_1} since time of purchase t_1. Capital gains on principal residence are deferred if households "trade up" in the property market. As it is assumed that the household retains the housing asset till death, there is no capital gain issue as the tax base will be stepped up to market at death.

The nonhousing wealth component during the mortgage period is

$$A_t = A_{t_1} \prod_{\tau=t_1}^{t} [1 + g_\tau(1 - m_\tau)] + \int_{t_1}^{t} \left[(1 - m_\tau) Y_\tau - c_\tau^o - K - u_\tau P_\tau H + i m_\tau M_\tau\right] [1 + g_\tau(1-m_\tau)]^{t+1-\tau} d\tau$$

$$= A_0 \left[\prod_{\tau=1}^{t} [1 + g_\tau(1 - m_\tau)]\right] + \left[\prod_{\tau=t_1}^{t} [1 + g_\tau(1 - m_\tau)]\right] \int_{1}^{t_1} \left[(1 - m_\tau) Y_\tau - c_\tau^R - R_\tau h_\tau^R\right] [1 + g_\tau(1 - m_\tau)]^{t_1+1-\tau} d\tau$$

$$+ \int_{t_1}^{t} \left[(1 - m_\tau) Y_\tau - c_\tau^M - K - u_\tau P_\tau H + i m_\tau M_\tau\right] [1 + g_\tau(1-m_\tau)]^{t+1-\tau} d\tau, \qquad \text{for } t_1 < t \le t_2. \tag{10}$$

where u_τ is the maintenance and property tax expenditures for the owner-occupied housing expressed as a proportion of the house value:

$$u_\tau = [d_\tau + \beta_\tau(1 - m_\tau)], \tag{11}$$

and c_τ^M = the nonhousing consumption during mortgage term of homeownership phase,

d_τ = the rate of maintenance expenditure at time τ to just offset housing stock deterioration,

β_τ = the rate of property tax at time τ,

M_τ = the outstanding mortgage loan at time τ.

The first term in the nonhousing wealth equation is the gross value of the initial wealth accumulated up to time t. The second term shows the cumulative value of investing savings from income flow carried over from the rental period into time t. The last term captures the cumulative value of investing savings from income flow net of mortgage payments and other housing expenses during the mortgage period. The equation considers the outflows due to mortgage repayment, maintenance expenditure, property taxes, but incorporates the tax benefit arising from the tax-deductibility of mortgage interest and property taxes in the U.S. tax system.

Homeownership Phase After Mortgage Term (period t_2 to T)

During this period, the total wealth is given by

$$W_t = A_t + P_{t_1} H(1 + G)^{t-t_1}, \qquad for \quad t_2 < t \le T, \tag{12}$$

and the nonhousing wealth component is given by

$$\begin{aligned} A_t = A_0 & \left[\prod_{\tau=1}^{t}\left[1 + g_\tau(1 - m_\tau)\right]\right] + \left[\prod_{\tau=t_1}^{t}\left[1 + g_\tau(1 - m_\tau)\right]\right] \int_{t_1}^{t_1}\left[(1 - m_\tau)Y_\tau - c_\tau^R - R_\tau h_\tau^R\right]\left[1 + g_\tau(1 - m_\tau)\right]^{t_1+1-\tau} d\tau \\ & + \left[\prod_{\tau=t_2}^{t}\left[1 + g_\tau(1 - m_\tau)\right]\right] \int_{t_1}^{t_2}\left[(1 - m_\tau)Y_\tau - c_\tau^M - K - u_\tau P_\tau H + im_\tau M_\tau\right]\left[1 + g_\tau(1-m_\tau)\right]^{t+1-\tau} d\tau \\ & + \int_{t_2}^{t}\left[(1 - m_\tau)Y_\tau - c_\tau^o - u_\tau P_\tau H\right]\left[1 + g_\tau(1-m_\tau)\right]^{t+1-\tau} d\tau, \qquad for \quad t_2 < t \le T. \end{aligned} \tag{13}$$

Note that the last term no longer contains any mortgage instalment payment K or tax benefit from mortgage interest $im_\tau M_\tau$, as the mortgage term is over. c_τ^o is the nonhousing consumption after the mortgage term.

At time T, the household terminal wealth to be bequeathed, W_T, is

$$W_T = A_T + P_{t_1} H(1 + G)^{(T-t_1)}, \tag{14}$$

with A_T derived from equation (13) when $t = T$.

The household is assumed to have non-negative wealth holdings at any time, i.e.,

$$W_\tau \ge 0. \tag{15}$$

The Owner Household's Optimization Problem

At any time t between 0 and T, the owner household seeks to maximize the present value of its utility function:

$$U(t) = \int_{t}^{T} e^{-\delta(\tau - t)}\, U(c_\tau, h_\tau)\, d\tau \;+\; \phi(W_T)\,, \tag{16}$$

where δ is the subjective discount rate of the household. U is assumed to be a smooth, continuous, differentiable, concave, monotonically increasing function. The bequest motive is explicitly incorporated into the lifetime utility as $\phi(W_T)$.

Given its initial wealth and income path, the household chooses the optimal tenure switching time, and the path of optimal nonhousing consumption, c_τ^R, c_τ^M and c_τ^o, and housing services, h_τ^R or h^o (depending on which segment of the life-cycle the household is in), so as to

$$\textit{Maximize} \quad \int_{0}^{T} e^{-\delta\tau}\, U(c_\tau, h_\tau) d\tau \;+\; \phi(W_T) \tag{P1-OWN}$$

subject to the constraints in equations (1) to (15). The optimal consumption path would imply an optimal wealth accumulation path incorporating a bequest motive.

2.3.2 Wealth Accumulation by Renter Households

For the renter household with initial nonhousing wealth of A_0 and a life-span of T, the total household wealth at time t (W_t) is exactly the amount of nonhousing wealth accumulated up to time t:

$$A_t = A_0 \prod_{\tau=1}^{t} \left[1 + g_\tau(1 - m_\tau)\right] + \int_{\tau=1}^{t} \left[(1 - m_\tau) Y_\tau - c_\tau^R - R_\tau h_\tau^R\right]\left[1 + g_\tau(1 - m_\tau)\right]^{t+1-\tau} d\tau\,, \quad \textit{for } 0 < t \le T. \tag{17}$$

The variables are as defined earlier. The model assumes that the renter household has exactly the same initial nonhousing wealth A_0, same pattern of income flows, life-cycle stage, and

income tax bracket as the homeowner. Net savings from non-consumption of the labor income flows are invested into similar portfolios of assets held by the household.

The optimization problem of the lifelong renter for the period $0 \leq t \leq T$ consists of choosing c_τ^R and h_τ^R, so as to

$$\textit{Maximize} \quad \int_0^T e^{-\delta\tau} U(c_\tau^R, h_\tau^R)\, d\tau \quad + \quad \phi(W_T) \qquad \text{(P2-RENT)}$$

subject to the constraint in equation (17) and the non-negativity of net wealth constraint.

Given similar life-cycle position, socio-economic and demographic characteristics, and initial wealth endowment, the owner household's net wealth accumulation could differ from that of the renter household, if its different portfolio composition, arising from possession of the housing asset, yields returns that are systematically different from those of the renters' portfolios. The two primary elements that could affect the wealth accumulation path is the relative owning-to-renting costs and the capital gain component relating to housing asset. Where the relative user costs of owning-to-renting is lower arising from tax advantages accorded to owner-occupied housing and the housing asset return generally exceeds those of nonhousing assets, the homeowners' wealth accumulation process could be favorably affected by the tenure decision. Comparing the lifetime utility derived from homeownership and renting tenure, a household would choose the tenure that optimizes his lifetime utility. The following section examines empirically the net wealth of the owner and renter households.

2.4 EMPIRICAL ESTIMATION

2.4.1 Methodology

In estimating the impact of homeownership on household's net wealth in a simultaneous framework, this paper applies the "switching regression model with endogenous switching" as suggested by Maddala and Nelson (1975).[36] Depending on the tenure status of the household i, the observed household net wealth W_i is described by one of the two regimes:

Regime 1 (Owner Household):

$$W_{1i} = X_{1i}\beta_1 + u_{1i} \quad for \quad \varepsilon_i > -Z_i\gamma \,, \tag{18}$$

Regime 2 (Renter Household):

$$W_{2i} = X_{2i}\beta_2 + u_{2i} \quad for \quad \varepsilon_i \leq -Z_i\gamma \,. \tag{19}$$

The criterion function (tenure choice equation) that determines the observed tenure status of the household, and thus the appropriate regime to which the household belongs, is specified as:

$$I_i^* = Z_i\gamma + \varepsilon_i \,. \tag{20}$$

$$\textit{Owning}: \quad I_i = 1 \quad iff \quad I_i^* > 0 \quad (or \quad \varepsilon_i > -Z_i\gamma) \,, \tag{21}$$

$$\textit{Renting}: \quad I_i = 0 \quad iff \quad I_i^* \leq 0 \quad (or \quad \varepsilon_i \leq -Z_i\gamma) \,. \tag{22}$$

I_i^* is an unobservable latent index measuring the household's net utility gained from owning relative to renting a house, and I_i is a dummy variable indicating the observed tenure status of the household. X_{1i}, X_{2i} and Z_i are vectors of exogenous variables. β_1, β_2 and γ are the

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[36] Switching regression models were first considered by Goldfeld and Quandt (1973), and later extended by Maddala and Nelson (1975), and Lee and Trost (1978). In such models, the behavior of the agents is governed by one of two regimes (regression equations), the classification of which is determined by a criterion function. The term "endogenous" arises when the error term in the criterion function is correlated with the error terms in the two regression equations.

corresponding vectors of coefficients for the parameters. It is assumed that u_{1i}, u_{2i} and ε_i have a trivariate normal distribution, with mean vector zero and covariance matrix Σ,

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_2^2 & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{bmatrix} . \tag{23}$$

Var $(\varepsilon_i) = \sigma_\varepsilon^2$ has been normalized to 1.

If ε_i is correlated with u_{1i} and u_{2i}, an ordinary least squares estimation of either the owner or renter household's net wealth equations will give biased and inconsistent estimates. This is the case since $E(u_{1i}/I_i=1)\neq 0$ and/or $E(u_{2i}/I_i=0)\neq 0$. The selection process results in expected values of u_{1i} and u_{2i} that differ from zero after households sort into the two regimes. With the assumption that ε_i is normally distributed, it is shown in Appendix 2.9 that,

$$E(u_{1i}/I_i=1) = \sigma_{1\varepsilon}\left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)}\right] = \sigma_{1\varepsilon}M_{1i} , \tag{24}$$

and

$$E(u_{2i}/I_i=0) = -\sigma_{2\varepsilon}\left[\frac{\phi(Z_i\gamma)}{1 - \Phi(Z_i\gamma)}\right] = \sigma_{2\varepsilon}M_{2i} , \tag{25}$$

where M_{1i} and M_{2i} are the Inverse Mills Ratios:

$$M_{1i} = \frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)} > 0, \quad \textit{and} \quad M_{2i} = -\frac{\phi(Z_i\gamma)}{[1 - \Phi(Z_i\gamma)]} = \frac{\phi(Z_i\gamma)}{[\Phi(Z_i\gamma) - 1]} < 0 . \tag{26}$$

$\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the density function and the distribution function of the standard normal variable, $Z_i\gamma$.

Substituting $E(u_{1i}/I_i=1)$ and $E(u_{2i}/I_i=0)$ into the respective wealth equations, the expected net wealth for the owner and renter households after selection would then be

$$\textit{Owner Household:} \quad E(W_{1i}/I_i = 1) = X_{1i}\beta_1 + \sigma_{1\varepsilon}M_{1i}\,, \tag{27}$$

$$\textit{Renter Household:} \quad E(W_{2i}/I_i = 0) = X_{2i}\beta_2 + \sigma_{2\varepsilon}M_{2i}\,, \tag{28}$$

The two net wealth equations (18) and (19) can be rewritten as:

$$\textit{Owner Household } (I_i = 1): \quad W_{1i} = X_{1i}\beta_1 + \sigma_{1\varepsilon}M_{1i} + \eta_{1i}\,, \tag{29}$$

$$\textit{Renter Household } (I_i = 0): \quad W_{2i} = X_{2i}\beta_2 + \sigma_{2\varepsilon}M_{2i} + \eta_{2i}\,, \tag{30}$$

with $E(\eta_{1i}/I_i=1)=0$ and $E(\eta_{2i}/I_i=0)=0$.

Selectivity bias, therefore, exists if there is correlation between the error terms in the net wealth and tenure choice equations. In this case, inconsistent parameter estimates are obtained if one simply estimates the original net wealth equations (18) and (19) for *separate* samples of homeowners and renter households. To correct for selectivity bias, a two-stage probit/ols method proposed by Heckman (1976, 1979) and Lee (1976) has to be applied.

In the first stage, one obtains consistent estimates of γ ($\hat{\gamma}$) from the probit maximum-likelihood estimation of the tenure choice (criterion function) equation, and computes estimates of the Inverse Mills Ratios using $\hat{\gamma}$. In the second stage, the owner and renter households' net wealth equations (29) and (30) are then estimated by Ordinary-Least-Squares (OLS) method, including the estimated Inverse Mills Ratios obtained from the first stage probit estimation. The above procedure gives consistent estimates of β_1, β_2, $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$. The coefficients of the Inverse Mills Ratios are the values for $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$. Any significance in the Inverse Mills Ratios in the net wealth equations is indicative of the presence of selectivity bias, i.e., there is a correlation between ε_i and u_{1i} (if $\sigma_{1\varepsilon}$ is significantly different from zero), and/or a correlation

between ε_i and u_{2i} (if $\sigma_{2\varepsilon}$ is significantly different from zero).

The covariance terms capture the effects of *unobserved* factors that influence both the tenure choice and wealth accumulation processes. A significantly positive (negative) $\sigma_{1\varepsilon}$ in the owner's net wealth equation implies that a household that is influenced by some unobserved factors to have a greater tendency to own its home is likely to have accumulated a higher (lower) than average level of net wealth. For the renters, a positive (negative) $\sigma_{2\varepsilon}$ implies the existence of some unobserved factors, which influence a household to choose renting, thereby resulting in the household having a lower (higher) than average level of net wealth.

While it is of interest to test whether selectivity bias exists, a more important issue is to examine the signs and magnitudes of the covariances, $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$. There are four possible situations:

(a) $\sigma_{1\varepsilon} > 0$ and $\sigma_{2\varepsilon} > 0$ (both positive).

Given that $M_{1i} > 0$ in equation (29), and $M_{2i} < 0$ in equation (30), the expected net wealth of the owner households is greater than the unconditional mean under random assignment in their current and alternative tenure. The renter households have an expected net wealth that is below average in both tenure.

(b) $\sigma_{1\varepsilon} < 0$ and $\sigma_{2\varepsilon} < 0$ (both negative).

This is the reverse of case (a). In this case, the owner households have below average expected net wealth in both tenure, while the expected net wealth of the renter households is above average in both tenure.

(c) $\sigma_{1\varepsilon} > 0$ and $\sigma_{2\varepsilon} < 0$.

This implies that both the owner and renter households have *above* average expected net wealth after selection. The tenure selection process has enabled both households to accumulate wealth at higher levels in their respective tenure than under random assignment.

(d) $\sigma_{1\varepsilon} < 0$ and $\sigma_{2\varepsilon} > 0$.

In this case, the expected net wealth of both groups in their current tenure is *lower* than the average under random assignment, but is above average if otherwise.

Further insight could be obtained on the effects of self-selection when one compares the actual net wealth of each household against its expected net wealth, had it chosen the alternative tenure. The question of interest is whether the renters would have held a greater level of net wealth, if they had otherwise been homeowners, *ceteris paribus*. The parallel question for the homeowners is whether they are put on a less favorable wealth accumulation path, if they had chosen to be renters.

The expected net wealth of the renter household, had it chosen to be a homeowner, is given by

$$E(W_{1i} / I_i = 0) = X_{1i}\beta_1 + \sigma_{1\varepsilon} M_{2i} . \tag{31}$$

Note that equation (31) is similar to the owner expected net wealth equation (27), (81), except that the values for the vector X_{1i} and M_{2i} are those of the renter. Given $M_{2i} < 0$, a positive $\sigma_{1\varepsilon}$ implies a renter conditional expected wealth after selecting into homeownership that is below the

average household wealth under random assignment. The difference between the renter actual wealth W_{2i} and the conditional expected wealth based on homeownership, would then be

$$D_R = W_{2i} - E(W_{1i}/I_i=0) . \tag{32}$$

If homeownership enhances the wealth position of the renter, D_R should be negative.

Similarly, the expected net wealth of the homeowner, had it chosen to be a renter, would be

$$E(W_{2i}/I_i = 1) = X_{2i}\beta_2 + \sigma_{2\varepsilon}M_{1i} , \tag{33}$$

where homeowner's values for X_{2i} and M_{1i} are substituted into the renter net wealth equation (28). Given $M_{1i}>0$, the homeowner conditional expected wealth if otherwise renting is above the average renter wealth under random assignment if $\sigma_{2\varepsilon}>0$, and vice versa if $\sigma_{2\varepsilon}<0$. The difference between the owner actual wealth W_{1i} and the conditional expected wealth, if otherwise renting, would be

$$D_O = W_{1i} - E(W_{2i}/I_i=1) \tag{34}$$

Under the hypothesis that homeownership enhances the wealth position of a household, D_O should be positive.

The effects of selection under the four cases can be summarized in Table 2.1. The signs and magnitudes of the covariances yield interesting interpretations to the net wealth equations. These form the bases for analyzing the impact of homeownership on the net wealth holdings of households. Further, if the two sets of independent variables for the owner and renter household net wealth equations are the same (i.e., $X_1=X_2$), one can compare the coefficients of the equations to analyze the varying degree to which each independent variable impacts the wealth accumulation of the renter and owner households. Differences in the coefficients imply different

wealth accumulation paths for the renter and owner households. The t test is used to check whether the coefficients for each independent variable in the two sets of equation are significantly different. A test of the null hypothesis that the difference in the coefficients for all the independent variables are jointly equal to zero is also conducted using the Wald Test.

The Wald Test is valid for large samples whether or not the disturbance variances are the same. Assume that $\hat{\beta}_1$ and $\hat{\beta}_2$ are two normally distributed estimators of a parameter based on independent samples, with variances matrices V_1 and V_2. Then, under the null hypothesis that the two estimates have the same expected value,

$$\hat{\beta}_1 - \hat{\beta}_2 = 0 \tag{35}$$

and variance $[V_1 + V_2]$, the Wald Test statistic is computed using the formula:

$$W = (\hat{\beta}_1 - \hat{\beta}_2)'(V_1 + V_2)^{-1}(\hat{\beta}_1 - \hat{\beta}_2) . \tag{36}$$

This statistic is distributed chi-squared with K degrees of freedom, and is compared to the criterion value.

TABLE 2.1: EFFECTS OF TENURE CHOICE DECISION ON HOUSEHOLD NET WEALTH

CONDITIONAL EXPECTED NET WEALTH	$\sigma_{1\varepsilon}>0$, $\sigma_{2\varepsilon}>0$	$\sigma_{1\varepsilon}<0$, $\sigma_{2\varepsilon}<0$	$\sigma_{1\varepsilon}>0$, $\sigma_{2\varepsilon}<0$	$\sigma_{1\varepsilon}<0$, $\sigma_{2\varepsilon}>0$
1ST REGIME (OWNER households): $E[W_1/(I_i=1)]=X\beta_1+\sigma_{1\varepsilon}M_1$	$> X\beta_1$	$< X\beta_1$	$> X\beta_1$	$< X\beta_1$
OWNER households alternatively renting: $E[W_2/(I_i=1)]=X\beta_2+\sigma_{2\varepsilon}M_1$	$> X\beta_2$	$< X\beta_2$	$< X\beta_2$	$> X\beta_2$
2ND REGIME (RENTER households): $E[W_2/(I_i=0)]=X\beta_2+\sigma_{2\varepsilon}M_2$	$< X\beta_2$	$> X\beta_2$	$> X\beta_2$	$< X\beta_2$
RENTER households alternatively owning: $E[W_1/(I_i=0)]=X\beta_1+\sigma_{1\varepsilon}M_2$	$< X\beta_1$	$> X\beta_1$	$< X\beta_1$	$> X\beta_1$
Implications:	Owners have *higher* than average expected net wealth in their current & alternative tenure. Renters' expected net wealth is *below* average in both tenure.	Owners have *lower* than average expected net wealth in their current & alternative tenure. Renters' expected net wealth is *above* average in both tenure.	Both owners and renters have *above* average expected net wealth based on their current tenure decisions, but *below* average if otherwise.	Both owners and renters have *below* average expected net wealth based on their current tenure decisions, but *above* average if otherwise.

Note: By construction, $M_1 > 0$ and $M_2 < 0$.

Alternatively, it is possible to estimate the two net wealth equations (29) and (30) simultaneously, using all the observations in the whole sample in a two-stage method. Note that

$$\begin{aligned} E(W_i) &= E(W_i/I_i=1) \cdot P(I_i=1) + E(W_i/I_i=0) \cdot P(I_i=0) \\ &= \left[\beta_1' X_{1i} + \sigma_{1\varepsilon} \frac{\phi_i}{\Phi_i} \right] \Phi_i + \left[\beta_2' X_{2i} - \sigma_{2\varepsilon} \frac{\phi_i}{(1-\Phi_i)} \right] [1-\Phi_i] \\ &= \beta_1' X_{1i} \Phi_i + \beta_2' X_{2i} (1 - \Phi_i) + \phi_i (\sigma_{1\varepsilon} - \sigma_{2\varepsilon}) \end{aligned} \tag{37}$$

When both the owner and renter net wealth equations have the same set of explanatory variables, then $X_{1i} = X_{2i} = X_i$. In that case, equation (37) can be rewritten as

$$E(W_i) = \beta_2' X_i + (\beta_1' - \beta_2') X_i \Phi_i + \phi_i (\sigma_{1\varepsilon} - \sigma_{2\varepsilon}) \tag{38}$$

Thus, W_i is regressed on X_i, $\hat{\phi}_i$, and the interaction variables $X_i \hat{\Phi}_i$, where $\hat{\phi}_i$ and $\hat{\Phi}_i$ are obtained from the first stage probit estimation of the tenure choice equation. The estimation of this equation allows the testing of any significant differences in the coefficients β_1 and β_2.

2.4.2 The Database

This study employs the 1989 Survey of Consumer Finances (1989 SCF), which is among the few reliable sources of data on family finances.[37] This survey is part of a current series of surveys that has been ongoing on a triennial basis since 1983. It is designed to collect household-level information on the assets and liabilities and income flows of a nationally representative

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[37] Surveys of consumer finances were conducted annually with support from the Federal Reserve from 1946 through 1970. In 1977, balance-sheet data were collected in the *1977 Consumer Credit Survey* as part of a survey on the use of consumer credit. Another source of balance-sheet data sponsored by the Federal Reserve Board is the one-time *Survey of Financial Characteristics of Consumers* conducted in 1962. Since the 1962 Survey, the *1983 and 1989 Surveys of Consumer Finances* are the most comprehensive survey of household wealth. The 1989 SCF was sponsored by the Federal Reserve Board in cooperation with the Department of the Treasury, the Department of Health and Human Services, the National Institute on Aging, the Small Business Administration, the General Accounting Office, the Comptroller of the Currency, and the Congressional Joint Committee on Taxation.

sample of American families. In addition, the survey sought information on the attitudes of consumers toward credit use, their use of financial services and reactions to consumer credit regulations, as well as detailed information on consumer pension rights and benefits. The survey was carried out by the Survey Research Center of the University of Michigan between August 1989 and March 1990.

To ensure a good coverage of the wealthier households, the survey employs a two-part strategy for sampling households. Of the 3143 households in the database, 2277 were selected by standard multistage area-probability sampling methods from the 48 contiguous states. The remaining 866 high-income households in the survey were selected using tax files from the Internal Revenue Service in a manner that preserves the anonymity of the participants.

The unit of observation is the family, which is defined to include all persons who are related by blood, marriage, or adoption, residing together in the same dwelling. The 1989 SCF definition, which differs from that used by the Bureau of the Census, includes one-person units. The Census definition excludes single individuals, and classifies them as "unrelated individuals". The income reported is for the year 1988, while other data are as of the date of survey.

This study excludes households that live on farm/ranch/mobile homes, those that neither rent nor own, and cases with missing values on important variables used for computation of the household's current net wealth. In addition, three cases with atypical household size of more than 12 persons, and two other cases that have recording discrepancies have also been deleted. The study has also excluded the extremely wealthy households and those with extreme negative net wealth, as it is believed that the investment and saving behavior of these households would

differ significantly from that of a typical American household. The hypothesis that the possession of a single principal residence influences the wealth accumulation path of a typical household is appropriately analyzed with a sample that is more representative of the American households. As such, the sample consists of those households with net wealth between minus $1 million and $5 million. The final sample comprises 2506 households (668 renters and 1838 owners). Appendix 2.2 summarizes the salient characteristics of the full sample, the renter subsample, and the owner subsample.

2.4.3 Empirical Implementation

For empirical estimation with the 1989 Survey of Consumer Finances, the household net wealth structural equation[38] for both owners and renters is formulated as a linear function of the following explanatory variables:

Household Net Wealth Structural Equation

$$NETWORTH = f\,(MILL,\ EARNPR,\ YTRFPR,\ CHILDHU,\ MALE,\ WHITE,\ MARR,\ BQUEST,\ INHPST,\ EXPINH,\ EXPPEN,\ LC30L,\ LC3039,\ LC4049,\ LC5059,\ LC6075,\ LC6075SQ,\ LC75G,\ LC75GSQ). \quad (39)$$

[38] Preliminary estimations of the 'net worth' equations for both the homeowner and renter households included dummies for 6 major categories of occupation (MGTPROF, TECSCLRK, SERVICE, PRODCRFT, OPERATOR, FARMFISH), and dummies for 12 life-cycle variables reflecting characteristics of marital status, whether age of household head is greater or less than 45 years, presence of children, and if so, whether children are greater or less than 18 years of age (S45LZERO, M45LZERO, M45L18L, S45L18L, M45L18G, S45L18G, S45GZERO, M45GZERO, M45G18L, S45G18L, M45G18G, S45G18G). These initial regression results show no major contribution by these explanatory variables.

Appendix 2.1 provides a complete list of definitions for all variables. The "NETWORTH" of the household is defined as the sum of the market value of cash, deposits, stocks and shares, Keogh and IRA savings plans, other financial assets, vehicles, owner-occupied houses and other real estate, equity in a business, face value of bonds, cash values of life insurance policies, less debts of various kinds. It excludes the present value of future social security and pension wealth, consumer durables other than cars, and the expected value of future inheritances.[39]

To account for the simultaneity between tenure choice and household net wealth, this study employs the two-stage estimation method proposed by Heckman (1976, 1979) and Lee (1976). In the first stage, one estimates the reduced-form probit tenure choice equation, using *all* predetermined variables in the whole system of structural equations, and computes the Inverse Mills Ratios (denoted as *MILL*). These ratios are then included as additional independent variables in separate OLS regressions of owner and renter household net wealth at the second stage for the correction of selection bias. The analysis is conducted using the "SHAZAM" econometric software programme (version 7.0) designed by Kenneth White from the University of British Columbia. The first-stage reduced-form probit results are shown in Appendix 2.5.

Excluded exogenous variables in the tenure choice structural equation are *BQUEST, INHPST, EXPINH* and *EXPPEN.* These variables are appropriately in the net wealth equation. Although it has been argued that the nonlinearity in the probit estimation itself would contribute to the identification of the tenure choice equation, additional variables, e.g., *NJOBHR, INHER*

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[39] King & Dicks-Mireaux (1982), and Manchester & Poterba (1989) have used a similar networth definition that excludes pension assets and social security wealth.

and *WELFAR* are included in the probit tenure choice equation to assist further in its identification. The total number of full-time jobs held in the household head's lifetime (*NJOBHR*) captures the negative influence of household mobility on the tenure decision. *INHER*, a dummy indicator for household ever receiving any past inheritances, is included to reflect the likely positive impact of intergenerational transfers on tenure decision. The inclusion of *WELFAR*, a dummy indicator for households that are receiving welfare assistance, suggests the possible negative impact that such status would have on tenure decision.

This study has formulated the tenure choice decision to depend on current net wealth and stabilized household earned income (*EARNPR*) and transfer income (*YTRFPR*), rather than permanent income as have been the treatment in traditional tenure choice literature. This is premised on the findings in recent housing studies by Dynarski and Sheffrin (1985) and Jones (1989, 1990, 1993a), who have found transitory income and current nonhuman wealth of the households to have greater impact on the tenure decision.

One may note the omission of the housing price variable in the tenure choice as well as the net wealth equations. Unlike earlier surveys, the 1989 SCF does not have any information at all on the location of the household, for reasons of maintaining the anonymity of survey participants. Ideally, we should have location-specific constant-quality housing price index variable, but the database only has the purchase price of the principal residence. It is not possible to even construct proxies using broad regional location characteristics as was done in Jones' (1993) study employing the 1983 and 1986 Surveys of Consumer Finances databases. Since house prices are location-specific, it is also inappropriate to use constant-quality house price indices at the national level as measurement errors arise from local variations in house

prices.

Specification error arising from the omission of the housing price variable may not be as serious as it first appears to be. Polinsky and Ellwood (1979) present evidence indicating that the omission of housing price variables in housing demand equation does not significantly bias coefficients of earnings and wealth variables when micro household data are used. This is further corroborated by Jones (1993a), who demonstrates that the coefficients of the key wealth variables in logit analyses of tenure choice in the U.S. are virtually unaffected by the deletion of the price variable.

Being one component of homeowner net wealth, house value directly affects the level of net wealth. However, house values are fundamentally location-specific. On the premise that location choice is ultimately determined by household preferences and characteristics, house value could be proxied to some extent by exogenous household demographic and socio-economic variables reflecting tastes for a specific location. It poses less of a problem particularly when the net wealth equation is in reduced-form, and when the primary purpose of the tenure choice equation is to compile the Inverse Mills Ratios for selectivity bias correction, rather than estimation of its parameters per se. To the extent that housing price influences both the tenure choice and net wealth equations, the error terms in both equations would be correlated, and the *MILL* variables would have captured the remaining omitted price effect.

It is postulated that differences in the current net wealth of individual households, accumulated as of 1989, arise partly from differences in their earnings capacity, as well as their socio-economic and demographic characteristics of the household head (*EARNPR, YTRFPR,*

CHILDHU, MALE, WHITE, MARR). To control for the endogeneity of total income flows in the net wealth equation, predicted values of household labor earnings (*EARNPR*) and transfer income (*YTRFPR*) are used in place of the actual total household current income. These predicted income flows are obtained from separate OLS regressions of *EARN* and *YTRF* listed in Appendices 2.3 and 2.4. *YTRF* consists of any transfer income currently received by the household in the forms of pension incomes, social security benefits and welfare assistance. *EARNPR* is expected to have a positive coefficient, as households with greater labor earnings save more, given the same expenditure pattern. As for *YTRFPR*, its influence could be ambiguous. The effect can be positive, indicating that a larger amount of transfer income increases the current nonhuman wealth. Yet, the receipt of transfer income is usually associated with households being in an economically non-productive phase of their life-cycle. This signals a time at which decumulation of wealth is most likely to occur. The coefficient of *YTRFPR* could be negative.

Household heads who are married (*MARR*) with children (*CHILDHU*) tend to have higher financial commitment in terms of family expenditures. *MARR* and *CHILDHU* therefore should have negative coefficients. *MALE* and *WHITE* are expected to exert a positive impact on the household net wealth.

Net wealth accumulation could also be affected by a strong desire of the household to leave bequests to the younger generation (*BQUEST*), the dollar amount of any intergenerational transfers received in the past (*INHPST*), and the potential impact that expectations about receipt of future resources such as inheritances and pension funds might have on their savings (*EXPINH, EXPPEN*). King and Dicks-Mireaux (1982) and Hayashi, Ito and Slemrod (1988) recognize the

potential importance of the bequest motive on saving behavior. One, therefore, expects *BQUEST* and *INHPST* to deliver a positive boost to household savings. *EXPINH* and *EXPPEN* are likely to exert a negative influence, as households are less inclined to save as vigilantly as before if they are expecting some future income sources.

To investigate whether the life-cycle model affects net wealth accumulation, the following life-cycle variables for each household i are constructed. This is based on a modified version of the splined age function of King and Dicks-Mireaux (1982):

$$
\begin{aligned}
LC30L_i &= LC_{1i} = D_{1i}(AGE_i - 15) + 15\sum_{j=2}^{6} D_{ji}, \\
LC3039_i &= LC_{2i} = D_{2i}(AGE_i - 30) + 10\sum_{j=3}^{6} D_{ji}, \\
LC4049_i &= LC_{3i} = D_{3i}(AGE_i - 40) + 10\sum_{j=4}^{6} D_{ji}, \\
LC5059_i &= LC_{4i} = D_{4i}(AGE_i - 50) + 10\sum_{j=5}^{6} D_{ji} \\
LC6075_i &= LC_{5i} = D_{5i}(AGE_i - 60) + 15D_{6i}, \\
LC6075SQ_i &= LC_{6i} = D_{5i}(AGE_i - 60)^2 + 225\,D_{6i}, \\
LC75G_i &= LC_{7i} = D_{6i}(AGE_i - 75), \\
LC75GSQ_i &= LC_{8i} = D_{6i}(AGE_i - 75)^2,
\end{aligned}
\qquad (40)
$$

where D_{ji}'s are age-bracket dummy variables defined for the head of household i, aged AGE_i:

$$\begin{aligned}
D_{1i} &= D30L = 1 \quad if \quad AGE_i < 30, \quad zero\ otherwise,\\
D_{2i} &= D3039 = 1 \quad if \quad 30 \le AGE_i < 40, \quad zero\ otherwise,\\
D_{3i} &= D4049 = 1 \quad if \quad 40 \le AGE_i < 50, \quad zero\ otherwise,\\
D_{4i} &= D5059 = 1 \quad if \quad 50 \le AGE_i < 60, \quad zero\ otherwise,\\
D_{5i} &= D6075 = 1 \quad if \quad 60 \le AGE_i \le 75, \quad zero\ otherwise,\\
D_{6i} &= D75G = 1 \quad if \quad AGE_i > 75, \quad zero\ otherwise.
\end{aligned} \tag{41}$$

Leaving out the other independent variables for the moment, one essentially has the following linear regression on the life-cycle variables:

$$W_i = a_0 + \sum_{j=1}^{8} a_j LC_{ji} + u_i . \tag{42}$$

The life-cycle variables, *LC30L* to *LC75GSQ*, capture the linear and non-linear wealth accumulation effects over the number of years in the various life-cycle stages that the household head has passed, right up to the present stage as indicated by his age. The youngest age at which working life begins is assumed to be age 15. The value a_0 reflects the average wealth level at the age of 15. The coefficients of *LC30L* to *LC5059* (a_1 to a_4) measure the linear rate of change in wealth in the first four age brackets, while the coefficients of *LC6075* to *LC75GSQ* (a_5 to a_8) measure both the linear and nonlinear rate of change in wealth in the years after age 60. Such a formulation allows one to test whether a maximum wealth level occurs (i.e., one of the coefficients of *LC6075SQ* and *LC75GSQ* must be negative, if the wealth-age profile is hump-shaped) and if so, to estimate the age at which this happens. Depending on the age bracket in which the wealth-age profile peaks, the maximum is reached at either $AGE_i = 60 - (a_5/2a_6)$

or $AGE_i = 75 - (a_7/2a_8)$.[40]

As of 1989, wealth accumulation by each household would have been affected by the entire historical path of differing rates of return and accruals of capital gains/losses on different assets in the wealth portfolio.[41] However, it is difficult to incorporate variables which directly track the relevant trajectory of the rates of return before 1989 for individual assets owned by each household, as well as the changing portfolio composition over the life-time of the household. The use of a single-period (1989) relative rates of return between housing and financial assets is unsatisfactory, as variations of such relative returns over time are not reflected. The life-cycle variables are used to proxy the entire historical path faced by the households. Given the same age, two households would have been exposed to the same influences of past prevailing economic conditions on their accumulation of assets. These variables, however, would not capture the impact on wealth accumulation due to different portfolio compositions.

The portfolio shares of the assets held by the household have an important bearing on the total value of the individual asset accumulated. Peek's (1983, 1986) studies emphasize the

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[40] The first order derivative of W_i with respect to AGE_i is given by:

$$\frac{\partial (W_i)}{\partial (AGE_i)} = a_1 D_{1i} + a_2 D_{2i} + a_3 D_{3i} + a_4 D_{4i} + a_5 D_{5i} + 2a_6 D_{5i}(AGE_i - 60) + a_7 D_{6i} + 2a_8 D_{6i}(AGE_i - 75).$$

The second order derivative of W_i with respect to AGE_i is given by:

$$\frac{\partial^2 (W_i)}{\partial (AGE_i)^2} = 2(a_6 D_{5i} + a_8 D_{6i}).$$

For a hump-shaped wealth-age profile, the second order derivative must necessarily be negative, implying that either a_6 or a_8 must be negative. The age at which the peak of the profile occurs is derived by setting the first order derivative to zero.

[41] In addition, a household's net wealth is also affected by its consumption/investment behavior.

importance of household portfolio composition on net wealth accumulation through differential capital gains (losses) accrual for different assets. However, no information is available on the household portfolio history and characteristics in the database. Like the relative rates of return, the use of the 1989 household asset composition as a proxy is also unsatisfactory, since it does not capture the history of portfolio composition. Also, portfolio composition is in itself an endogenous variable affected by the household's net wealth. For want of better alternative proxies, dummy variables reflecting whether the household has a brokerage account (*BROKACC*), and whether it has other forms of real estate investment (INVRE), have been included in another net wealth ols specification. Although, strictly speaking, these variables could be endogenous as well, they reflect to some degree differences in the characteristics of household portfolios. The inclusion of *INVRE* is to control for the possible confounding effect that renter households that possess other forms of real estate investment could have similarly benefited from the price appreciation of real estate in general.[42] *BROKACC* proxies the presence of financial assets as one component in the household portfolio. Having controlled for the effects due to portfolio diversity, one would be able to focus on the differences in the homeowner and renter net wealth arising strictly from the homeownership decision.

To test for equality of the slope coefficients, the same set of explanatory variables has been used in the renter and owner net wealth equations. As discussed earlier, significant differences in the parameter estimates would imply different wealth accumulation paths for the homeowners and renters, as a result of different portfolio composition by virtue of the possession

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[42] Ibbotson and Siegel (1984) compile a real estate composite index, comprising residential/farm/business real estate, for the years 1947 to 1982. This composite index generally moves in tandem with the residential real estate index, but at slightly higher levels.

of a housing asset.

2.5 EMPIRICAL RESULTS

The results show that the coefficients of most variables are different in the uncorrected and selection-bias-corrected net wealth regressions. The results from the analyses of the full and reduced samples are discussed separately.

Full Sample

Table 2.3 shows that selection bias is a concern in both the homeowner and the renter net wealth equations for the full sample. The renter *MILL* ratio is highly significant at the 0.05 level, while the owner *MILL* ratio is significant at the 0.10 level. In the presence of selectivity bias, the application of ordinary-least-squares method to separate subsamples, without incorporating the selection-correction variable, will yield parameter estimates that are biased and inconsistent.

The coefficient of the homeowners' *MILL*, $\sigma_{1\varepsilon}$, is positive while the corresponding renters' *MILL* coefficient, $\sigma_{2\varepsilon}$, is negative. This is case (c) discussed earlier in Section 2.4.1. A positive $\sigma_{1\varepsilon}$ and a negative $\sigma_{2\varepsilon}$ imply a situation in which *both* the homeowners and renters have above average expected net wealth based on their current tenure decisions, but below average if otherwise. The tenure selection process results in higher expected net wealth for *both* homeowners and renters than if random regime assignments were made. Households that have a *greater* than average propensity to own home tend to possess a *higher* than average level of net wealth after self-selecting into homeownership. Had they chosen to be renters, these households would have a *lower* than average conditional expected wealth. The negative $\sigma_{2\varepsilon}$

imply that households that have a *lower* than average propensity to own home (i.e., renters) are likely to still have *higher* than average level of expected net wealth being renters. Had they chosen to own their home, the renters would have a *lower* than average conditional expected net wealth.

As discussed earlier, the covariance terms capture the effects of *unobserved* factors that influence both the tenure choice and wealth accumulation processes. A significantly positive $\sigma_{1\varepsilon}$ in the owner's net wealth equation implies that a household that is influenced by some unobserved factors to have a greater tendency to own its home is likely to have accumulated a higher than average level of net wealth. For the renters, the negative $\sigma_{2\varepsilon}$ implies the existence of some unobserved factors, which influence a household to choose renting, thereby resulting in the household having a higher than average level of net wealth. The unobserved factor that is likely to affect both the tenure choice and wealth accumulation processes is most probably household mobility. Highly mobile households are more likely to rent so as to avoid the negative impact that high moving costs have on their net wealth each time they dispose of a housing asset. By choosing to rent, they optimize their wealth accumulation path.

To test whether $\sigma_{1\varepsilon} > 0$ *and* $\sigma_{2\varepsilon} < 0$ hold most of the time, one computes the joint probability and tests the hypothesis that the two events occur jointly, assuming independence in the owner and renter subsamples. The hypotheses are:

$$H_0 : \sigma_{1\varepsilon} \leq 0 \quad \textit{and} \quad \sigma_{2\varepsilon} \geq 0 ,$$
$$H_1 : \sigma_{1\varepsilon} > 0 \quad \textit{and} \quad \sigma_{2\varepsilon} < 0 .$$

One uses the t-ratios of the owner and renter *MILL* coefficients and their respective 't' probability density functions and cumulative distribution functions (CDFs) to calculate the joint probability. Independently, an upper-tailed test of the null hypothesis that $\sigma_{1\varepsilon} \leq 0$ can be rejected at a level of significance equal to the (1-CDF_1) value of $\sigma_{1\varepsilon}$'s t-ratio. Similarly, an independent lower-tailed test of the null hypothesis that $\sigma_{2\varepsilon} \geq 0$ can be rejected at a level of significance equal to the CDF_2 value of $\sigma_{2\varepsilon}$'s t-ratio. For the null joint hypothesis, it can be rejected at the (1-CDF_1)*(CDF_2) level of significance based on the one-tailed test.

From Table 2.3, the null joint hypothesis that $\sigma_{1\varepsilon} \leq 0$ and $\sigma_{2\varepsilon} \geq 0$ can be rejected at 0.00003423 level of significance on the basis of a one-tailed test. That is, one expects $\sigma_{1\varepsilon} > 0$ and $\sigma_{2\varepsilon} < 0$ to occur 99.997 percent of the times.

To further analyze whether owners and renters are better off in their current or alternative tenure, each household's actual wealth position in the existing tenure is compared with its conditional net wealth in the alternative tenure. The difference between the actual net wealth and the expected net wealth conditional on the tenure being otherwise is computed for *individual* households (D_O and D_R). The calculated mean and median D_O and D_R values for the owner and renter subsamples based on different net wealth ols specifications are shown in Table 2.5.

The table indicates that, on average, the owners have much higher net wealth than the renters. The owners' mean actual net wealth is about 7.5 times that of the renters, while the median actual net wealth is about 70.7 times. It is, however, interesting to note that the D_O and D_R values are all positive for *both* homeowners and renters, indicating that they are all better

off in their own selected tenure, but not otherwise. It appears that homeownership enhances the wealth position of the homeowners, but not that of the renters. The conclusion is that households self-select into either homeownership or renting tenure based on their economic and social characteristics, so that they are better off in terms of net wealth accumulation in their respective tenure choices. There is one likely explanation for the renters to be better off remaining as renters than otherwise. For example, highly mobile families may prefer to rent than own their homes so as to avoid the negative impact on their net wealth due to the high costs of home sale upon each move.

The above results apparently lend only partial support to the hypothesis that homeownership improves the wealth position of a household. One possible confounding effect is that renter households that possess other forms of real estate investment could have similarly benefited from the price appreciation of real estate in general. The two-stage procedure is repeated using another net wealth specification that includes a dummy variable for owning other forms of real estate besides the principal residence (*INVRE*). The renters could have also enjoyed high returns from holding financial assets too. Another *BROKACC* dummy variable has been added in this specification to proxy riskiness and portfolio diversity. Controlling for portfolio diversity allows one to focus on the differences in the homeowner and renter net wealth arising strictly from the homeownership decision. The first-stage probit is attached as Appendix 2.7, while the second-stage ols results are presented in Table 2.4.

Table 2.4 indicates that both the *INVRE* and *BROKACC* variables are highly significant and positive in the renter and owner net wealth equations. The confounding effect on renter net wealth arising from the possession of other assets is indeed present. After controlling for

portfolio diversity, the bias-correction variable MILL, although still negative, is no longer significant in the renter equation. This implies that there is neither selection bias in the renter net wealth equation nor correlation between the tenure decision and wealth accumulation for the renters. The renters' expected net wealth under the existing tenure is now the *same* as, and not significantly higher than, the average as before. Had they been owners, the renters would have *below* average conditional expected net wealth. The calculated mean and median D_R values for the renters are still positive, implying that they are better off being renters than owners. It appears that homeownership does not necessarily enhance the wealth position of the renters. Mobile renter households could in effect achieve to some extent similar portfolio options as homeowners, if they rent but own other forms of real estate (and/or financial assets).

For the owners, the increased significance and larger magnitude of the *MILL* variable in Table 2.4, as compared to Table 2.3, shows the positive influence of homeownership on net wealth accumulation over and above the effects due to *INVRE* or *BROKACC*. The mean and median D_O values are positive for the homeowning households. The implication is that those who chose homeownership have an expected net wealth that is higher than the average under random assignment. They are also better off owning than renting.

Thus, the initial results that renters currently have significantly higher than average expected net wealth is attenuated, when one controls for portfolio diversity. Even then, these households are still better off being renters than owners. One could possibly draw the following conclusions. The socio-economic characteristics of the renters, e.g., having high mobility and loose family ties, may have encouraged them to choose the renting tenure in which the wealth accumulation process is optimal for them. They could have achieved similar portfolio options

to some extent as homeowners through the possession of other real estate and financial assets.

As before, the empirical results further show that the underlying wealth accumulation processes are inherently different for the homeowner and renter households. In Table 2.3, the individual t statistics for the coefficient difference of the variables indicate that *MILL, EARNPR, YTRFPR, WHITE, BQUEST, EXPPEN* and *LC5059* have different impact for renters and owners. They are significantly different at $\alpha=0.05$ level of significance. *LC75G* and *LC75GSQ* are different in the owner and renter net wealth equations at the $\alpha=0.10$ level. Based on the Wald statistics, the joint null hypothesis that all the coefficients are the same can be rejected at $\alpha=0.05$ level. Appendix 2.6 contains the regression results based on equation (38), which is another alternative for testing the equality of the slope coefficients in the renter and owner net wealth equations. The results generally concur with those of Table 2.3, with additional variables *INHPST, MARR* and *LC30L* being identified as having different coefficients.

EARNPR, YTRFPR, WHITE and *BQUEST* seem to have a greater positive role in the owners' wealth accumulation process. *EXPPEN* exerts a greater negative effect on owners' wealth accumulation. The coefficients of *LC5059, LC75G* and *LC75GSQ* (the number of years into the 50-59, >75 life-cycle stages and its quadratic effect) are significantly different for the two types of households. The homeowners accumulate wealth from the very early stages of their life-cycle, and dissave only marginally in the later periods after the age of 60, and significantly so after 75. Wealth appears to peak within the 50-59 age range for the owners. Renters tend to have a more irregular pattern of saving behavior. They are dissavers right from the early stages of their life-cycle up to the age of 39. Renter wealth accumulates and peaks within the 40-49

life-cycle stage, only to be drawn down over the years after the age of 50.[43] This result adds another dimension to the findings of two earlier studies. King and Dicks-Mireaux (1982) report that the wealth-to-permanent income ratio peaks at the age of 60-64. Hayashi, Ando and Ferris (1988) affirm that wealth peaks at the age 65. Thus, the homeowner and renters have social and economic characteristics that put them on different wealth accumulation paths over their life-cycles.

Reduced Sample

Analysis using the selected full sample may not be able to address the effects on net wealth of previous home purchases by households. The conclusion that both owners and renters have *above* average expected net wealth in their existing tenure, but not otherwise, could have been attributed to the presence of households in the full sample, which may have experienced housing gains made from previous home sales. In particular, the sample of renters may include previous homeowning retirees moving into smaller rental accommodation to liquidate their housing equity, which may possibly have been augmented by past housing price appreciation. The presence of these households will favorably bias the results of the renter net wealth regressions.

To control for such possible bias, this paper conducts another analysis, using a reduced sample that excludes households that are likely to have liquidated their housing equity earlier through tenure switching. Unfortunately, the 1989 SCF does not contain any information indicating whether there have been previous home purchases. The following discussion focuses

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[43] One may have to make adjustments for differential mortality rate between the rich (who are likely to be homeowners) and the poor (who are likely to be renters), as was done in Shorrocks (1975).

on the identification of these households.

There are a number of notable studies on the liquidation of housing wealth through tenure switches. The Venti and Wise (V & W, 1989) paper finds no systematic tendency among the elderly aged 58 to 63 to give up homeownership. The probability of moving from owner-occupation to rental accommodation is 0.22 based on their Retirement History Survey (RHS) panel data. V & W (1989, 1990) and Feinstein and McFadden (1989) both conclude that the decisions of the homeowning elderly to move are triggered primarily by recent retirement and changes in family composition, such as the death of a spouse, and not by a desire to consume housing wealth. If the elderly move, they are as likely to increase as to decrease housing equity. V & W also discover that families with high income and low housing wealth are as likely, if not more likely, to move as those with low incomes and high housing wealth (which are likely to be liquidity-constrained households). Conditional on moving, the latter group is more likely than the former to liquidate some housing equity. V & W's evidence thus suggests that the typical mover is not liquidity constrained, although some apparently are.

However, there are reasons to believe that V & W's results may have understated the mobility rates. Poterba (1989) comments that the V & W's (1989) reported incidence of moves involving a tenure switch by elderly homeowners may have been downwardly biased by a substantial sample attrition. He compares V & W's low conditional probability of tenure switch at 0.22 to the 1973 Annual Housing Survey (AHS)'s reported 0.39, and Feinstein and McFadden's (1989) figure of 0.373 estimated from the Panel Survey of Income Dynamics. Jones (1993c) provides further evidence to show that liquidation by elderly households involving tenure change from ownership to tenancy is greater than is usually acknowledged. Jones examines the

tenure choices of households that moved during 1980-1985 using the 1985 AHS. He ascertains that no significant net transition appears to occur until homeowners are well into their seventies. The incidence of tenure transition for homeowners doubled from 0.25 for the 55-64 age cohort to 0.52 for the cohort aged 75 and over. On average, the tenure transition rate for homeowners above 55 years of age is 0.37.

Other evidence on mobility rates provided by the U.S. Department of Commerce, Bureau of the Census (1979) and Stahl (1989) suggest a declining mobility rate with age. On the other hand, Feinstein and McFadden (1989) report a declining mobility rate from age 55 to 72, but an increased rate thereafter. Table 2.2 shows the homeownership rates for the United States by age cohorts over the period from 1982 to 1989. It indicates that homeownership rate generally increases with age, peaks at around 80% for the age categories between 60 to 69 years, and then drops sharply to about 70% for the age cohort of 75 years or more. Thus, there is a significant dip in homeownership rate for heads aged more than 75. Homeowners appear to continue to own even after retirement till the age of 75, when they are likely to make the tenure transition decision.

Based on the evidence provided by the above studies, it appears that renters who might have been previous homeowners are likely to be in the cohort aged 75 and over. To control for the possibility that the net wealth of these renter households may have been enhanced by housing equity previously held, the sample excludes 197 households with heads aged 75 and above. It is recognized that this does not totally preclude some renters who had been previous homeowners. The reduced sample consists of 2309 households (617 renters and 1692 owners). The Heckman's two-stage probit/ols analysis is repeated using this reduced sample. Appendix

2.8 shows the first-stage probit results, while Table 2.6 contains the second-stage ols results.

Based on the reduced sample and a net wealth specification including *INVRE* and *BROKACC*, Table 2.6 shows that the elimination of households with heads aged more than 75 years of age results in the owner *MILL* coefficient $\sigma_{1\varepsilon}$ still retaining its positive significance, and the negative renter *MILL* coefficient $\sigma_{2\varepsilon}$ becoming slightly significant at $\alpha=0.10$. The owners have higher than average level of expected net wealth, and are better off owning than renting. The renter households have higher than average expected net wealth, and are better off renting than owning. Relative to the figures in the last row of Table 2.5 based on the full sample, the empirical results indicate that both the owner and renter subsamples excluding older households have slightly higher mean and median difference between actual and conditional net wealth (D_O or D_R). The exclusion of older households raises D_O or D_R, implying that the younger owners and renters who are not likely to be previous homeowners are slightly better off in their respective tenures than when probable previous homeowners are included. This indicates that the problem of previous homeownership increasing the wealth position of household is not seriously confounding the initial results.

As indicated by the t-ratios for the coefficient difference in Table 2.6, the homeowner and renter wealth accumulation processes are inherently different for the reduced sample too. The variables are generally similar to those in Table 2.3 discussed under the full sample analysis. In addition, *CHILDHU* and *INVRE* have a greater positive impact in the owner's net wealth equation.

2.6 CONCLUSIONS

While other factors such as household earned and transfer income, life-cycle factors, bequest motives and past inheritances explain most of the variations in the household net wealth, the evidence from this study suggests that the underlying wealth accumulation paths are inherently different for the owner and renter households. Such insights are made possible through the two-stage estimation of the net wealth equations for a sample stratified by tenure status. The analysis of the full sample indicates that the owners and renters are better off in their own selected tenure, but not otherwise. The possession of a housing asset may have contributed to the accumulation of higher level of net wealth for homeowning households, subject to their being able to access homeownership. Homeowners are placed on a more favorable wealth accumulation path being owners rather than renters. However, this is not the case for the renters, who are better off in their existing tenure.

The result of renters currently having higher than average expected net wealth is attenuated, after accounting for alternative forms of real estate and financial assets held by renter households. Even then, these households are better off being renters than owners. It appears that households self-select themselves into the appropriate tenure in which their wealth accumulation paths are optimal. There is one suggestion for why renters are better off remaining in their current tenure. For example, highly mobile families may prefer to rent than to own their homes so as to avoid the negative impact on their net wealth due to the high costs of home sale upon each move. The socio-economic characteristics of the renters may have encouraged them to choose the renting tenure in which the wealth accumulation process is optimal for them.

TABLE 2.2

HOMEOWNERSHIP RATES FOR THE UNITED STATES, BY AGE OF HOUSEHOLDER: 1982 TO 1989

AGE	1982	1983	1984	1985	1986	1987	1988	1989
Total	64.8	64.6	64.5	63.9	63.8	64.0	63.8	63.9
Less than 25	19.3	18.8	17.9	17.2	17.2	16.0	15.8	16.6
25 to 29	38.6	38.3	38.6	37.7	36.7	36.4	35.9	35.3
30 to 34	57.1	55.4	54.8	54.0	53.6	53.5	53.2	53.2
35 to 39	67.6	66.5	66.1	65.4	64.8	64.1	63.6	63.4
40 to 44	73.0	72.8	72.3	71.4	70.5	70.8	70.7	70.2
45 to 49	76.0	75.3	74.6	74.3	74.1	74.6	74.4	74.1
50 to 54	78.8	78.8	78.4	77.5	78.1	77.8	77.1	77.2
55 to 59	80.0	80.1	80.1	79.2	80.0	80.0	79.3	79.1
60 to 64	80.1	79.8	79.9	79.9	79.8	80.4	79.8	80.1
65 to 69	77.9	78.7	79.3	79.5	79.4	79.5	80.0	80.0
70 to 74	75.2	75.4	75.5	76.8	77.2	77.7	77.7	77.8
75 or more	71.0	71.9	71.5	69.8	70.0	70.8	70.8	71.2
Less than 35	41.2	40.7	40.5	39.9	39.6	39.5	39.3	39.1
Less than 50	55.3	55.1	54.9	54.4	54.2	54.4	54.5	54.4
50 or more	77.2	77.4	77.3	76.9	77.2	77.4	77.1	77.2
65 and over	74.4	75.0	75.1	74.8	75.0	75.5	75.6	75.8

Source: Homeownership Trends in the 1980's, Series H121/90-2. Also in American Statistical Index 1993 (2486-1.18, pg. 16)

TABLE 2.3

2ND-STAGE OLS REGRESSION OF HOUSEHOLD NETWORTH.

FULL SAMPLE:
HOUSEHOLDS WITH -$1 MIL < NW < $5 MIL.
(2506 OBSERVATIONS: 1838 OWNERS & 668 RENTERS).

BIAS-CORRECTED OWNER NW OLS			BIAS-CORRECTED RENTER NW OLS			
VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 1818 DF	VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 648 DF	T-RATIO OF COEFF DIFF
MILL	0.26935E+06	1.830	MILL	-0.17510E+06	-3.098	2.819
EARNPR	13.135	16.720	EARNPR	3.4479	4.719	9.029
YTRFPR	39.308	7.220	YTRFPR	5.4245	1.189	4.770
CHILDHU	18962.	0.958	CHILDHU	-3962.2	-0.289	0.953
MALE	0.22084E+06	2.520	MALE	69095.	1.969	1.607
WHITE	0.16091E+06	2.525	WHITE	19338.	0.613	1.991
MARR	-0.33449E+06	-3.589	MARR	-0.22948E+06	-4.763	-1.001
BQUEST	0.16632E+06	4.375	BQUEST	62257.	2.389	2.258
INHPST	0.43058	7.637	INHPST	0.48153	2.304	-0.235
EXPINH	-20837.	-0.424	EXPINH	18147.	0.506	-0.640
EXPPEN	-0.24275E+06	-5.282	EXPPEN	-73984.	-1.992	-2.856
LC30L	38262.	1.048	LC30L	-10995.	-1.667	1.328
LC3039	13367.	1.147	LC3039	-1516.3	-0.261	1.143
LC4049	31380.	3.633	LC4049	19714.	2.864	1.056
LC5059	9598.8	0.980	LC5059	-21017.	-2.435	2.345
LC6075	-22179.	-0.924	LC6075	17916.	0.823	-1.237
LC6075SQ	869.18	0.528	LC6075SQ	-1220.9	-0.841	0.952
LC75G	-70091.	-1.714	LC75G	22151.	0.650	-1.733
LC75GSQ	6017.4	1.985	LC75GSQ	-953.05	-0.361	1.733
CONSTANT	-0.14040E+07	-2.302	CONSTANT	-28205.	-0.335	-2.235
R-SQUARE ADJUSTED =	0.2643		R-SQUARE ADJUSTED =	0.1561	WALD =	145.4184

	T-RATIO	PDF	CDF	1-CDF
$\sigma_{1\epsilon}$	1.8302	0.07477	0.96631	0.033691
$\sigma_{2\epsilon}$	-3.0981	0.003378	0.001016	0.99898

THE ONE-TAILED TEST OF THE NULL JOINT HYPOTHESIS THAT $\sigma_{1\epsilon} \leq 0$ AND $\sigma_{2\epsilon} \geq 0$ CAN BE REJECTED AT THE (0.033691)*(0.001016)=0.00003423 LEVEL OF SIGNIFICANCE. INDEPENDENCE IN THE TWO SUBSAMPLES IS ASSUMED. THE PDF AND CDF FOR THE T-RATIO ARE THOSE OF THE T-DISTRIBUTION.

TABLE 2.4

2ND-STAGE OLS REGRESSION OF HOUSEHOLD NETWORTH.

FULL SAMPLE:
HOUSEHOLDS WITH -$1 MIL<NW<$5 MIL.
(2506 OBSERVATIONS: 1838 OWNERS & 668 RENTERS).

SPECIFICATION INCLUDES 2 ADDITIONAL INDEPENDENT VARIABLES, INVRE & BROKACC.

BIAS-CORRECTED OWNER NW OLS			BIAS-CORRECTED RENTER NW OLS			
VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 1816 DF	VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 646 DF	T-RATIO OF COEFF DIFF
MILL	0.43759E+06	3.192	MILL	-88197.	-1.538	3.539
EARNPR	8.1345	11.060	EARNPR	2.6671	4.001	5.507
YTRFPR	22.620	4.537	YTRFPR	2.3632	0.555	3.089
CHILDHU	49782.	2.736	CHILDHU	908.20	0.070	2.187
MALE	61516.	0.765	MALE	48770.	1.480	0.147
WHITE	0.13117E+06	2.258	WHITE	24857.	0.840	1.631
MARR	-92917.	-1.072	MARR	-0.15681E+06	-3.347	0.648
BQUEST	0.13190E+06	3.799	BQUEST	51678.	2.111	1.888
INHPST	0.30357	5.872	INHPST	0.38898	1.996	-0.424
EXPINH	-21205.	-0.473	EXPINH	7778.9	0.231	-0.516
EXPPEN	-0.17085E+06	-4.040	EXPPEN	-72093.	-2.042	-1.792
LC30L	28442.	0.849	LC30L	-7331.0	-1.182	1.049
LC3039	12581.	1.187	LC3039	2289.6	0.419	0.863
LC4049	31221.	3.962	LC4049	13359.	2.066	1.752
LC5059	5709.2	0.638	LC5059	-16051.	-1.978	1.802
LC6075	-15109.	-0.688	LC6075	30028.	1.468	-1.504
LC6075SQ	785.64	0.522	LC6075SQ	-2035.0	-1.494	1.390
LC75G	-63893.	-1.710	LC75G	18270.	0.572	-1.672
LC75GSQ	6088.4	2.197	LC75GSQ	-475.40	-0.192	1.767
INVRE	0.42114E+06	10.520	INVRE	0.13023E+06	2.883	4.820
BROKACC	0.66018E+06	14.370	BROKACC	0.50074E+06	8.117	2.073
CONSTANT	-0.13392E+07	-2.387	CONSTANT	-47384.	-0.602	-2.280
R-SQUARE ADJUSTED =	0.3867		R-SQUARE ADJUSTED =	0.2601		WALD = 98.37532

	T-RATIO	PDF	CDF	1-CDF
$\sigma_{1\epsilon}$	3.1922	0.0024721	0.99928	0.00071805
$\sigma_{2\epsilon}$	-1.5384	0.12217	0.062221	0.93778

THE ONE TAILED TEST OF THE NULL JOINT HYPOTHESIS THAT $\sigma_{1\epsilon} \leq 0$ AND $\sigma_{2\epsilon} \geq 0$ CAN BE REJECTED AT THE (0.00071805)*(0.062221)=0.000044678 LEVEL OF SIGNIFICANCE. INDEPENDENCE IN THE TWO SUBSAMPLES IS ASSUMED. THE PDF AND CDF FOR THE T-RATIO ARE THOSE OF THE T-DISTRIBUTION.

TABLE 2.5

COMPARISON OF OWNERS' AND RENTERS' NET WEALTH POSITIONS
UNDER EXISTING & ALTERNATIVE TENURE.
(DOLLARS)
FULL SAMPLE (2506 OBSERVATIONS)

	OWNERS (1838 CASES)		RENTERS (668 CASES)	
	MEAN	MEDIAN	MEAN	MEDIAN
1) ACTUAL NW IN EXISTING TENURE	553570	157000	74177	2220
2) CONDITIONAL NW IN ALTERNATIVE TENURE (specification 1)	- 75819	- 102080	- 325920	- 342610
3) CONDITIONAL NW IN ALTERNATIVE TENURE (specification 2)	161390	44036	- 619450	- 660030
4) DIFFERENCE BETW. ACTUAL AND CONDITIONAL NW (Row 1 less Row 2) = D_O or D_R	629390	330620	400100	388660
5) DIFFERENCE BETW. ACTUAL AND CONDITIONAL NW (Row 1 less Row 3) = D_O or D_R	392190	177320	693630	691370
OVERALL DIFFERENCE BETW. ACTUAL MEAN NW OF OWNERS & RENTERS = 479393				
OVERALL DIFFERENCE BETW. ACTUAL MEDIAN NW OF OWNERS & RENTERS = 154780				

Row 2: Computation is based on net worth specification without INVRE and BROKACC.

Row 3: Computation is based on net worth specification that includes the two additional explanatory variables, INVRE and BROKACC.

TABLE 2.6

2ND-STAGE OLS REGRESSION OF HOUSEHOLD NETWORTH.

REDUCED SAMPLE:
HOUSEHOLDS WITH HEADS OF AGE ≤ 75 YEARS.
(2309 OBSERVATIONS: 1692 OWNERS & 617 RENTERS).

SPECIFICATION INCLUDES 2 ADDITIONAL INDEPENDENT VARIABLES, INVRE & BROKACC.

BIAS-CORRECTED OWNER NW OLS			BIAS-CORRECTED RENTER NW OLS			
VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 1672 DF	VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 597 DF	T-RATIO OF COEFF DIFF
MILL	0.45278E+06	3.183	MILL	-0.10577E+06	-1.744	3.612
EARNPR	8.0430	10.570	EARNPR	2.6242	3.780	5.262
YTRFPR	21.862	4.130	YTRFPR	6.3457	1.265	2.127
CHILDHU	50235.	2.718	CHILDHU	-515.10	-0.039	2.230
MALE	70454.	0.829	MALE	59169.	1.714	0.123
WHITE	0.14666E+06	2.404	WHITE	14501.	0.463	1.927
MARR	-98884.	-1.102	MARR	-0.17465E+06	-3.518	0.739
BQUEST	0.14779E+06	4.040	BQUEST	56468.	2.198	2.043
INHPST	0.37963	6.701	INHPST	0.25051	1.238	0.614
EXPINH	-28058.	-0.614	EXPINH	10125.	0.294	-0.667
EXPPEN	-0.16643E+06	-3.890	EXPPEN	-74867.	-2.079	-1.637
LC30L	31814.	0.935	LC30L	-8384.4	-1.326	1.162
LC3039	12935.	1.202	LC3039	1242.7	0.222	0.964
LC4049	31963.	4.017	LC4049	13155.	1.996	1.820
LC5059	5092.6	0.559	LC5059	-18232.	-2.189	1.889
LC6075	-9073.6	-0.392	LC6075	34195.	1.559	-1.357
LC6075SQ	184.75	0.112	LC6075SQ	-2832.7	-1.832	1.335
INVRE	0.41572E+06	10.050	INVRE	0.11818E+06	2.510	4.748
BROKACC	0.64087E+06	13.180	BROKACC	0.48033E+06	6.929	1.896
CONSTANT	-0.14127E+07	-2.458	CONSTANT	-32587.	-0.403	-2.377
R-SQUARE ADJUSTED =	0.3786		R-SQUARE ADJUSTED =	0.2443		WALD = 91.34326
MEAN D_O =	431440		MEAN D_R =	719300		
MEDIAN D_O =	204140		MEDIAN D_R =	714400		

	T-RATIO	PDF	CDF	1-CDF
$\sigma_{1\varepsilon}$	3.1831	0.002547	0.99926	0.000742
$\sigma_{2\varepsilon}$	-1.7437	0.087308	0.04086	0.95914

THE ONE-TAILED TEST OF THE NULL JOINT HYPOTHESIS THAT $\sigma_{1\varepsilon} \leq 0$ AND $\sigma_{2\varepsilon} \geq 0$ CAN BE REJECTED AT THE (0.000742)*(0.04086)=0.00003032 LEVEL OF SIGNIFICANCE. INDEPENDENCE IN THE TWO SUBSAMPLES IS ASSUMED. THE PDF AND CDF FOR THE T-RATIO ARE THOSE OF THE T-DISTRIBUTION.

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APPENDIX 2.1
VARIABLE DEFINITIONS

NETWORTH	'HOUSEHOLD NONPENSION NET WEALTH'.
EARNPR	'PREDICTED HOUSEHOLD LABOR EARNINGS'.
YTRFPR	'PREDICTED HOUSEHOLD TRANSFER INCOME'.
OWN	'DUMMY FOR OWNERSHIP STATUS (1=OWN)'.
MALE	'DUMMY FOR SEX (1=MALE)'.
WHITE	'DUMMY FOR RACE (1=WHITE)'.
MARR	'DUMMY FOR MARITAL STATUS (1=MARRIED)'.
AGE	'AGE OF RESPONDENT'.
AGES	'AGE OF SPOUSE'.
YRSFULR	'NO. OF YRS WORKED FULL TIME - RESPONDENT R'.
YRSFULS	'NO. OF YRS WORKED FULL TIME - SPOUSE S'.
NJOBHR	'NO. OF FULL-TIME JOBS HELD - RESPONDENT'.
NJOBHS	'NO. OF FULL-TIME JOBS HELD - SPOUSE'.
YRSEDUC	'YRS OF EDUCATION - RESPONDENT'.
YRSEDUCS	'YRS OF EDUCATION - SPOUSE'.
YRSCJOB	'NO. OF YRS AT CURRENT JOB - RESPONDENT'.
YRSCJOBS	'NO. OF YRS AT CURRENT JOB - SPOUSE'.
NOJOB	'DUMMY=1 IF NO OCCUPATION - RESPONDENT'.
MGTPROF	'DUMMY=1 FOR MANAGEMENT/PROF JOBS - RESPONDENT'.
TECSCLRK	'DUMMY=1 FOR TECHNICIANS/SALES/CLERICAL JOBS- RESPONDENT'.
SERVICE	'DUMMY=1 FOR SERVICE-RELATED JOBS - RESPONDENT'.
PRODCRFT	'DUMMY=1 FOR PRODUCTION/CRAFT JOBS - RESPONDENT'.
OPERATOR	'DUMMY=1 FOR MACHINE OPERATORS/LABORERS - RESPONDENT'.
FARMFISH	'DUMMY=1 IF FARM OR FISHERIES-RELATED JOBS - RESPONDENT'.
HHSIZE	'HOUSEHOLD SIZE'.
CHILDHU	'NUMBER OF CHILDREN STAYING IN HOME'
EARN	'EARNED HOUSEHOLD INCOME FROM CURRENT AND EXTRA JOBS'.
YTRF	'HOUSEHOLD TRANSFER INCOME:SOCIAL SECURITY BENEFITS, PENSION INCOME, UNEMPLOYMENT COMPENSATION, WELFARE INCOME'.
BQUEST	'DUMMY=1 IF RESPONDENT AND SPOUSE HAVE STRONG BEQUEST MOTIVE'.
INHER	'DUMMY=1 IF HOUSEHOLD EVER RECEIVES INHERITANCE IN THE PAST'.
INHPST	'DOLLAR AMOUNT OF PAST INHERITANCE RECEIVED'.
EXPINH	'DUMMY=1 IF HOUSEHOLD EXPECTS TO RECEIVE INHERITANCE'.
EXPPEN	'DUMMY=1 IF EITHER R OR S EXPECTS FUTURE PENSION INCOME'.
OWNBIZ	'DUMMY=1 IF HOUSEHOLD OWNS BUSINESS'.
RAVERSE	'DUMMY=1 IF HOUSEHOLD IS AVERSE TO RISK'.
HEALTH	'DUMMY=1 IF HOUSEHOLD HEAD HAS EXCELLENT/GOOD/FAIR HEALTH'.
WIDOWED	'DUMMY=1 IF HOUSEHOLD HEAD IS WIDOWED'.
RETIRED	'DUMMY=1 IF HOUSEHOLD HEAD IS RETIRED'.
WELFAR	'DUMMY=1 IF HOUSEHOLD IS RECEIVING WELFARE ASSISTANCE'.
INVRE	'DUMMY=1 IF HOUSEHOLD HAS OTHER FORMS OF REAL ESTATE O/R THAN HOME'.
BROKACC	'DUMMY=1 IF HOUSEHOLD HAS BROKERAGE ACCOUNT'.

D30L (D1) 'DUMMY FOR 1ST STAGE OF LIFE-CYCLE FOR $AGE<30$'.

D3039 (D2) 'DUMMY FOR 2ND STAGE OF LIFE-CYCLE FOR $30\leq AGE<40$'.

D4049 (D3) 'DUMMY FOR 3RD STAGE OF LIFE-CYCLE FOR $40\leq AGE<50$'.

D5059 (D4) 'DUMMY FOR 4TH STAGE OF LIFE-CYCLE FOR $50\leq AGE<60$'.

D6075 (D5) 'DUMMY FOR 5TH STAGE OF LIFE-CYCLE FOR $60\leq AGE\leq 75$'.

D75G (D6) 'DUMMY FOR 6TH STAGE OF LIFE-CYCLE FOR $AGE>75$'.

LC30L (LC1) 'NO. OF YRS INTO 1ST STAGE OF LIFE-CYCLE FOR $AGE<30$, FROM ASSUMED ACTIVE WORKING AGE OF 15 YEARS OLD. VALUES RANGING FROM 3 TO 15, SINCE MINIMUM AGE IN SAMPLE=18'.

LC3039 (LC2) 'NO. OF YRS INTO 2ND STAGE OF LIFE-CYCLE FOR $30\leq AGE<40$, VALUES RANGING FROM 0 TO 10'.

LC4049 (LC3) 'NO. OF YRS INTO 3RD STAGE OF LIFE-CYCLE FOR $40\leq AGE<50$, VALUES RANGING FROM 0 TO 10'.

LC5059 (LC4) 'NO. OF YRS INTO 4TH STAGE OF LIFE-CYCLE FOR $50\leq AGE<60$, VALUES RANGING FROM 0 TO 10'.

LC6075 (LC5) 'NO. OF YRS INTO 5TH STAGE OF LIFE-CYCLE FOR $60\leq AGE\leq 75$, VALUES RANGING FROM 0 TO 15'.

LC6075SQ (LC6) 'QUADRATIC EFFECT OF NO. OF YRS INTO 5TH STAGE OF LIFE-CYCLE, VALUES RANGING FROM 0 TO 225'.

LC75G (LC7) 'NO. OF YRS INTO 6TH STAGE OF LIFE-CYCLE FOR $AGE>75$, VALUES RANGING FROM 0 TO 16, SINCE MAXIMUM AGE IN SAMPLE=91'.

LC75GSQ (LC8) 'QUADRATIC EFFECT OF NO. OF YRS INTO 6TH STAGE OF LIFE-CYCLE, VALUES RANGING FROM 1 TO 256'.

APPENDIX 2.2

SUMMARY STATISTICS

	ALL OBSERVATIONS (2506 CASES)		OWNER SUBSAMPLE (1838 CASES)		RENTER SUBSAMPLE (668 CASES)	
VARIABLE	MEAN	STD. DEV	MEAN	STD. DEV	MEAN	STD. DEV
OWN	0.73344	0.44225	1	0	0	0
NETWORTH	425790	842820	553570	928810	74177	350770
HPRICE	61948	132970	84462	149020	0	0
HGAIN	76924	168990	104880	189760	0	0
EARN	41797	111470	50770	128110	17106	25083
YTRF	5424.1	13735	6276	15497	3079.9	6294.3
YREP	89375	262530	111660	299510	28060	81543
HHSIZE	2.7638	1.4549	2.8874	1.4287	2.4237	1.4729
CHILDHU	0.94174	1.1894	0.98313	1.198	0.82784	1.1585
AGE	50.399	16.124	53.034	14.673	43.15	17.654
MALE	0.76776	0.42235	0.84168	0.36514	0.56437	0.49621
WHITE	0.79529	0.40357	0.85637	0.35081	0.62725	0.4839
MARR	0.66401	0.47243	0.77584	0.41714	0.35629	0.47926
BQUEST	0.5004	0.5001	0.48749	0.49998	0.53593	0.49908
INHER	0.28731	0.4526	0.33841	0.4733	0.14671	0.35408
INHPST	36457	290140	47533	336030	5980.9	62357
EXPINH	0.19274	0.39453	0.20239	0.40189	0.16617	0.37251
EXPPEN	0.2897	0.45372	0.33134	0.47082	0.17515	0.38038
SAVER	0.72147	0.44837	0.76496	0.42414	0.6018	0.48989
OWNBIZ	0.23424	0.42361	0.284	0.45106	0.097305	0.29660
WELFAR	0.077015	0.26667	0.028836	0.16739	0.20958	0.40731
RAVERSE	0.42019	0.49369	0.37867	0.48519	0.53443	0.49919
CONSUMP	0.1249	0.33067	0.11425	0.31821	0.15419	0.3614
EMERG	0.4154	0.49289	0.38901	0.48766	0.48802	0.50023
LUX	0.066241	0.24875	0.066921	0.24995	0.064371	0.24560
DUR	0.77494	0.41771	0.79217	0.40587	0.72754	0.44556

VARIABLE	MEAN (ALL)	STD. DEV	MEAN (O)	STD. DEV	MEAN (R)	STD. DEV
BROKACC	0.19433	0.39577	0.24755	0.43171	0.047904	0.21372
INVRE	0.31325	0.46391	0.38901	0.48766	0.10479	0.30651
NJOBHR	3.5367	2.9643	3.6589	2.8708	3.2006	3.1857
YRSCJOB	7.8747	9.974	9.3966	10.626	3.6871	6.2203
YRSFULR	24.334	14.362	27.435	13.241	15.804	13.871
YRSEDUC	13.115	3.3544	13.478	3.3046	12.117	3.2894
NJOBHS	1.4812	2.0208	1.7601	2.0896	0.71407	1.5835
YRSCJOBS	2.8536	5.7983	3.5419	6.3053	0.95958	3.4459
YRSFULS	7.7769	9.8368	9.4456	10.172	3.1856	7.0478
YRSEDUCS	8.7813	6.6287	10.368	6.0633	4.4147	6.143
MGTPROF	0.29968	0.45821	0.34929	0.47688	0.16317	0.3698
TECSCLRK	0.15802	0.36483	0.1556	0.36258	0.16467	0.37116
SERVICE	0.056265	0.23048	0.03482	0.18337	0.11527	0.31959
PRODCRFT	0.10375	0.305	0.10501	0.30664	0.1003	0.30062
OPERATOR	0.079808	0.27105	0.068553	0.25276	0.11078	0.31409
FARMFISH	0.011173	0.10513	0.010337	0.10117	0.013473	0.11538
RETIRED	0.2083	0.40617	0.24048	0.42749	0.11976	0.32492
D1	0.094573	0.29268	0.033188	0.17918	0.26347	0.44085
D2	0.19513	0.39638	0.17084	0.37647	0.26198	0.44004
D3	0.21987	0.41424	0.23721	0.42549	0.17216	0.3778
D4	0.18276	0.38655	0.21436	0.41049	0.095808	0.29455
D5	0.22905	0.42031	0.26496	0.44143	0.13024	0.33682
D6	0.078611	0.26918	0.079434	0.27049	0.076347	0.26575
LC1	14.56	1.6175	14.896	0.65709	13.635	2.7327
LC2	8.0431	3.506	8.8341	2.6786	5.8668	4.4649
LC3	5.8053	4.558	6.5675	4.321	3.7081	4.5384
LC4	3.8803	4.5499	4.3874	4.5861	2.485	4.143
LC5	2.6907	4.9851	2.9309	5.0797	2.0299	4.655
LC6	32.081	69.407	34.379	70.507	25.757	65.926
LC7	0.41979	1.7842	0.41785	1.7749	0.42515	1.8109
LC8	3.3583	19.654	3.3232	19.88	3.4551	19.033

APPENDIX 2.3

OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD LABOR EARNINGS.

(DEPENDENT VARIABLE = EARN, PROXY=EARNPR).

FULL SAMPLE (2506 OBSERVATIONS).

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 2488 DF	PARTIAL P-VALUE	CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
AGE	356.45	252.8	1.410	0.159	0.028	0.0516	0.4298
MALE	1300.4	7851.	0.1656	0.868	0.003	0.0049	0.0239
WHITE	-5069.1	5667.	-0.8945	0.371	-0.018	-0.0184	-0.0965
YRSCJOB	310.20	284.6	1.090	0.276	0.022	0.0278	0.0584
YRSFULR	-360.84	257.0	-1.404	0.160	-0.028	-0.0465	-0.2101
YRSEDUC	2190.1	814.2	2.690	0.007	0.054	0.0659	0.6872
RETIRED	-20925.	8095.	-2.585	0.010	-0.052	-0.0762	-0.1043
MGTPROF	46104.	8639.	5.337	0.000	0.106	0.1895	0.3306
TECSCLRK	23392.	8657.	2.702	0.007	0.054	0.0766	0.0884
SERVICE	7684.5	0.1082E+05	0.7100	0.478	0.014	0.0159	0.0103
PRODCRFT	8184.6	9937.	0.8236	0.410	0.017	0.0224	0.0203
OPERATOR	5980.1	0.1024E+05	0.5842	0.559	0.012	0.0145	0.0114
FARMFISH	-5743.7	0.2100E+05	-0.2735	0.784	-0.005	-0.0054	-0.0015
AGES	-14.461	102.2	-0.1416	0.887	-0.003	-0.0033	-0.0064
YRSCJOBS	199.45	429.0	0.4649	0.642	0.009	0.0104	0.0136
YRSFULS	-272.20	290.7	-0.9362	0.349	-0.019	-0.0240	-0.0506
YRSEDUCS	3065.5	553.0	5.543	0.000	0.110	0.1823	0.6440
CONSTANT	-35473.	0.1675E+05	-2.117	0.034	-0.042	0.0000	-0.8487

R-SQUARE ADJUSTED = 0.1147

APPENDIX 2.4

OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD TRANSFER INCOME.

(DEPENDENT VARIABLE = YTRF, PROXY = YTRFPR).

FULL SAMPLE (2506 OBSERVATIONS).

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 2498 DF	PARTIAL P-VALUE	CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
AGE	86.804	20.13	4.312	0.000	0.086	0.1019	0.8066
MALE	-232.35	913.3	-0.2544	0.799	-0.005	-0.0071	-0.0329
MARR	151.37	860.3	0.1759	0.860	0.004	0.0052	0.0185
WHITE	1224.7	638.0	1.920	0.055	0.038	0.0360	0.1796
RETIRED	11305.	777.6	14.54	0.000	0.279	0.3343	0.4342
WELFAR	2428.1	974.8	2.491	0.013	0.050	0.0471	0.0345
AGES	85.817	11.79	7.280	0.000	0.144	0.1588	0.2925
CONSTANT	-3975.2	1191.	-3.339	0.001	-0.067	0.0000	-0.7329

R-SQUARE ADJUSTED = 0.2229

APPENDIX 2.5

1ST-STAGE REDUCED-FORM PROBIT ESTIMATION OF TENURE CHOICE EQUATION. (TO OBTAIN INVERSE MILLS RATIOS, MILL)

FULL SAMPLE (2506 TOTAL OBSERVATIONS)
1838 OBSERVATIONS WITH OWN=1.
668 OBSERVATIONS WITH OWN=0.

DEPENDENT VARIABLE = OWN.

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO	ELASTICITY AT MEANS	WEIGHTED AGGREGATE ELASTICITY
EARNPR	0.71957E-05	0.14050E-05	5.1216	0.10363	0.61945E-01
YTRFPR	0.40107E-04	0.10075E-04	3.9810	0.74958E-01	0.45183E-01
CHILDHU	0.14219	0.33927E-01	4.1911	0.46141E-01	0.33590E-01
MALE	0.41183E-02	0.10827	0.0380	0.10895E-02	0.73263E-03
WHITE	0.33793	0.81258E-01	4.1587	0.92603E-01	0.66022E-01
MARR	0.52826	0.11846	4.4593	0.12086	0.73835E-01
BQUEST	0.48985E-01	0.66323E-01	0.73858	0.84460E-02	0.65976E-02
INHPST	0.11725E-05	0.58164E-06	2.0159	0.14729E-01	0.29697E-02
EXPINH	-0.43727E-01	0.90583E-01	-0.48273	-0.29040E-02	-0.20006E-02
EXPPEN	0.31812	0.79203E-01	4.0165	0.31756E-01	0.21007E-01
LC30L	0.12185	0.29942E-01	4.0697	0.61132	0.46991
LC3039	0.57818E-01	0.15381E-01	3.7590	0.16023	0.11568
LC4049	0.24921E-01	0.15648E-01	1.5926	0.49849E-01	0.33362E-01
LC5059	0.29750E-01	0.19230E-01	1.5471	0.39777E-01	0.26645E-01
LC6075	0.21407E-01	0.47255E-01	0.45301	0.19848E-01	0.15010E-01
LC6075SQ	-0.23193E-02	0.31661E-02	-0.73254	-0.25637E-01	-0.20320E-01
LC75G	-0.42745E-01	0.72166E-01	-0.59231	-0.61829E-02	-0.57610E-02
LC75GSQ	0.17276E-02	0.53843E-02	0.32086	0.19991E-02	0.19024E-02
NJOBHR	-0.23864E-01	0.10028E-01	-2.3798	-0.29081E-01	-0.22654E-01
INHER	0.32703	0.85176E-01	3.8395	0.32375E-01	0.17712E-01
WELFAR	-0.90855	0.12149	-7.4785	-0.24110E-01	-0.22828E-01
CONSTANT	-2.9813	0.40066	-7.4408	-1.0272	-0.78669

LOG-LIKELIHOOD FUNCTION = -966.90
LOG-LIKELIHOOD(0) = -1453.0
LIKELIHOOD RATIO TEST = 972.204 WITH 21 D.F.
PERCENTAGE OF RIGHT PREDICTIONS = 0.82522

MADDALA R-SQUARE 0.3216
CRAGG-UHLER R-SQUARE 0.46847
MCFADDEN R-SQUARE 0.33455
ADJUSTED FOR DEGREES OF FREEDOM 0.32893
APPROXIMATELY F-DISTRIBUTED 0.52669 WITH 21 AND 22 D.F.
CHOW R-SQUARE 0.37818

APPENDIX 2.6

OLS REGRESSION OF HOUSEHOLD NETWORTH BASED ON EQUATION 38 WITH INTERACTION VARIABLES. FULL SAMPLE (ALL 2506 OBSERVATIONS).

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 2468 DF
EARNPR	-7.9525	2.732	-2.911
YTRFPR	-35.254	15.36	-2.295
CHILDHU	-14521.	0.4686E+05	-0.310
MALE	-98443.	0.1207E+06	-0.816
WHITE	65420.	0.1042E+06	0.628
MARR	0.27733E+06	0.1828E+06	1.518
BQUEST	-0.11551E+06	0.8572E+05	-1.348
INHPST	3.2581	1.173	2.777
EXPINH	88167.	0.1224E+06	0.720
EXPPEN	0.32753E+06	0.1563E+06	2.096
LC30L	34632.	0.1683E+05	2.058
LC3039	-725.87	0.2103E+05	-0.035
LC4049	-5658.0	0.2607E+05	-0.217
LC5059	-34434.	0.3191E+05	-1.079
LC6075	18784.	0.7606E+05	0.247
LC6075SQ	328.28	5051.	0.065
LC75G	15685.	0.1036E+06	0.151
LC75GSQ	-592.59	7402.	-0.080
PHI	0.14925E+06	0.3007E+06	0.496
FEARNPR	22.281	3.173	7.021
FYTRFPR	77.305	18.59	4.159
FCHILDHU	30910.	0.5790E+05	0.534
FMALE	0.40820E+06	0.2138E+06	1.909
FWHITE	72355.	0.1496E+06	0.484
FMARR	-0.80509E+06	0.2697E+06	-2.985
FBQUEST	0.32032E+06	0.1090E+06	2.940
FINHPST	-2.8837	1.180	-2.445
FEXPINH	-0.11747E+06	0.1498E+06	-0.784
FEXPPEN	-0.66021E+06	0.1860E+06	-3.550
FLC30L	-74596.	0.1815E+05	-4.110
FLC3039	23445.	0.2869E+05	0.817
FLC4049	39694.	0.3123E+05	1.271
FLC5059	45194.	0.3753E+05	1.204
FLC6075	-38327.	0.9145E+05	-0.419
FLC6075Q	237.38	6167.	0.038
FLC75G	-94258.	0.1371E+06	-0.688
FLC75GQ	7977.0	0.1008E+05	0.791
CONSTANT	-0.22593E+06	0.1893E+06	-1.193

R-SQUARE ADJUSTED = 0.3164

APPENDIX 2.7

1ST-STAGE REDUCED-FORM PROBIT ESTIMATION OF TENURE CHOICE EQUATION. (TO OBTAIN INVERSE MILLS RATIOS, MILL)

SPECIFICATION INCLUDES 2 ADDITIONAL INDEPENDENT VARIABLES, INVRE & BROKACC.

FULL SAMPLE (2506 TOTAL OBSERVATIONS)
1838 OBSERVATIONS WITH OWN=1.
668 OBSERVATIONS WITH OWN=0.
DEPENDENT VARIABLE = OWN.

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO	ELASTICITY AT MEANS	WEIGHTED AGGREGATE ELASTICITY
EARNPR	0.54408E-05	0.14781E-05	3.6810	0.77261E-01	0.46078E-01
YTRFPR	0.34129E-04	0.10250E-04	3.3295	0.62891E-01	0.38001E-01
CHILDHU	0.14689	0.33974E-01	4.3236	0.46998E-01	0.34759E-01
MALE	-0.31254E-01	0.10936	-0.28578	-0.81523E-02	-0.55058E-02
WHITE	0.31632	0.81556E-01	3.8786	0.85468E-01	0.61252E-01
MARR	0.57560	0.12034	4.7832	0.12985	0.79687E-01
BQUEST	0.37834E-01	0.66663E-01	0.56753	0.64320E-02	0.50787E-02
INHPST	0.77568E-06	0.55613E-06	1.3948	0.96076E-02	0.19206E-02
EXPINH	-0.39799E-01	0.90996E-01	-0.43737	-0.26061E-02	-0.18131E-02
EXPPEN	0.33017	0.79547E-01	4.1507	0.32497E-01	0.21766E-01
LC30L	0.11564	0.29583E-01	3.9090	0.57202	0.44324
LC3039	0.56115E-01	0.15409E-01	3.6417	0.15334	0.11132
LC4049	0.22088E-01	0.15705E-01	1.4064	0.43564E-01	0.29306E-01
LC5059	0.29351E-01	0.19381E-01	1.5144	0.38694E-01	0.26029E-01
LC6075	0.26298E-01	0.47605E-01	0.55242	0.24041E-01	0.18259E-01
LC6075SQ	-0.24828E-02	0.31870E-02	-0.77904	-0.27061E-01	-0.21543E-01
LC75G	-0.40018E-01	0.72360E-01	-0.55304	-0.57074E-02	-0.53526E-02
LC75GSQ	0.17385E-02	0.54129E-02	0.32118	0.19836E-02	0.18975E-02
NJOBHR	-0.23747E-01	0.10117E-01	-2.3473	-0.28534E-01	-0.22383E-01
INHER	0.29418	0.86406E-01	3.4047	0.28716E-01	0.15884E-01
WELFAR	-0.87928	0.12160	-7.2310	-0.23007E-01	-0.22336E-01
INVRE	0.19649	0.88465E-01	2.2210	0.20911E-01	0.97031E-02
BROKACC	0.33166	0.11472	2.8911	0.21898E-01	0.78297E-02
CONSTANT	-2.8456	0.39548	-7.1954	-0.96678	-0.74690

LOG-LIKELIHOOD FUNCTION = -959.45
LOG-LIKELIHOOD(0) = -1453.0
LIKELIHOOD RATIO TEST = 987.088 WITH 23 D.F.
PERCENTAGE OF RIGHT PREDICTIONS = 0.82961

MADDALA R-SQUARE 0.3256
CRAGG-UHLER R-SQUARE 0.47432
MCFADDEN R-SQUARE 0.33967
ADJUSTED FOR DEGREES OF FREEDOM 0.33355
APPROXIMATELY F-DISTRIBUTED 0.53677 WITH 23 AND 24 D.F.
CHOW R-SQUARE 0.38554

APPENDIX 2.8

1ST-STAGE REDUCED-FORM PROBIT ESTIMATION OF TENURE CHOICE EQUATION.
(TO OBTAIN INVERSE MILLS RATIOS, MILL)

SPECIFICATION INCLUDES 2 ADDITIONAL INDEPENDENT VARIABLES,
INVRE & BROKACC.

REDUCED SAMPLE (2309 TOTAL OBSERVATIONS)
1692 OBSERVATIONS WITH OWN=1.
617 OBSERVATIONS WITH OWN=0.
DEPENDENT VARIABLE = OWN.

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO	ELASTICITY AT MEANS	WEIGHTED AGGREGATE ELASTICITY
EARNPR	0.55004E-05	0.15204E-05	3.6177	0.82928E-01	0.46683E-01
YTRFPR	0.27325E-04	0.11624E-04	2.3507	0.42529E-01	0.21818E-01
CHILDHU	0.14465	0.34474E-01	4.1958	0.49212E-01	0.33788E-01
MALE	-0.46921E-01	0.11483	-0.40861	-0.12385E-01	-0.77953E-02
WHITE	0.33948	0.85094E-01	3.9895	0.89902E-01	0.58453E-01
MARR	0.59749	0.12492	4.7831	0.13618	0.78188E-01
BQUEST	0.50585E-01	0.70325E-01	0.71931	0.83992E-02	0.60646E-02
INHPST	0.93204E-06	0.64936E-06	1.4353	0.10972E-01	0.19497E-02
EXPINH	-0.54737E-01	0.92466E-01	-0.59197	-0.37929E-02	-0.24381E-02
EXPPEN	0.32400	0.79942E-01	4.0529	0.34076E-01	0.21216E-01
LC30L	0.11795	0.29795E-01	3.9588	0.57457	0.40655
LC3039	0.58328E-01	0.15494E-01	3.7645	0.15409	0.10097
LC4049	0.21802E-01	0.15756E-01	1.3837	0.39835E-01	0.23525E-01
LC5059	0.32765E-01	0.19628E-01	1.6694	0.36907E-01	0.21026E-01
LC6075	0.28141E-01	0.50350E-01	0.55890	0.15485E-01	0.93145E-02
LC6075SQ	-0.22042E-02	0.35341E-02	-0.62369	-0.11549E-01	-0.71330E-02
NJOBHR	-0.28299E-01	0.11526E-01	-2.4552	-0.33681E-01	-0.24272E-01
INHER	0.29947	0.93081E-01	3.2173	0.27886E-01	0.13634E-01
WELFAR	-0.89485	0.13048	-6.8580	-0.22749E-01	-0.20000E-01
INVRE	0.15895	0.91988E-01	1.7279	0.17086E-01	0.73948E-02
BROKACC	0.43364	0.12443	3.4849	0.28095E-01	0.83862E-02
CONSTANT	-2.8915	0.39948	-7.2380	-0.96986	-0.68433

LOG-LIKELIHOOD FUNCTION = -866.43
LOG-LIKELIHOOD(0) = -1340.3
LIKELIHOOD RATIO TEST = 947.751 WITH 21 D.F.
PERCENTAGE OF RIGHT PREDICTIONS = 0.83456

MADDALA R-SQUARE 0.3367
CRAGG-UHLER R-SQUARE 0.49017
MCFADDEN R-SQUARE 0.35356
ADJUSTED FOR DEGREES OF FREEDOM 0.34762
APPROXIMATELY F-DISTRIBUTED 0.57297 WITH 21 AND 22 D.F.
CHOW R-SQUARE 0.40131

APPENDIX 2.9
DERIVATION OF THE INVERSE MILLS RATIOS

$$E[u_{1i}/I_i = 1] = E[u_{1i}/\varepsilon_i > -Z_i\gamma]$$

$$= E[E(u_{1i}/\varepsilon_i)/\varepsilon_i > -Z_i\gamma]$$

$$= \frac{\sigma_{1\varepsilon}}{(\sigma_\varepsilon)^2} E[\varepsilon_i/\varepsilon_i > -Z_i\gamma] \quad \text{since } E(u_{1i}/\varepsilon_i) = \frac{\sigma_{1\varepsilon}}{(\sigma_\varepsilon)^2}\varepsilon_i.$$

$$= \left[\frac{\sigma_{1\varepsilon}}{\sigma_\varepsilon}\right] E\left[\frac{\varepsilon_i}{\sigma_\varepsilon} / \frac{\varepsilon_i}{\sigma_\varepsilon} > -\frac{Z_i\gamma}{\sigma_\varepsilon}\right] \quad \text{using std normal variables. Let } s = \frac{\varepsilon_i}{\sigma_\varepsilon}.$$

$$= \left[\frac{\sigma_{1\varepsilon}}{\sigma_\varepsilon}\right] \left[\frac{\int_{-\left(\frac{Z_i\gamma}{\sigma_\varepsilon}\right)}^{\infty} s \cdot \phi(s)\, d(s)}{1 - \Phi\left[-\frac{Z_i\gamma}{\sigma_\varepsilon}\right]}\right] \quad \text{since } E(s/s>c) = \frac{\int_c^\infty s \cdot \phi(s)\, ds}{1 - \Phi(c)}.$$

$$= \sigma_{1\varepsilon}\left[\frac{\frac{1}{\sqrt{2\Pi}}\int_{-Z_i\gamma}^{\infty} s \cdot \exp\left[-\frac{s^2}{2}\right] ds}{1 - \Phi(-Z_i\gamma)}\right] \quad \text{since } \phi(s) = \frac{1}{\sqrt{2\Pi}}\exp\left[-\frac{s^2}{2}\right] \sim N(0,1) \text{ and } \sigma_\varepsilon = 1.$$

$$= \sigma_{1\varepsilon}\left[\frac{-\frac{1}{\sqrt{2\Pi}}\exp\left[-\frac{s^2}{2}\right]_{-Z_i\gamma}^{\infty}}{1 - \Phi(-Z_i\gamma)}\right]$$

$$= \sigma_{1\varepsilon}\left[\frac{\frac{1}{\sqrt{2\Pi}}\exp\left[-\frac{(Z_i\gamma)^2}{2}\right]}{1 - \Phi(-Z_i\gamma)}\right]$$

$$= \sigma_{1\varepsilon}\left[\frac{\phi(Z_i\gamma)}{1 - \Phi(-Z_i\gamma)}\right]$$

$$= \sigma_{1\varepsilon}\left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)}\right] \quad \text{since } 1 - \Phi(-c) = \Phi(c).$$

$$= \sigma_{1\varepsilon} M_{1i}$$

$$E[u_{2i}/I_i = 0] = E[u_{2i}/\varepsilon_i \le -Z_i\gamma]$$

$$= E[E(u_{2i}/\varepsilon_i)/\varepsilon_i \le -Z_i\gamma]$$

$$= \frac{\sigma_{2\varepsilon}}{(\sigma_\varepsilon)^2} E[\varepsilon_i/\varepsilon_i \le -Z_i\gamma] \quad \text{since } E(u_{2i}/\varepsilon_i) = \frac{\sigma_{2\varepsilon}}{(\sigma_\varepsilon)^2}\varepsilon_i .$$

$$= \left[\frac{\sigma_{2\varepsilon}}{\sigma_\varepsilon}\right] E\left[\frac{\varepsilon_i}{\sigma_\varepsilon}/\frac{\varepsilon_i}{\sigma_\varepsilon} \le -\frac{Z_i\gamma}{\sigma_\varepsilon}\right] \quad \text{using std normal variables. Let } s = \frac{\varepsilon_i}{\sigma_\varepsilon}.$$

$$= \left[\frac{\sigma_{2\varepsilon}}{\sigma_\varepsilon}\right] \left[\frac{\int_{-\infty}^{-\left(\frac{Z_i\gamma}{\sigma_\varepsilon}\right)} s \cdot \phi(s)\, d(s)}{\Phi\left[-\frac{Z_i\gamma}{\sigma_\varepsilon}\right]}\right] \quad \text{since } E(s/s \le c) = \frac{\int_{-\infty}^{c} s \cdot \phi(s)\, ds}{\Phi(c)} .$$

$$= \sigma_{2\varepsilon}\left[\frac{\frac{1}{\sqrt{2\Pi}}\int_{-\infty}^{-Z_i\gamma} s \cdot \exp\left[-\frac{s^2}{2}\right] ds}{\Phi(-Z_i\gamma)}\right] \quad \text{since } \phi(s) = \frac{1}{\sqrt{2\Pi}}\exp\left[-\frac{s^2}{2}\right] \sim N(0,1) \text{ and } \sigma_\varepsilon = 1.$$

$$= \sigma_{2\varepsilon}\left[\frac{-\frac{1}{\sqrt{2\Pi}}\exp\left[-\frac{s^2}{2}\right]\Big|_{-\infty}^{-Z_i\gamma}}{1 - \Phi(Z_i\gamma)}\right]$$

$$= \sigma_{2\varepsilon}\left[\frac{-\frac{1}{\sqrt{2\Pi}}\exp\left[-\frac{(Z_i\gamma)^2}{2}\right]}{1 - \Phi(Z_i\gamma)}\right]$$

$$= \sigma_{2\varepsilon}\left[-\frac{\phi(Z_i\gamma)}{1 - \Phi(Z_i\gamma)}\right]$$

$$= \sigma_{2\varepsilon}\left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma) - 1}\right]$$

$$= \sigma_{2\varepsilon} M_{2i}$$

CHAPTER THREE

HOUSEHOLD CONSUMPTION/INVESTMENT BEHAVIOR AND HOME EQUITY LOANS

CHAPTER 3

3.1 INTRODUCTION

3.1.1 Background

This paper investigates the impact of home equity loans on the consumption/investment behavior of homeowners, household portfolio decisions and the wealth accumulation process. These issues arise from the increased availability and utilization of home equity loans by U.S. households in recent years. Between 1977 and 1994, the percentage of homeowners who hold a home equity loan more than doubled from 5.4% to 12.9%.[44] The 1975-80 property boom and the Tax Reform Act (TRA) of 1986 have apparently contributed to the growth. Housing windfalls in the property boom have increased the level of homeowners' housing equity, against which substantial funds have been raised for various purposes. Further, a change in TRA tax law enhanced the attractiveness of using home equity loans to fund expenditures previously financed by conventional consumer credit. The new TRA tax law restricts the tax deductibility of interest paid on non-mortgage consumer debt, and effectively raises the after-tax interest cost of these debts relative to home equity loans.

Homeowners have four means of borrowing to liquidate their accumulated home equity.[45] First, for households without any prior mortgage commitment, a first mortgage liquidates home equity. The second means involves refinancing an existing first mortgage on the

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[44] Sources: 1977 Survey of Consumer Credit, and 1993-94 Survey of Consumers.

[45] The household could also liquidate its home equity by selling the house, and either purchasing a lower-priced house or renting. The analysis in this paper will not consider this case.

residence for an amount greater than the outstanding mortgage balance plus refinancing costs.[46] The third method is to obtain a post-acquisition junior mortgage in addition to the first mortgage. These junior mortgages have been the traditional home equity loans used by households. The fourth mode involves home equity lines of credit (HELOC) which, since 1982, have become an increasingly popular means of tapping accumulated home equity. These are revolving accounts that allow homeowners great flexibility in borrowing, at their discretion, up to the maximum amount of credit permitted.[47]

During the 1977 to 1989 period, the proportion of mortgage debt holders who have refinanced their first mortgage has increased markedly from only 8 percent to 20 percent.[48] Refinancing activity was strongest in 1986 and 1987, when interest rates were substantially lower than rates in the previous years. Second and junior mortgages grew at an average rate of 23.3% per year during 1980-1987.[49] Although second mortgages accounted for 10.8% of the total mortgage debt outstanding at the end of 1987, there is a growing trend towards increased usage of the HELOC channel. The most recent 1993-94 Survey of Consumers[50] reveals that a greater proportion of homeowners took up the open-ended HELOC than the close-ended second

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[46] Refinancing costs include mortgage fees (points), application and appraisal fees, and other costs associated with obtaining a new mortgage, as well as any prepayment penalty on the old mortgage.

[47] The maximum credit is usually limited to 70 to 80% of the home equity, and is secured by a lien on the residence. HELOC holders are typically charged a variable interest rate, pegged at a margin of 1.5% above the prime rate, which is the commonly quoted index. Other indexes include rates on the 90-day or 6-month Treasury bills. The convenience of immediate access to funds on a continual basis up to the maximum credit has been cited as one reason for its use by nearly 50% of credit line holders in the 1988 Surveys of Consumer Attitudes. It reduces consumers' transaction costs by eliminating the need to apply for credit upon each request for funds. Advantages of tax deductibility and flexible repayment schedules are other cited reasons for borrowers' preference for HELOCs over closed-end traditional loans.

[48] Sources: 1977 Survey of Consumer Credit, and 1989 Survey of Consumer Attitudes.

[49] Manchester and Poterba (1989).

[50] The survey is conducted by the Survey Research Center of the University of Michigan.

mortgage loans (8.3% versus 4.9%).[51] The growth of such credit lines has been spurred by the 1986 Tax Reform Act. The tax advantage and convenience of the home equity credit accounts, coupled with aggressive promotion by creditors offering deeply discounted finance rates,[52] led to its rapid growth from 1986 onwards.

3.1.2 Focus of Study

This paper focuses on three questions raised by the rapid growth of home equity loans:

1) Has the accessibility to home equity loans increased or decreased household savings?
2) Is household consumption/investment behavior with respect to home equity borrowing governed by the life-cycle model, bequest motive model, or precautionary savings model?
3) Have home equity loans affected household portfolio decisions?

The three questions address issues related to home-equity loans. A common objective of the inquiries is to provide a better understanding of the impact of capital market innovations on household consumption/investment behavior, portfolio decisions, and net wealth accumulation. All three aspects are intertwined as shown in Figure 3.1. Household borrowing decision filters through household consumption/investment decisions with respect to the home equity loans, and manifest its impact on the household portfolio shares and net wealth.

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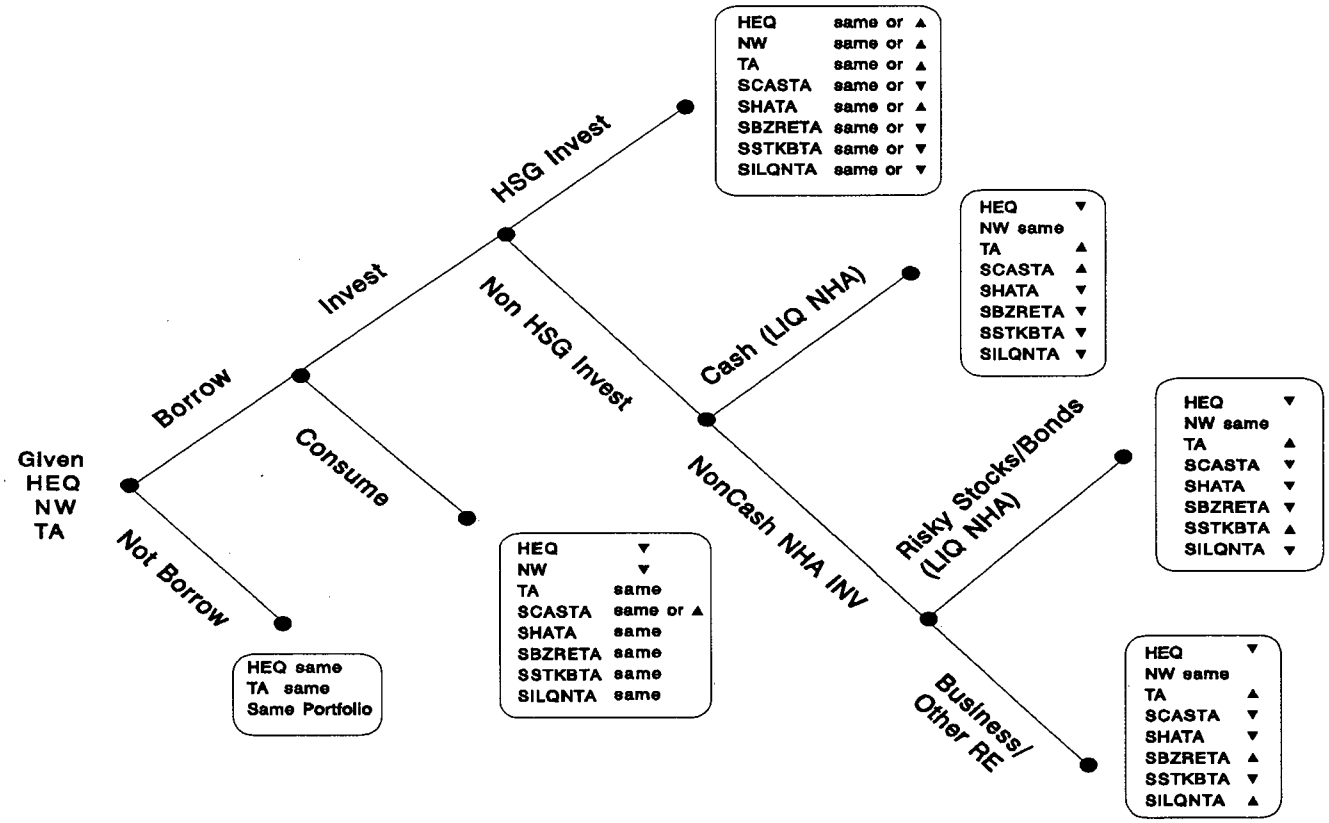
[51] Source: Federal Reserve Bulletin, July 1994, 571-583.

[52] Interest rates for home equity credit lines in 1986/87 are about 8 percentage points lower than those charged on credit card (18%), and about 4 percentage points lower than 24-month personal loan rates (14.5%) (Federal Reserve Bulletin, June 1988). Although mortgage contract rates drop from 9.7% in 1986 to 8.9% in 1987, households have to pay another 2.5% of loan amount in 1986 (2.26% in 1987) for fees and charges (Statistical Abstract of The U.S., 1989).

FIGURE 3.1: Impact of Household Borrowing Decision



Note: This chart shows the immediate impact of household borrowing decision on housing equity (HEQ), net worth (NW), total assets (TA), and portfolio shares of cash, housing, business/real estate, financial, and illiquid nonhousing assets in total asset (SCASTA, SHATA, SBZRETA, SSTKBTA, SILQNTA), assuming the asset market values are held constant. Any subsequent changes in market values of asset should affect these items accordingly.

The first question investigates how the availability of home equity loans affects household savings through the consumption and investment of these funds. The impact on household private savings has important implications for aggregate savings, since household sector wealth is one of its components. Past consumer surveys[53] indicate that home equity loans are basically used for housing improvements, debt repayment, purchase of other nonhousing assets, or for current consumption. When the borrowed funds are invested in housing improvements or other assets that yield positive *net* returns (inclusive of capital gains), the household net worth is likely to increase. If the funds are consumed, or invested in assets generating losses, household net worth will decrease. Past studies have revealed that home equity loans tend to reduce household savings.[54] This study expands previous work by incorporating innovative capital market instruments such as HELOC. It controls for simultaneity between net worth and home equity loans, by using loan proxies obtained from Heckman's (1976) two-stage Probit/Ols estimation method.

The second question examines whether household consumption/investment behavior with respect to home equity loans is governed by the life-cycle model, bequest motive model, or the precautionary savings model. Using multinomial logit (MNL) analysis, the paper empirically tests which of the three models of consumption/saving behavior in Skinner (1993a) is valid for the sample. This is a more direct approach than the analysis in the first question, given that households in the dataset report the primary purposes for which home equity borrowings are used. The knowledge of the motivating forces behind household consumption and investment

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[53] 1987, 1988, and 1989 Surveys of Consumer Attitudes.

[54] Summers and Carroll (1987); Manchester and Poterba (1989).

behavior at the micro level is fundamental to understanding aggregate consumption/investment behavior arising from the household sector. For instance, if the life-cycle model prevails in motivating household consumption/investment behavior, demographic shifts would presumably have a significant impact on the aggregate saving rate.

The third question asks whether the availability of home equity loans has affected household portfolio decisions. The ability to borrow against housing windfalls through innovative home equity loan instruments has undoubtedly altered the illiquid nature of housing investment. In particular, if households could conveniently draw on their HELOCs, the household's desire to hold liquid assets to hedge against portfolio risks arising from a highly undiversified portfolio could be reduced. Households may want to re-structure their typically nondiversified portfolios to the desired mix, by reducing excessive housing equity through home equity loans, and investing the funds in nonhousing assets.[55] After having controlled for other factors that affect portfolio mix, it is expected that households that use home equity loans for portfolio balancing purposes have *lower* shares of cash holdings, liquid assets and housing asset in total assets, but *higher* nonliquid nonhousing asset shares. The ready access to home equity through home equity loans may have reduced the household need to hold liquid assets for hedging purposes, while facilitating portfolio diversification. To account for zero holdings for some assets by some households, this paper adopts Maddala's (1983) two-stage probit/tobit estimation method.[56] If home equity loans exert an influence in the allocation of funds among different assets, this would

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[55] Hendershott & Peek (1985) find that, while many of the observed portfolio shifts are consistent with the passive acceptance of specific asset capital gains, households have in some instances chosen to actively respond to such portfolio shocks.

[56] see Maddala (1983), Model 5, page 246.

again have implications for whether resources are re-channelled to the corporate or household sectors appropriately as desired in economic planning.

The paper is organized as follows. Section 3.2 outlines the contributions of this essay. The remainder of this paper is structured in line with the three questions under investigation. Each question is discussed in a separate section, which includes the literature review, methodology, database employed, empirical specification, and the estimation results. Section 3.3 concentrates on the first issue of how home equity loans affect household net wealth. Section 3.4 focuses on the motivating forces underlying household consumption/investment behavior with respect to home equity loans. Section 3.5 discusses the impact of home equity loans on household portfolio decisions. Section 3.6 concludes the study. Section 3.7 contains the bibliography for this essay.

3.2 CONTRIBUTIONS OF THE PAPER

First, this paper broadens the scope of research on HELOC, which is in an embryonic stage. A number of descriptive papers on HELOC by Canner, Fergus, Luckett and Durkin (1988, 1989, 1994) have emerged, emphasizing the importance of HELOC as an additional loan instrument. This study fills the gap in the Manchester and Poterba's (1989) analysis of the effect of mortgage loans on household net worth, by including HELOC as an additional instrument for liquidation of home equity. The M & P analysis excludes HELOC, as the 1984/1985 Survey of Income and Program Participation (SIPP) dataset predates the sharp growth in HELOC after 1986. This study employs the 1989 Survey of Consumer Finances (1989 SCF), which is a much richer dataset that captures household behavior after the rapid growth of both second mortgages and HELOC. The SCF dataset avoids the problem associated with the top-coding of mortgage

debts, monthly income and house value, which is a limitation of the SIPP dataset used by Manchester and Poterba.

This study controls for possible simultaneity between home equity loans (as well as housing gains)[57] and household net worth. Instead of using the actual outstanding loan balances (as in M & P), it uses proxies for the original home equity loan amounts secured at the time of loan acquisition in the net wealth ols regression. These loan proxies for first, refinanced, second and third mortgages as well as HELOC are obtained using Heckman's (1976) two-stage probit/ols method. The study also uses an alternative constant-quality national house price series compiled by Peek and Wilcox (1991) to construct a measure for accrued housing gain. This nominal price series runs from 1950 to 1989, and is computed basically from the Freddie Mac Weighted-Repeat-Sales house price index. It adjusts for net upgrading that took place through expenditures on addition and alterations to existing stock of houses. Although this national index does not reflect location-specific price movements, it is certainly an improvement over the Census Bureau price series.

Second, this paper expands the existing literature that has hitherto examined the quantitative aspect of the consumption decision using consumption outlays.[58] Existing studies have analyzed the factors influencing the consumption decision using aggregate or household

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[57] The M & P study recognizes the simultaneity between actual outstanding loan balances and net wealth. However, its attempt to control for the endogeneity of outstanding mortgages by using household's outstanding medical and tuition bills as proxies has not been successful. The study also attempts to control for simultaneity between housing gain and net wealth by using a proxy for accrued housing gain, constructed from the Census Bureau constant-quality single-family regional house price indexes. This price series is considered inadequate as it ignores land values.

[58] Deaton (1972), Artle and Varaiya (1978), Flavin (1981), Hall and Mishkin (1982), Hayashi (1985), Skinner (1988), Zeldes (1989), Mankiw and Zeldes (1991), Engelhardt (1993).

expenditures. This paper focuses on the behavioral aspect of the household consumption decision. Using multinomial logit analysis of the qualitative consumption/investment decision of households, it analyses the underlying factors that influence those household decisions at the micro level.

Third, by emphasizing the improved liquidity of housing investment achieved through home equity loans, this paper demonstrates that innovations in the capital market could impact household portfolio decisions. Innovations such as HELOC allow convenient tapping of locked-up resources in an asset that is distinctly illiquid in the homeowner's portfolio. With the growing importance of HELOC, this paper contributes to a better understanding of its potential impact on resource allocation.

3.3 HOME EQUITY LOANS AND HOUSEHOLD NET WEALTH

3.3.1 Literature Review

The first question asks: "Has the accessibility to home equity loans increased or decreased household savings?" This issue has not been extensively examined in the existing literature. A study by Summers and Carroll (1987) contends that the growth in mortgage debt since 1980 has spurred consumer spending and depressed private savings. This assertion is supported by Manchester and Poterba (M & P, 1989), which represents the first attempt at analyzing the impact of first mortgage, refinanced mortgages and second mortgages on homeowner's net worth. Since this first question is an extension of M & P's research, their work is examined in greater detail to allow comparison of the results.

The M & P study uses the 1985 (Wave VII) Survey of Income and Program Participation (SIPP) database. It estimates a reduced-form ols equation for net worth. Similarly defined as in this study, their net worth is inclusive of investments in individual retirement plans such as Keoghs, but exclusive of pension assets and social security wealth. Manchester and Poterba use three independent variables to measure a household's *outstanding* mortgage debt positions in first, refinanced, and second mortgages. Other independent variables include income variables (interacted with age dummies), household head's marital status, household size, number of children, highest year of schooling, occupation dummies, indicator variables for region of residence, and whether household mortgage debt or housing equity was top-coded. In addition, a proxy for accrued housing capital gain, constructed from the Census Bureau regional constant-quality single-family house price series, is used in place of actual housing gain as an explanatory variable. However, this measure ignores land values.

M & P recognize the endogeneity of mortgage debts in net worth ols regression. They first attempt to control for the endogeneity of second mortgages by using the household's outstanding medical and tuition bills, on the ground that they might reflect liquidity shocks that induce borrowing. This resulted in a large standard error for the coefficient of the second mortgage variable. Their second attempt to use indicator variables for the presence of such debts as instrumental variables was also not successful. There is a lack of robustness in the ols estimation when these instrumental variables are used, reflecting the inappropriateness of these variables.

The M & P results indicate that home equity loans have a negative impact on household net wealth. While first mortgage borrowing has a small *positive* effect on household net worth,

refinanced and second mortgages have significant *negative* impacts. Each dollar of refinanced mortgage is associated with between 20 to 30 cents reduction in net worth. The negative effect is stronger when high-income and high-wealth households are included. Each dollar of second mortgage is associated with a larger 75 cents reduction in net worth. The negative relationships suggest that a portion of home equity liquidated under the two forms of home equity loans has been used for consumption rather than investment purposes. The greater impact of second mortgage relative to that of refinanced mortgages implies a greater tendency for second mortgage loans to be applied to consumption purposes (or invested in assets with capital losses).

3.3.2 Methodology

In analyzing the relationship between home equity loans and household net wealth, one has to bear in mind that household debt demand and its net worth are invariably intertwined. In the credit market, the amount of debt a household can secure is subject to the level of its net worth, as prudent lending practices dictate. At the same time, household net worth is directly affected by the total debt held by the household. The presence of such a simultaneous relationship suggests an analysis that uses a simultaneous equation framework. In the context of the question, the model is given by

$$W = \gamma_1 L^* + X_1\beta_1 + u_1 , \tag{42}$$

$$L^* = \gamma_2 W + X_2\beta_2 + u_2 . \tag{43}$$

W is an (Nx1) vector for N observations on household net wealth, and L^* is an (Nx1) vector for household desired debt demand (* denotes a latent variable). X_1 and X_2 are the (k_1x1) and (k_2x1) vectors for the independent variables influencing W and L^*, respectively. β_1 and β_2 are the (k_1x1) and (k_2x1) vectors of structural parameters corresponding to X_1 and X_2, respectively. γ_1 and γ_2 are the parameters relating to L^* and W.

To control for simultaneity between home equity loans and net wealth, loan proxies are derived from Heckman's (1976) two-stage probit/ols method.[59] In the first stage, one obtains the Inverse Mills Ratios from probit estimation of usage of home equity loans (AHEL=1 or 0). One then estimates the ols regressions of debt demand equations, incorporating the selection correction variables, and computes the expected debt amounts *conditional* on the decision to hold positive debt. These loan proxies are subsequently included in the ols regression of the household net worth structural equation (42).

For the first stage of Heckman's method, the criterion function determining the censoring is of the probit type:

$$I_i^* = Z_i\gamma + \varepsilon_i \,. \tag{44}$$

$$\textit{HEL-holder:} \quad AHEL \text{ or } I_i = 1 \quad \textit{iff} \quad I_i^* > 0 \quad (\textit{or} \quad \varepsilon_i > -Z_i\gamma) \,, \tag{45}$$

$$\textit{Non-HEL:} \quad AHEL \text{ or } I_i = 0 \quad \textit{iff} \quad I_i^* \leq 0 \quad (\textit{or} \quad \varepsilon_i \leq -Z_i\gamma) \,. \tag{46}$$

I_i^* is an unobservable latent index measuring the household's net utility gained from the decision to hold HEL relative to that of not having HEL, and I_i *(or AHEL)* is a dummy variable indicating the observed HEL usage status of the household.

If ε_i is correlated with u_{2i}, the expected value of u_{2i} differs from zero. Assuming that ε_i is normally distributed, it can be shown that,

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[59] Heckman's (1976) two-stage PROBIT/OLS method is an alternative to Nelson-Olsen's (1978) single-stage tobit process for obtaining the loan proxies. Unlike the tobit method, Heckman's procedure allows the processes governing the household borrowing decision (probit on whether to borrow any home equity loan) and the debt demand decision (ols on dollar amounts of home equity loans) to differ. See also Maddala (1983), page 158.

$$E(u_{2i}/I_i=1) = \sigma_{2\varepsilon}\left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)}\right] = \sigma_{2\varepsilon}M_i\,, \tag{47}$$

where M_i are the Inverse Mills Ratios for households with HEL. Equation (43) can then be rewritten as:

$$E(L^*/I_i = 1) = \gamma_2 W + X_2\beta_2 + \sigma_{2\epsilon}\left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)}\right]. \tag{48}$$

This debt demand equation is estimated for each type of home equity loan at the second stage. To account for zero loan holding by some households,[60] the appropriate proxies for debt demand should be the expected loan amounts, *conditional* on the household decision to hold positive loan. These are computed using the second-stage ols regressions of debt demand equations, incorporating the Inverse Mills Ratios. Detailed specifications for empirical implementation are discussed in Section 3.4.

[60] The existence of zero loan positions for some households gives rise to censored data (or limited dependent variable) problem. Censoring occurs when one observes actual loan holdings for households with positive desired debt demand, but zero loan holdings for those households without such demand. In other words, the loan amount initially secured on any home equity loan at the time of loan acquisition is only observed above the zero limit. If the dependent variable is limited, simple ordinary-least-squares (OLS) estimates are biased, even asymptotically.

3.3.3 Database

This study employs the 1989 Survey of Consumer Finances (1989 SCF), which is among the few reliable sources of data on family finances.[61] This survey is part of a current series of surveys that has been ongoing on a triennial basis since 1983. It is designed to collect household-level information on the assets and liabilities and income flows of a nationally representative sample of families in the United States. In addition, the survey sought information on the attitudes of consumers toward credit use, their use of financial services and reactions to consumer credit regulations, as well as detailed information on consumer pension rights and benefits. The survey was carried out by the Survey Research Center of the University of Michigan between August 1989 and March 1990.

To ensure a good coverage of the wealthier households, the survey employs a two-part strategy for sampling households. Of the 3143 households in the database, 2277 were selected by standard multistage area-probability sampling methods from the 48 contiguous states. The remaining 866 high-income households in the survey were selected using tax files from the Internal Revenue Service in a manner that preserves the anonymity of the participants.

The unit of observation is the family, which is defined to include all persons who are related by blood, marriage, or adoption, residing together in the same dwelling. The 1989 SCF

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[61] Surveys of consumer finances were conducted annually with support from the Federal Reserve from 1946 through 1970. In 1977, balance-sheet data were collected in the *1977 Consumer Credit Survey* as part of a survey on the use of consumer credit. Another source of balance-sheet data sponsored by the Federal Reserve Board is the one-time *Survey of Financial Characteristics of Consumers* conducted in 1962. Since the 1962 Survey, the *1983 and 1989 Surveys of Consumer Finances* are the most comprehensive survey of household wealth. The 1989 SCF was sponsored by the Federal Reserve Board in cooperation with the Department of the Treasury, the Department of Health and Human Services, the National Institute on Aging, the Small Business Administration, the General Accounting Office, the Comptroller of the Currency, and the Congressional Joint Committee on Taxation.

definition, which differs from that used by the Bureau of the Census, includes one-person units.[62] The income reported is for the year 1988, while other data are as of the date of survey.

This study excludes households that live on farm/ranch/mobile homes, those that neither rent nor own, and cases with missing values on important variables used for computation of the household's current net wealth. In addition, three cases with atypical household size of more than 12 persons, and two other cases that have recording discrepancies have also been deleted. Unlike earlier surveys, the 1989 SCF does not top code the income, asset or liability variables. Anonymity of respondents is preserved by non-disclosure of their location of residence. Other than in cases where variable values cannot be imputed in any way, high income and high wealth households are included in this sample. Since the study is concerned with home equity loans, the sample has also excluded renter households, except in the case when the selection-correction variables (i.e., the Inverse Mills Ratios) are to be derived. As there is a need to construct a proxy for accrued housing capital gain using Peek and Wilcox's (1991) constant-quality national house price series, which only runs from 1950 to 1989, 77 other cases where the home was purchased before 1950 have to be deleted.

There is a necessity to separately distinguish refinanced mortgages from first mortgages acquired at the time of home purchase. Households take up refinancing for a number of reasons. One reason is to reduce the mortgage repayment burden through lower interest rates or longer loan terms obtained from refinancing, given the same loan amount. Such refinancing is likely to increase household net worth, if the differential debt payment is saved or profitably invested,

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[62] The Census definition excludes single individuals, and classifies them as "unrelated individuals".

rather than consumed. Another reason for refinancing is to liquidate the built-up housing equity by way of larger debt borrowings for consumption or investment purposes. Whether the loan is consumed or profitably invested will affect household wealth accumulation. It would be ideal to be able to identify these cases involving an *increase* in the amount borrowed.

However, the 1989 SCF does not have questions uniquely related to refinanced mortgages, as they are all embodied in questions on existing mortgages. Nevertheless, the survey does have information on the date of home purchase and the date of mortgage acquisition. One could only distinguish the refinanced mortgages from the first acquisition mortgages by assuming that refinancing is more likely to have taken place after the date of home purchase. Where the date of existing first mortgage secured is later than the date of home purchase, these cases have been classified as refinanced mortgages. While it is not possible to further identify specific refinancing cases involving an increase in loan amount, Canner, Luckett and Durkin (1990) provide evidence from the 1989 Survey of Consumer Attitudes indicating that 60 percent of those who refinanced also borrow additional funds.

Second mortgages are also different from refinanced mortgages. While most refinancing are obtained at lower interest rates, second mortgages representing additional debt are likely to be used by households that have existing first mortgages contracted at very favorable interest rates. Where the amount of new funds required is small relative to the existing first mortgage, the homeowner would rather take up second mortgages than give up the attractive loan terms through refinancing.

The final sample consists of 1991 homeowners, out of which 915 households have first acquisition mortgages, 278 with refinanced mortgages, 192 with HELOC, 127 with second mortgages, and 53 with third mortgages. Appendix 3.2 summarizes the salient characteristics of the full sample, and the subsamples of households with at least one type of home equity loans, and those households without any home equity loan at all.

3.3.4 Empirical Implementation

The household net worth structural equation for the OLS estimation is specified as a linear function as follows:

$$NETWORTH = f(EARNPR, YTRFPR, CHILDHU, MALE, WHITE, MARR, BQUEST, INHPST, EXPINH, EXPPEN, LC30L, LC3039, LC4049, LC5059, LC6075, LC6075SQ, LC75G, LC75GSQ, HGAINLT, RLACQM, RLREFIN, RLMORT2, RLMORT3, URMHLOCA). \quad (49)$$

Appendix 3.1 provides a complete list of definitions for all variables. The "NETWORTH" of the household is defined as the sum of the market value of cash, deposits, stocks and shares, Keogh and IRA savings plans, other financial assets, vehicles, owner-occupied houses and other real estate, equity in a business, face value of bonds, cash values of life insurance policies, less debts of various kinds. It excludes the present value of future social security and pension wealth, consumer durables other than cars, and the expected value of future inheritances.[63] Since credit market practices typically consider liquefiable net worth in credit evaluation and this paper concerns home equity loans, a definition of household net worth based

[63] King & Dicks-Mireaux (1982), and Manchester & Poterba (1989) have used a similar networth definition that excludes pension assets and social security wealth.

on the current value of liquefiable assets appears appropriate.

This paper has used a linear specification for *NETWORTH* instead of a Log-Log specification, as there is a need to retain those observations with negative net worth.[64] Such observations are likely to reflect the negative impact that home equity loans might have had on the household net worth. The use of "Log Networth" would have censored these important observations. As such, the linear specification is preferred.

For the purpose of this study, the variables that are of prime interest are those related to the five types of home equity loans (*RLACQM, RLREFIN, RLMORT2, RLMORT3, URMHLOCA*). To control for simultaneity and censoring problem due to zero loan positions, loan proxies for first acquisition mortgage (*RLACQM*), refinanced mortgage (*RLREFIN*), second mortgage (*RLMORT2*), third mortgage (*RLMORT3*) and HELOC (*RMHLOCA*) have to be derived from Heckman's (1976) two-stage probit/ols method. In the first stage, household preference for holding debt is estimated using the probit method. The Inverse Mills Ratios (*MILLPHEL*), obtained from the first stage probit, are subsequently included in the second-stage ols regressions of debt demand equation for each type of home equity loans to correct for selection bias. The loan proxies derived are not just the predicted values of the loan amounts, but are the conditional expectations given that the debt amount of that loan type is positive. The probit/ols regressions are reported in Appendices 3.9 to 3.15. In these regressions, dependent variables based on the loan amounts initially secured at the time of acquisition (hereinafter termed "initial loan amount") of each loan type have been used. These measures are more

[64] There are 34 such homeowners in our sample.

appropriate than current outstanding loan balances. Any impact on net worth must necessarily be determined by the amount of initial loan secured and how they are eventually utilized. The use of such measures further reduces simultaneity with household net worth.

In the net wealth structural equation, an interaction variable *URMHLOCA* is used in place of *RMHLOCA* (the loan proxy for the maximum credit allowed on all HELOCs). This interaction variable is equal to the product of *UHELOCA* and *RMHLOCA*. *UHELOCA* is a dummy variable indicating whether any HELOC is drawn upon. Canner, Luckett and Durkin (1989, 1994) reveal that a large number of HELOC-holding homeowners do not draw on their credit accounts, but have apparently established the lines of credit as a standby source of funds. The proportion of unused accounts, however, has declined from about 40% in 1988 to 20% in 1993. For the 1989 sample in this study, 121 out of 192 (63%) HELOC-holders draw on their accounts. Since the impact on net wealth is felt only upon either the consumption or investment of the borrowed funds, it is appropriate that the maximum credit allowed under HELOC is interacted with a dummy variable indicating usage of the credit line.[65]

Household net wealth is affected by whether the borrowed funds are used for investment or consumption. If the funds are utilized directly for consumption purposes, then household

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[65] It may be argued that the mere existence of home equity lines of credit could in itself affect household portfolio decisions. It may encourage households to invest in housing assets of higher value, since housing investment is now made more liquid through convenient tapping of housing equity using HELOCs. In addition to the benefits of tenure security, tax advantage, and prestige associated with homeownership, the preference for real asset as a collateral for later loan applications in the credit market may further increase the attractiveness of diverting more resources into housing asset at the time of purchase. However, it is believed that such manifestations of enhanced liquidity in housing investment through home equity loans would only be evident in future home purchase decisions of potential homeowners, possibly after longer exposure and consumer acceptance of HELOC instruments in the capital market. This behavior may not be reflected in the 1989 Survey of Consumer Finance, which is conducted at a time when home equity lines of credit are relatively new in the market. For future study, the use of panel data that covers the period before and after HELOCs gain popularity is highly recommended.

savings would be depressed, since greater liabilities are incurred with no addition of new assets. If the borrowed funds are profitably invested in assets generating a positive net returns, household net worth is likely to increase.

The 1987, 1988 and 1989 Surveys of Consumer Attitudes indicate that home equity loans are basically used for housing improvements, debt repayment, purchase of other nonhousing assets, or consumed.[66] When the loans are used for home improvements which is a form of housing asset investment, their impact on household net worth depends on whether the home renovation/extension adds to the housing asset value by more than the debt incurred. Net housing equity (and hence, net worth) increases if home value is dramatically increased as a result of the home extension, but declines if the renovation does not enhance its market value.

Where borrowings are used for debt repayment, their ultimate impact[67] depends on whether the original debts are consumer debts, or debts incurred for the acquisition of assets. Consumer debts are presumably incurred for consumption, which reduces household net worth. Where the debts are incurred for the acquisition of assets that yield positive *net* returns, household net worth is likely to increase. In cases where the investments yield returns that are less than borrowing costs, or incur capital losses, household net worth would be decreased.

In debt repayment, one could also be substituting mortgage debt for non-mortgage debt

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[66] Sources: 1987, 1988 and 1989 Surveys of Consumer Attitudes, as well as 1993-94 Survey of Consumers. Details on loan usage are discussed in the results section for the first question. This allows better interpretation of findings on the impact of home equity loans on net wealth.

[67] Although debt repayment merely substitutes one debt component for another without influencing net worth immediately, its effect might be positive in the long run, if the assets acquired with original debts appreciate in values.

to gain a more favorable rate, in which case, the monthly debt payment decreases, releasing funds either for consumption or investments. The subsequent effects of these consumption or investment decisions on net worth are as discussed earlier.

The focus on the household net worth regression is on the sign and magnitude of the coefficients of the home equity loan variables. Near-zero and positive coefficients conclusively signal the use of borrowed funds in asset investment. Near-zero coefficients imply investments yielding returns that marginally offset the costs of acquisition/borrowing, thus maintaining net wealth at the same level. Positive coefficients imply fund investments that generate returns over and above the costs of acquisition/borrowing. These asset returns could include capital appreciation. Negative coefficients do not provide conclusive evidence that borrowed funds are consumed. They could also reflect usage of funds in investments incurring capital losses, thus reducing net worth. The magnitude will indicate the degree to which the investment or consumption of funds impact household net worth.

To separately capture the positive impact that housing price appreciation has on household net wealth, the net wealth regression includes an explanatory variable for accrued housing capital gain as of 1989 (*HGAINLT*). A proxy is used in place of actual housing capital gains to avoid possible simultaneity with net wealth through housing equity. The proxy is calculated for the accrued nominal housing capital gain accumulated since the household head's age of 30 years, rather than from the time of purchase of *current* home. This allows for any capital gains enjoyed on homes that might have been previously owned by the household. It is the lifetime capital

gains that impact household net worth. Data compiled by Chicago Title Insurance Company[68] indicate that the average age of first-time buyers for the period 1977 to 1990 ranges from 28 to 31 years old. In the sample, there are 429 (21.5%) out of 1991 homeowners who are less than 30 years of age.[69] For these households, the accrued capital gains are calculated since their purchase of current home.

This paper adopts Peek and Wilcox's (1991) 1950-1989 constant-quality national house price index series as the basis for calculating the capital gain proxy. The year 1950 is the base year with a price index of 1.000. This series adjusts for net upgrading that took place through expenditures on addition and alterations to existing stock of houses. The construction of the capital gain proxy requires a price series that reflects housing appreciation arising from price inflation rather than from housing improvements. As Manchester and Poterba (1989) points out, a homeowner who spends significant amounts on renovations will report a current market value well above the purchase price, but may not have a capital gain. The use of this series will help sieve out changes in housing asset arising from renovations. The shortcoming is that it does not reflect location-specific price movements.

Using the price indexes in conjunction with the year in which the household head's age is 30, the proxy for life-time housing capital gain (*HGAINLT*) is constructed by computing the difference between 1989 house price index and the price index for the year the household head

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[68] See "The Statistical Abstract of The United States", 1989 and 1992 issues.

[69] *Homeownership Trends in the 1980's*, Series H121/90-2, indicates that over the years 1982-1989, the homeownership rate of those less than 35 years old averages 40 percent. For the same category, our sample reflects a homeownership rate of 42.4 percent. No official figures are available for those less than 30 years old.

is 30 years old (or the price index at the year of current home purchase for younger households less than 30 years of age).

It is further postulated that differences in the current net wealth of individual households, accumulated as of 1989, arise partly from differences in their earnings capacity, as well as differences in their socio-economic and demographic characteristics of the household head (*EARNPR, YTRPR, CHILDHU, MALE, WHITE and MARR*). To control for the endogeneity of total income flows in the net wealth equation, predicted values of household labor earnings (*EARNPR*) and transfer income (*YTRFPR*) are used in place of the actual total household current income. These predicted income flows are obtained from separate OLS regressions of *EARN* and *YTRF* listed in Appendices 3.6 and 3.7. *YTRF* consists of any transfer income currently received by the household in the forms of pension incomes, social security benefits and welfare assistance. *EARNPR* is expected to have a positive coefficient, as households with greater labor earnings save more, given the same expenditure pattern. As for *YTRF*, its influence could be ambiguous. The effect can be positive, indicating that a larger amount of transfer income increases the current nonhuman wealth. Yet, the receipt of transfer income is usually associated with households being in an economically non-productive phase of their life-cycle. This signals a time at which decumulation of wealth is most likely to occur. The coefficient of *YTRFPR* could be negative.

Household heads who are married (*MARR*) are likely to have better labor market outcomes. *MARR* is expected to be positive. Households with children (*CHILDHU*) tend to have higher financial commitment in terms of family expenditures. *CHILDHU* therefore should have a negative coefficient. *MALE* and *WHITE* are expected to have a positive impact on household

net wealth.

Net wealth accumulation could also be affected by a strong desire of the household to leave bequests to the younger generation (*BQUEST*), the dollar amount of any intergenerational transfers received in the past (*INHPST*), and the potential impact that expectations about receipt of future resources such as inheritances and pension funds might have on their savings (*EXPINH, EXPPEN*). King and Dicks-Mireaux (1982) and Hayashi, Ito and Slemrod (1988) recognize the potential importance of the bequest motive on saving behavior. One, therefore, expects *BQUEST* and *INHPST* to deliver a positive boost to household savings. *EXPINH* and *EXPPEN* are likely to exert a negative influence, as households are less inclined to save as vigilantly as before if they are expecting some future income sources.

Extensive literature exists on the life-cycle theory of household savings, which underpins most wealth accumulation studies. The life-cycle theory predicts a hump-shaped pattern of lifetime saving.[70] During the early years of family formation when needs are substantial, households might spend beyond the limits of current income with the expectation that future earnings would rise with work experience. Later, during the productive working years, households accumulate wealth at higher rates by saving part of their income. These accumulated assets then finance consumption during retirement when earnings fall. The wealth-age profile increases during the working lifetime but declines in later years. Other studies, however, have

[70] Modigliani and Brumberg (1954), Modigliani and Ando (1957), Shorrocks (1975), Hayashi, Ando & Ferris (1988) support the life-cycle theory of savings.

rejected the hump-shaped wealth-age profile.[71] To investigate whether the life-cycle model affects net wealth accumulation, the following life-cycle variables for each household i are constructed. This is based on a modified version of the splined age function of King and Dicks-Mireaux (1982):

$$
\begin{aligned}
LC30L_i &= LC_{1i} = D_{1i}(AGE_i - 15) + 15\sum_{j=2}^{6} D_{ji}, \\
LC3039_i &= LC_{2i} = D_{2i}(AGE_i - 30) + 10\sum_{j=3}^{6} D_{ji}, \\
LC4049_i &= LC_{3i} = D_{3i}(AGE_i - 40) + 10\sum_{j=4}^{6} D_{ji}, \\
LC5059_i &= LC_{4i} = D_{4i}(AGE_i - 50) + 10\sum_{j=5}^{6} D_{ji}, \\
LC6075_i &= LC_{5i} = D_{5i}(AGE_i - 60) + 15D_{6i}, \\
LC6075SQ_i &= LC_{6i} = D_{5i}(AGE_i - 60)^2 + 225D_{6i}, \\
LC75G_i &= LC_{7i} = D_{6i}(AGE_i - 75), \\
LC75GSQ_i &= LC_{8i} = D_{6i}(AGE_i - 75)^2,
\end{aligned}
\tag{50}
$$

where D_{ji}'s are age-bracket dummy variables defined for the head of household i, aged AGE_i:

$$
\begin{aligned}
D_{1i} &= D30L = 1 \quad if \quad AGE_i < 30, \quad zero\ otherwise, \\
D_{2i} &= D3039 = 1 \quad if \quad 30 \le AGE_i < 40, \quad zero\ otherwise, \\
D_{3i} &= D4049 = 1 \quad if \quad 40 \le AGE_i < 50, \quad zero\ otherwise, \\
D_{4i} &= D5059 = 1 \quad if \quad 50 \le AGE_i < 60, \quad zero\ otherwise, \\
D_{5i} &= D6075 = 1 \quad if \quad 60 \le AGE_i \le 75, \quad zero\ otherwise, \\
D_{6i} &= D75G = 1 \quad if \quad AGE_i > 75, \quad zero\ otherwise.
\end{aligned}
\tag{51}
$$

[71] Atkinson (1971), Atkinson and Harrison (1978), King and Dicks-Mireaux (1982), Kennickell (1984), Ando and Kennickell (1987), Kennickell (1990) found no tendency for wealth to decline with age.

Leaving out the other independent variables for the moment, one essentially has the following linear regression on the life-cycle variables:

$$W_i = a_0 + \sum_{j=1}^{8} a_j LC_{ji} + u_i . \tag{52}$$

The life-cycle variables, *LC30L* to *LC75GSQ*, capture the linear and non-linear wealth accumulation effects over the number of years in the various life-cycle stages that the household head has passed, right up to the present stage as indicated by his age. The youngest age at which working life begins is assumed to be age 15. The value a_0 reflects the average wealth level at the age of 15. The coefficients of *LC30L* to *LC5059* (a_1 to a_4) measure the linear rate of change in wealth in the first four age brackets, while the coefficients of *LC6075* to *LC75GSQ* (a_5 to a_8) measure both the linear and nonlinear rate of change in wealth in the years after age 60. Such a formulation allows one to test whether a maximum wealth level occurs (i.e., one of the coefficients of *LC6075SQ* and *LC75GSQ* must be negative, if the wealth-age profile is hump-shaped) and if so, to estimate the age at which this happens. Depending on the age bracket in which the wealth-age profile peaks, the maximum is reached at either $AGE_i = 60 - (a_5/2a_6)$ or $AGE_i = 75 - (a_7/2a_8)$.[72]

As of 1989, wealth accumulation by each household would have been affected by the entire historical path of differing rates of return and accruals of capital gains/losses on different

---

[72] The first order derivative of W_i with respect to AGE_i is given by:

$$\frac{\partial (W_i)}{\partial (AGE_i)} = a_1 D_{1i} + a_2 D_{2i} + a_3 D_{3i} + a_4 D_{4i} + a_5 D_{5i} + 2a_6 D_{5i}(AGE_i - 60) + a_7 D_{6i} + 2a_8 D_{6i}(AGE_i - 75) .$$

The second order derivative of W_i with respect to AGE_i is given by:

$$\frac{\partial^2 (W_i)}{\partial (AGE_i)^2} = 2(a_6 D_{5i} + a_8 D_{6i}) .$$

For a hump-shaped wealth-age profile, the second order derivative must necessarily be negative, implying that either a_6 or a_8 must be negative. The age at which the peak of the profile occurs is derived by setting the first order derivative to zero.

assets in the wealth portfolio. However, it is difficult to incorporate variables which directly track the relevant trajectory of the rates of return before 1989 for individual assets owned by each household, as well as the changing portfolio composition over the life-time of the household. The life-cycle variables are used to proxy the entire historical path faced by the households. Given the same age, two households would have been exposed to the same influences of past prevailing economic conditions on their accumulation of assets. These variables, however, would not capture the impact on wealth accumulation due to different portfolio compositions.

Since the analysis uses a homeowner subsample, sample selection bias arising from possible simultaneity between tenure choice decision and net wealth accumulation is corrected by including an Inverse Mills Ratio computed from probit estimation of tenure choice (*MILLOWN*) in the net wealth equation.

3.3.5 Results

Before examining the main net wealth ols estimation results in Table 3.2, this section will first discuss the preliminary Heckman's two-stage probit/ols estimation results in Appendices 3.6 to ? for obtaining the loan proxies. The Heckman method controls for any simultaneity between household preference for holding debt and the debt demand, yielding parameter estimates that are consistent. Any correlation between the errors in the debt preference and debt demand equations would be reflected in the Inverse Mills Ratios (*MILLPHEL*). Focusing first on the probit for debt preference in Appendix 3.10, one notes that the probability of using home equity loan increases with household earnings (*EARNPR*), and with the propensity to borrow for consumption (*CONSUMP*) and car purchase purposes (*DUR*). Life-time housing capital gains

(*HGAINLT*) increase the likelihood of a household taking up a home equity loan. This result concurs with Manchester and Poterba's (1989). Households with older heads (*AGE*) or a large downpayment-to-house-price ratio at the time of home purchase (*EHPRATIO*) are less likely to borrow.

As for the second-stage ols debt demand regression results in Appendices 3.11 to 3.15, the results show that selection bias occurs only in the refinanced, second and third mortgage equations. *MILLPHEL* is significantly positive in these three debt demand ols equations. This implies that households with a greater debt preference are likely to demand levels of refinanced/second/third mortgage amounts that are higher than the average. Households with high earnings (*EARNPR*) or an inclination to borrow for consumption purposes (*CONSUMP*) are likely to demand a higher first or third mortgage debt. The positive coefficient of *EARNPR* probably reflects in part the ability of high-income families to qualify for higher levels of borrowing. First mortgage debt demand is negatively related with household propensity to borrow for car purchase (*DUR*). Life-time housing gain (*HGAINLT*) plays a role in motivating households to demand more of second and third mortgage debts. Households with higher net wealth (*NWPRED*) appear to have higher demand for refinanced mortgages and HELOC. The demand for HELOC as a standby credit line is confirmed by the significant positive coefficient of the variable indicating household inclination to borrow for emergency purposes (*EMERG*).

Turning now to the main issue of interest, Table 3.2 shows the estimation results for the linear specification of household net worth, after having controlled for selection bias from using homeowner subsample, endogeneity of loan demand, and zero loan positions. The insignificant *MILLOWN* indicates that there is no selectivity bias for this sample arising from homeowner

tenure status. Although the results differ on the details, they concur with Manchester and Poterba's (1989) in the main. Where the coefficients are significant, home equity loans tend to *reduce* household net wealth. The implication is that the home equity loans are used for consumption, or are invested in assets that do not generate positive net returns.

Focusing on the home equity loan variables, one observes that first mortgage (*RLACQM*) and HELOC (*URMHLOCA*) significantly reduce household net worth. The negative coefficients suggest that these borrowed funds are likely to have been consumed, or that the funds have been invested in assets that have not generated the expected returns to more than cover the costs of acquisition/borrowing.[73]

The 1987, 1988 and 1989 Surveys of Consumer Attitudes[74] indicate that the most prevalent uses of HELOC are for the repayment of other debts and home improvement (see Appendices 3.3 to 3.5). Canner, Fergus and Luckett (1988) report that 53% of the households cited repayment of other debt as the first use of their HELOCs in the 1987 survey. 25% indicated home improvement as motivating their borrowing decision. Other uses include auto purchase, business and financial investments, payment of educational and medical expenses, real estate investment, and expenditures for vacation and consumer durables.[75] Based on the above

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[73] The 1989 SCF database does not have information that shed light on the usage of first mortgage. However, information is available on how HELOC is being used by those who have such credit facility. About 47% of HELOC-holders in the sample report using the funds for consumption.

[74] Sources: Federal Reserve Bulletin, June 1988 (page 365), May 1989 (page 337), and August 1990 (page 609) issues. These surveys are conducted by the Survey Research Center of the University of Michigan.

[75] The recent 1993-94 Survey of Consumers reports that there has been a surge in the use of HELOC for business expenses (28% of HELOC users) since 1988, although the predominant uses of HELOC are still home improvement (64%) and repayment of other debts (45%) [Source: Federal Reserve Bulletin,July 1994, page 577].

reported usages, the negative coefficient of HELOC is consistent with the suggestion that the funds have been consumed, or deployed to repay debts incurred mainly for consumption purposes or for investment in loss-incurring assets.

Refinanced, second and third mortgages have insignificant positive impact on household net worth. The positive coefficient is consistent with impact arising from investment of borrowed funds. The 1980 Census of Housing reveals that 51% of borrowers have used second mortgages for home improvements (instead of debt repayment) and 18% for investments in either real estate or other assets. For the sample under examination, 72% of households with second mortgages and 60% of third-mortgage holders report investing the borrowed funds in housing improvements or nonhousing assets. Although the 1989 SCF dataset does not have information relating to the purpose of usage for refinanced mortgages, another 1989 Survey of Consumer Attitudes reveals that the first four important uses of refinanced mortgages, in decreasing order, are home improvement, repayment of other debts, purchase of other real estate, and business investment. The estimation results are consistent with the four reported investment uses (see Appendix 3.4).

The results on first, second and refinanced mortgages are contrary to those of Manchester and Poterba (1989). In the M & P study, first mortgages have a small positive effect, while second and refinanced mortgages exert a significantly negative impact on household net worth. My results show that first mortgages have a significant negative impact, while second and refinanced mortgages have insignificant positive impact. This suggests that first mortgages are more likely to have been consumed, but it is not the case for second and refinanced mortgages. It is believed that the estimated parameters in the M & P study may be biased arising from the endogeneity of mortgage debts in the net wealth equation for that study. Having controlled for

such endogeneity through Heckman's two-stage probit/ols method, this study should yield parameters that are consistent.

Life-time housing capital gains (*HGAINLT*), calculated using national house price index, apparently have no significant impact on household net wealth. It may help improve the estimation if there is a constant-quality housing price series that capture location-specific price movements. The result differs from the M & P's (1989) conclusions that housing price appreciation affects net worth in a positive and significant manner. However, the results are not comparable since the price series used in that study does not include land values.

Households that have received past inheritances (*INHPST*), or have high labor earnings (*EARNPR*), are likely to have high net wealth. The coefficient of *YTRFPR* is negative, but insignificant. Households with heads who are *WHITE*, or have a strong bequest motive (*BQUEST*) tend to possess higher levels of net worth. These findings are consistent with existing literature. It appears that the expectations of future inheritances (*EXPINH*) and pension income (*EXPPEN*) have decreased household's incentive to save, and have exerted a negative impact on household net worth.

The life-cycle variables support the hump-shaped wealth-age profile only to some extent. Net wealth accumulates at an increasing rate from early *LC30L* life-stage. It continues to accumulate but at a decreasing rate during the *LC6075* and *LC75G* life-stages.[76] The significant positive signs shows that the older cohorts are in fact not dissaving, but continuing to accumulate

[76] Based on Canadian data, King & Dicks-Mireaux (1982) find that net wealth peaks in the age bracket 60-64, and decumulation occurs in the retirement phase.

wealth.

In summary, the empirical results concur with Summers and Carroll's (1987) and Manchester and Poterba's (1989) main conclusions that the growth in mortgage debt has decreased household savings. In particular, first mortgages and HELOCs have significant negative impact on household net worth. This suggests that these borrowed funds are likely to have been consumed, or invested in assets that do not yield net positive returns. Contrary to M&P's results, second and refinanced mortgages do not exert a significant negative impact on household net worth. Past inheritances received, high labor earnings, strong bequest motive and white race are other important factors positively affecting household net wealth accumulation, while expectations of future inheritances and pension income tend to decrease household's incentive to save. The hump-shaped wealth-age profile is only partially supported. There is evidence of continued wealth accumulation, albeit at a decreasing rate, even during the later life-stages of the household.

3.4 HOME EQUITY LOANS AND CONSUMPTION/INVESTMENT BEHAVIOR

3.4.1 Literature Review

This section is concerned with the second question: "Is household consumption and investment behavior with respect to home equity loans governed by the life-cycle model, bequest motive model, or the precautionary savings model?"[77] Is the life-cycle model, that depicts young households as partly consuming housing windfalls in the early stages of their life-cycle, saving during the productive life-stages, and drawing down the remaining housing equity to

[77] See Skinner (1993a) for more discussion on the three models.

finance retirement consumption, corroborated? Or, as predicted by the bequest motive model, households are motivated to refrain from consumption with little drawdown on housing windfalls, in order to pass it along to the next generation? Is the third precautionary savings model, which views housing wealth as a form of insurance against retirement contingencies, and predicts that housing equity is only cashed out in bad states (e.g., widowhood, decline in health, or income downturn), a more valid description of the data?

The increase in the housing equity induced by the 1975-80 property boom has enabled households to raise substantial funds through home equity loans for consumption or investment needs. The few empirical papers on the effect of changes in housing wealth on consumption/ saving of households provide mixed evidence. Time-series studies by Bhatia (1987) and Hendershott and Peek (1987) suggest that the marginal propensity to consume out of housing wealth is between 4 and 5 cents. Similarly, Manchester and Poterba (1989) present evidence suggesting that homeowners who enjoy large unanticipated accrued housing gains are more likely to use second mortgages to liquidate their housing equity for consumption purposes. Other studies, however, have concluded that housing wealth changes arising from fluctuations in house prices do not influence consumption and saving behavior (Skinner, 1989; Venti and Wise, 1990; Levin, 1992). High psychic moving costs, bequest motive, and the lack of a well-functioning reverse mortgage market that allows tapping of housing equity have been cited as reasons for the little impact that housing wealth changes have on consumption and saving.

Skinner (1989) initially arrives at the conclusion that housing windfalls, whether expected or unexpected, do *not* have a large impact on consumption, if the bequest motive is so strong as to motivate households to bequeath the housing capital gain to the next generation. Although

a cross-section time-series regression shows a small but significant positive impact of housing wealth on consumption,[78] a fixed-effect model of consumption that corrects for heterogeneity among homeowners finds no effect. However, such results based on 1973-1983 Panel Study of Income Dynamics dataset could be reflective of household behavior before the sharp growth of innovative home equity loan instruments.

Using a more recent 1984/1989 PSID dataset, Skinner (1993a) ascertains that housing windfall *does* appear to affect the saving behavior of homeowners prior to retirement. It reduces the need for other types of precautionary savings, and increases consumption among middle-aged homeowners. Macro estimates in that paper suggest an effect corresponding to approximately six cents increase in consumption when housing wealth rises by one dollar. Skinner (1993a) concludes that the precautionary savings model reconciles the empirical observations that households are spending part of their housing windfalls while young, but not typically tapping into housing windfalls to finance consumption when old, unless bad states occur. This paper empirically tests which of Skinner's three models of consumption/investment behavior with respect to housing wealth is consistent with the data.

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[78] A 23% increase in the market value of housing would increase consumption by 1.4%.

3.4.2 Methodology

This paper applies the multinomial logit (MNL) model to analyze household consumption/ investment choice decisions, based on the primary purpose reported by households for the use of home equity loan funds. Households must choose one of three distinct uses:

(1) housing investment,

(2) nonhousing investment, or

(3) nonhousing consumption.

The explanatory variables include sets of variables that would help distinguish Skinner's three models of consumption/investment behavior. It is assumed that all borrowed funds are primarily channelled into that use. The following highlights the MNL model.

In the MNL analysis, a household i must choose one of $J \geq 2$ alternatives. Let y_{ij} be a binary variable that takes the value 1 if the jth alternative, $j = 1, \ldots, J$, is chosen and 0 otherwise. The probability that household i will select alternative j is $P_{ij} = \Pr[y_{ij} = 1]$. Then

$$\sum_{j=1}^{J} y_{ij} = \sum_{j=1}^{J} P_{ij} = 1 . \tag{53}$$

Given a sample of N households, the likelihood function is

$$L = \prod_{i=1}^{N} P_{i1}^{y_{i1}} P_{i2}^{y_{i2}} \ldots P_{iJ}^{y_{iJ}} , \tag{54}$$

or

$$\log L = \sum_{i=1}^{N} \sum_{j=1}^{J} y_{ij} \log P_{ij} . \tag{55}$$

It is assumed that each observation is drawn from independent distributions.

Such models are motivated employing the random utility model, in which the utility to a consumer of an alternative j is specified as a linear function of the household-specific attributes, plus an error term:

$$U_{ij} = \bar{U}_{ij} + \varepsilon_{ij} = \alpha_j' Z_i + \varepsilon_{ij} . \tag{56}$$

Z_i is a (Kx1) vector of household-specific attributes, and α_j is a (Kx1) vector of parameters relevant to the j alternative. The parameter vector is indexed by j, indicating that explanatory variables may have differential impacts depending upon the alternative. ε_{ij} is a random error that captures unobserved variations in tastes and in the attributes of alternatives, and errors in the perception and optimization by the household. These random utility error terms are assumed to be independently and identically distributed as a log Weibull (or type I extreme-value) distribution. The log Weibull distribution[79] has a probability density function

$$f(\varepsilon_{ij}) = \exp(-\varepsilon_{ij} - e^{-\varepsilon_{ij}}) , \tag{57}$$

and cumulative distribution function

$$F(\varepsilon_{ij} < a) = \Pr(\varepsilon_{ij} \leq a) = \exp(-e^{-a}) . \tag{58}$$

Given the utility function, each household chooses the alternative that maximizes his or her utility. The probability that the first alternative is chosen is

$$\begin{aligned} P_{i1} &= \Pr[U_{i1} > U_{i2} \text{ and } U_{i1} > U_{i3} \ldots \text{ and } U_{i1} > U_{iJ}] \\ &= \Pr[(\varepsilon_{i2} - \varepsilon_{i1}) < (\bar{U}_{i1} - \bar{U}_{i2}) \text{ and } \ldots \text{ and } (\varepsilon_{iJ} - \varepsilon_{i1}) < (\bar{U}_{i1} - \bar{U}_{iJ})] . \end{aligned} \tag{59}$$

[79] It has a mean of 0.577, and a mode at zero.

The difference between any two random errors with the log Weibull distribution has a logistic distribution function. The probabilities arising from this logistic model are

$$P_{ij} = \frac{\exp(\alpha_j' Z_i)}{\sum_{j=1}^{J} \exp(\alpha_j' Z_i)} . \tag{60}$$

The odds of choosing the kth alternative relative to the first are given by

$$\begin{aligned} \frac{P_{ik}}{P_{i1}} &= \frac{\exp(\alpha_k' Z_i)}{\exp(\alpha_1' Z_i)} \\ &= \exp[Z_i' (\alpha_k - \alpha_1)], \quad k = 2, \ldots, J . \end{aligned} \tag{61}$$

Normalizing by setting $\alpha_1 = 0$, and using the fact that the probabilities of all alternatives must sum to 1, one has

$$\begin{aligned} P_{i1} &= \frac{1}{1 + \sum_{j=2}^{J} \exp(\alpha_j' Z_i)} , \\ P_{ij} &= \frac{\exp(\alpha_j' Z_i)}{1 + \sum_{j=2}^{J} \exp(\alpha_j' Z_i)} , \quad j = 2, \ldots, J . \end{aligned} \tag{62}$$

The model also implies that the log of the odds ratios are

$$\ln\left[\frac{P_{ij}}{P_{i1}}\right] = \alpha_j' Z_i , \tag{63}$$

and

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = Z_i' (\alpha_j - \alpha_k) . \tag{64}$$

By differentiating (18), the marginal effects of the vector of regressors Z on the probabilities P_j are derived as:

$$\frac{\partial P_j}{\partial Z} = P_j \left[\beta_j - \sum_k P_k \beta_k \right] \tag{65}$$

The parameters of the MNL model are estimated using maximum likelihood procedures, based on the likelihood function L defined earlier. Given the characteristics of a household, one could then estimate the probability of that household choosing a particular alternative.

Although computationally easy, the MNL model has a drawback. It rests upon a very strong behavioral assumption referred to as the "independence of irrelevant alternatives" (IIA). The odds of a particular choice relative to another are *unaffected* by the presence of additional alternatives. The MNL model will be inappropriate whenever two or more of the alternatives are close substitutes. It predicts too high a probability of selection for two alternatives that are in fact perceived as similar rather than independent by the household.[80] This is the result of assuming the errors ε_{ij} are independent [Albright, Lerman, and Manski (1977)]. For the question under investigation, this is not a problem as the three alternatives (housing investment, nonhousing investment, and nonhousing consumption) are distinctly different.

[80] As an example, consider a commuter who is indifferent between private car and bus as a mode of travel. The odds ratio is 1:1. The probabilities of commuting by private car and bus are 1/2, 1/2 respectively. Suppose an extra (red) bus service is now added, differing from the existing (blue) bus service only in the color of the buses. If the commuter treats the two bus services as equivalent, one would expect the probability of commuting by bus to be cut in half between the two close substitutes. Thus, the probabilities of commuting by blue bus, red bus, and private car are 1/4, 1/4, and 1/2, respectively. Unfortunately, this is not the case. Instead, the MNL model produces the probabilities 1/3, 1/3, 1/3, to preserve the odds ratio. Note that the probabilities on the close substitutes are higher than expected. See Maddala (1983), page 62.

3.4.3 Database

The households in the 1989 SCF disclose the primary purpose[81] for which HELOC, second and third mortgages are used. These purposes are classified into three major groups in the following manner:

1) Housing Investment (*HINV*)

Includes home purchase, home improvement/addition, home repairs/maintenance/upkeep.

2) Nonhousing Investment (*NHINV*)

Includes investment in businesses, stocks/bonds, IRA deposit, gold, real estate, and other asset investments.

3) Nonhousing Consumption (*NHCON*)

Includes purchase of car/truck/other vehicles/household consumer durable goods, indoor and outdoor hobby/entertainment/recreational goods. Special expenses for travel/vacation, medical/dental treatment, education, tax/insurance, weddings/funerals, moving, personal needs, living costs and miscellaneous needs are classified under this category.

Dummy variables are created for each use category, taking the value of 1 if borrowed funds are applied to that use and zero otherwise. No such information is, however, available for the first acquisition and refinanced mortgages. However, Jones' (1993b, 1994a) works suggest that the majority of mortgage debts is used to finance nonhousing investments. For refinanced mortgages, Canner, Luckett and Durkin (1990) report that the most frequent uses, in decreasing

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[81] Households also report secondary uses of HELOC loan funds. When the secondary uses are similarly classified into three major categories, households have, in fact, 3x3 ways of using the borrowed funds. Ideally, a multinomial logit analysis based on the nine possible choices should have been conducted, but the sample size for each choice would be too small for effective analysis. As such, the analysis is based on the three mutually exclusive primary uses.

order of importance, are to finance home improvement, repayment of other debts, purchase of other real estate, and investment in business based on the 1989 Surveys of Consumer Attitudes.

Separate MNL analyses for household consumption/investment decisions relating to HELOC and second mortgages are conducted. Comparison of the two analyses could reveal any divergence in household behavior, arising from differences in the perceived roles of home equity loans in household portfolio. There are insufficient observations for similar analysis with third mortgages. In the sample, there are only 53 households that have a third mortgage. There are 121 observations for HELOC loan, and 127 cases for second mortgages. Out of 121 households that draw on their HELOC accounts, 64 invest the borrowed funds (40 invest in housing, and 24 in nonhousing assets), while 57 households consume. Of the 127 second-mortgage holders, 91 households invest (73 invest in housing and 18 in nonhousing), while 36 households consume.

3.4.4 Empirical Implementation

To distinguish among Skinner's three models of household consumption/investment behavior, the analysis uses sets of explanatory variables appropriate for each model. For the MNL analysis, NHCON (nonhousing consumption) is designated as the base alternative, in which case its parameter vector is normalized to zero. All other coefficients of the explanatory variables for NHINV (nonhousing investment) and HINV (housing investment) alternatives are interpreted relative to this base alternative. Zero coefficients in either the NHINV or HINV decisions indicate that the decision is on par with the consumption decision. Positive coefficients in either NHINV or HINV imply a stronger prevalence of that decision over the consumption decision. The differential impacts between the NHINV and HINV decisions arising from an explanatory variable can be derived from the difference in the coefficients of that variable.

For the 'life-cycle model', the relevant explanatory variables are the age category dummies (*D3039, D4049, D5059, D6075, D75G*). The sign and magnitude of the coefficients will indicate whether households generally consume in the early stages of their life-cycle, and save during the productive life stages to finance consumption during retirement phase. The variables *D3039* to *D5059* (the productive age range from 30 to 59 years) are expected to have positive coefficients, and *D6075* and *D75G*, to have a negative coefficient in the NHINV and HINV decisions. These coefficients are relative to the consumption decision. Any significance in these variables lends support to the 'life-cycle model' that has hitherto dominated literature on household consumption decision.

The strength of the 'bequest motive model' will be measured by the coefficient of the *BQUEST* variable. Households with strong bequest motive will refrain from consumption with little drawdown on housing windfalls. One expects *BQUEST* to have a negative impact on the consumption decision, but a positive impact on the investment decisions. Relative to the consumption decision, the coefficient of *BQUEST* is expected to be positive in the NHINV and HINV decisions, if the bequest motive model holds.

If the 'precautionary savings model' has any important role in the household consumption or investment of home equity loans, it will be reflected in the *NOJOB, HEALTH* and *WIDOWED* dummy variables. The model views housing wealth as a form of insurance against retirement contingencies, and predicts that housing equity is only cashed out in bad states. Interpretation of the coefficients of the variables could be confounded by whether the home equity loans have been secured before or at the time of occurrence of 'bad states', such as being unemployed (*NOJOB*=1), having poor health (*HEALTH*=0), and widowed (*WIDOWED*=1). Household

consumption/investment behavior is more precisely characterized if the loans are secured at the time when 'bad states' occur. However, the occurrence of such states may reduce the likelihood of the household even qualifying for a loan or the likelihood of being included in the subsample of HEL-holders. If home equity loans are already in place before the bad states happen, one would expect the households to use the remaining borrowed funds for consumption rather than investment when the bad states occur. In other words, *NOJOB* and *WIDOWED* should have *negative* coefficients in the NHINV and HINV decisions, while *HEALTH* is expected to be *positive* in these two decisions. Any significance in these variables gives support to the precautionary savings model.

The MNL analysis also includes other variables, such as *NWPRED* (predicted net wealth) and *CHILDHU* (number of children in the household). The possession of high net wealth (*NWPRED*) generally gives the household greater liberty to both consume and invest. In terms of investment, Ioannides (1989) reveals that households with higher net wealth tends to have a lower relative share of housing equity in net wealth, but a higher share of other real estate investment. He affirms that net financial asset share is insensitive to net wealth, but is positively related to earned income. Therefore, one expects *NWPRED* to exert a positive influence on consumption, a negative impact on housing investment, and zero/positive impact on nonhousing investment. In terms of the MNL parameters, *NWPRED* would have *negative* coefficients in the HINV, but *positive* coefficient in the NHINV if the nonhousing investment decision is even stronger than the consumption decision.

Households with more children (*CHILDHU*) are generally expected to have a higher probability of channelling borrowed funds into current consumption, rather than investment. The

coefficients of *CHILDHU* would be negative in the NHINV and HINV decisions. However, the presence of children could induce a bequest motive in altruistic households, motivating them to refrain from consumption and to increase their wealth through investment. In this case, *CHILDHU* could be positive in the NHINV and HINV decisions. In the context of the model, since any influence of bequest motive would have been captured by the dummy variable *BQUEST*, the variable *CHILDHU* should reflect the negative effect arising from higher expenditure for families with larger number of children.

3.4.5 Results

Table 3.3 presents both the MNL results on household consumption/investment behavior with respect to HELOC and second mortgage (MORT2) to facilitate comparison. There is evidence to suggest that the 'bequest motive model' is not a valid model for describing the consumption/ investment behavior of the households in the sample. *BQUEST* is not significant at all, and has the wrong sign indeed in both the usage decisions of HELOC and MORT2. The 'life-cycle model' and the 'precautionary savings model' provide a better description of the household behavior.

The highly significant age dummy variables (*D3039* to *D75G*) in both HELOC and MORT2 suggest the prominence of the 'life-cycle model'. Large, positive coefficients of *D3039* to *D6075* indicate that the households do not liquidate housing wealth for consumption purposes, but rather use the borrowed funds for investment over their productive age 30-60 life stages and even till the age of 75. HELOC is distinctly used for consumption only by households whose

heads are above 75 years old.[82] When invested, HELOC is likely to be used for housing investment (HINV), while MORT2 is for nonhousing investment (NHINV), as indicated by the larger magnitude of the coefficients for that use.

The 'precautionary savings model' is partially supported. While jobless (*NOJOB*) and widowed (*WIDOWED*) heads continue to invest borrowed funds in housing,[83] they are more likely to consume than use the funds for nonhousing investment. This probably reflects the situation that the households already have the home equity loans in place before the occurrence of the 'bad states'. The loans could have been initially secured for housing investment. But the bad events result in the households consuming borrowed funds and becoming more cautious about nonhousing investment. *HEALTH* is expected to have positive signs in both HINV and NHINV decisions, as healthy household heads (*HEALTH*=1) are more likely to invest relative to those in ill health who would likely consume. However, *HEALTH* is positive for both HINV and NHINV decisions in the MORT2 case, but not for HELOC.

The opposite signs of *HEALTH*, *MARR* and *CHILDHU* in HELOC and MORT2 indicate that different home equity loans are perceived to have different roles in household consumption/ investment behavior. Other than the zero coefficient of *NWPRED*, most variables have coefficients that differ in magnitude and sign. The insignificant zero coefficients of *NWPRED* imply the minimal influence of net wealth on the decisions of liquidating housing wealth for

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[82] *D75G* is not applicable to the 127 second mortgage holders, as none of these households has heads who are older than 75 years old.

[83] It is to be noted that the primary purpose for housing investment (HINV) includes uses such as home repairs/maintenance/upkeep, which may be appropriately interpreted as consumption.

investment purposes relative to consumption. Healthy and married household heads tend to consume HELOC, but use MORT2 for investment. On the contrary, households with children tend to consume MORT2. It is noted that *MALE* household heads tend to be more aggressive in liquidating housing wealth through HELOC and MORT2 for nonhousing investments.

In summary, household consumption/investment behavior with respect to HELOC and second mortgage borrowings is motivated by the "life-cycle model". Households are likely to invest the borrowed funds over the productive life-stages, and consume only after age 75. The "precautionary savings model" is partially supported, as household heads affected by bad events, such as loss of job and widowhood, are more likely to cash out part of the housing equity for consumption rather than for nonhousing investment, while retaining their housing asset. The "bequest motive model" is, however, not corroborated.

3.5 HOME EQUITY LOANS AND HOUSEHOLD PORTFOLIO DECISIONS

3.5.1 Literature Review

The third question asks: "Have home equity loans affected household portfolio decisions?" The linkage between household portfolio decisions and home equity loans has only been recently explored [Manchester and Poterba (1989), Jones (1993b, 1994a, 1994b)]. Extensive literature has developed on the theory of portfolio selection, while other empirical studies have mainly focused on examining the structure of household portfolio composition and the extent of diversification, estimating the joint discrete/continuous asset choice decision, and

evaluating the impact of taxation on portfolio composition.[84]

Theoretical discussions on portfolio theory have assumed that individuals choose their portfolios to maximise expected utility in a world of perfect information, perfect capital markets with no transaction costs or taxes. This basic model predicts an investor portfolio that is characterized by the (market) mutual fund. The proportions of wealth invested in each type of asset depend entirely on the stochastic characteristics of various assets, and are independent of the characteristics of individual investors. If these individuals exhibit constant relative risk aversion and have additively separable intertemporal utility function, the optimal portfolio is independent of total wealth and age.[85]

However, the existence of transaction costs, indivisibilities of investments, capital market imperfections and the tax systems in the real world makes it progressively more difficult to derive any firm predictions about portfolio structure. It is unlikely, as seen in later discussions, that portfolio decisions are unaffected by wealth and age. Analysis of portfolio behavior has become very much an empirical task that sets out to test broad implications of the theory. There are only a few empirical studies of investor behavior at the micro level, as data on household asset holdings are not readily available until recently.

The first empirical study by Uhler and Cragg (1971) examines household portfolio

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[84] Uhler & Cragg (1971), Friend & Blume (1975), Feldstein (1976), Sandmo (1977), Shorrocks (1982), King & Dicks-Mireaux (1982), King & Leape (1984), Hubbard (1985), Ortmeyer and Peek (1986), King & Leape (1987), Ioannides (1989, 1992), Svensson & Werner (1993), Perraudin & Sorensen (1993), Jones (1994b).

[85] Samuelson (1969) and Merton (1969).

behavior in terms of its choice among a few levels of diversification, its likelihood of holding a particular combination of assets given a specific level of diversification, and the amount of financial assets held at each level of diversification. The results indicate that wealth and income positively influence the level of diversification (number of financial assets held) and the dollar amount of financial assets held. However, these variables do not affect the choice of particular asset combinations within each level of diversification.

Later studies by Feldstein (1976) and Hubbard (1985) include taxation as additional influencing factor, as taxes alter the relative net yields on different assets received by the household. Feldstein (1976) concludes that the personal income tax has a strong effect on individuals' portfolio asset demands, after controlling for net wealth, age, sex and the ratio of human to nonhuman capital. As marginal tax rate increases, the demand for common stock/municipal bonds increases, while that for other types of financial assets such as bank accounts and all other bonds decreases.

King and Leape (1984) provide some conflicting evidence on tax effects. Their results show that marginal tax rates are a significant determinant of asset ownership, but *not* of the share of net worth invested in the asset. Their findings suggest that the magnitude of the distortion induced by taxation on household portfolio choices may be less than previously thought.[86]

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[86] This study omits the impact of taxation upon portfolio decisions as our dataset does not have information on locations of households, which are important in deriving the full impact of federal and state tax laws specific to the household. It is premised on King & Leape's (1984) findings.

Other research focuses on the impact of the life cycle on wealth composition. Shorrocks (1982) examines the relative importance of wealth and age effects on portfolio composition. The influence of wealth is considerably stronger than the age effect for shareholdings, and the property categories. Age effect is dominant in the holdings of life insurance, property debts, and other personal asset category. Housing share in net wealth has an inverted U-shaped relationship with wealth, and tends to fall with age. King and Leape (1987) record a pronounced life cycle pattern in both the number and the value of assets held by U.S. households.

Several studies reveal that the observed portfolio structures are not consistent with predictions from the basic portfolio theory [King and Leape (1984, 1987)]. Most households have incomplete portfolios, in which housing is by far the most important asset. The existence of incomplete portfolios is attributed to transaction and monitoring costs, restrictions on short sales for certain assets, taxes, heterogeneous beliefs about the distribution of asset returns, as well as incomplete information.[87] Large transaction costs inhibit the speedy adjustment of household wealth portfolios as hedging needs change. Grossman and Laroque (1990) show that in the presence of a proportional transaction cost, households do not change their holdings of illiquid assets like housing for small changes in wealth, unless its share is very much below or above certain thresholds.

Studies have also recognized that the dominance and illiquidity of housing asset result in large portfolio risks being assumed by homeowners. Plaut (1987) suggests that the illiquidity of housing asset induces risk-averse households to accumulate *additional* financial assets beyond

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[87] Auerbach and King (1983), King and Leape (1984), Perraudin and Sorensen (1993).

that necessary for downpayment *before* home purchase, to hedge against housing price uncertainty. Grossman and Laroque (1990) demonstrate that transaction costs cause the consumer to act in a more risk averse manner with regard to risky assets. They show that just *after* purchasing a new house, the household holds *less risky assets* than it would in the absence of transaction costs. The possession of a highly illiquid housing asset has thus engendered a need in households to hold more liquid and less risky assets for hedging purposes. This finding corroborates Ioannides' (1989) empirical evidence of substitutability among housing asset, financial assets, and other forms of real estate assets. The presence of housing asset reduces the relative shares of financial assets and other forms of real estate in the household's total wealth.

The analyses by Plaut (1987) and Grossman and Laroque (1990), however, do not allow for the possibility that a household can tap accumulated housing equity after home purchase. In recent years, the ability to borrow against housing windfall through innovative home equity loan instruments has undoubtedly altered the illiquid nature of housing investment. In particular, if households could conveniently draw on their HELOC, the household's desire to hold liquid assets for precautionary motives could be reduced. Further, increased household wealth resulting from unanticipated housing capital gains gives the household greater latitude to engage in active portfolio management. Households may want to re-structure their typically nondiversified portfolios to the desired mix, by reducing excessive housing equity through home equity loans, and investing the funds in nonhousing assets.

Studies have also uncovered the link between mortgage debt demand and household portfolio composition. Manchester and Poterba (1989) present some evidence of a link between mortgage debt and small business financing. Their study observes that households with higher

mortgage debts have larger net holdings of business equity and other real estate and IRAs, but have lower financial assets such as corporate stock/mutual funds and interest-bearing assets. They also conclude that accrued housing capital gains have significant positive impact on the net holdings of other real estate, interest-bearing assets, vehicle equity, and IRAs, besides housing equity. This finding is consistent with the results of Hendershott and Peek's (1985) study which, using macro data, shows that while many of the observed portfolio shifts are consistent with the passive acceptance of specific asset capital gains, households have in some instances chosen to actively respond to such portfolio shocks.

Recent studies highlight the importance of nonhousing portfolio objectives in the demand for mortgage debt (Jones, 1993b, 1994a, 1994b). Jones (1993b) establishes that 79% of wealthy young American households and 59% of older wealthy households have home mortgage debt in excess of the minimum mortgage debt derived from housing demand. About half the mortgage debt of young U.S. households and about three-quarters of the older cohort's are used to finance nonhousing asset positions. The prevalence of nonhousing portfolio objectives in mortgage debt demand is also evident in Canadian household data.[88] Jones (1994a) provides further evidence that the demand for mortgage debt is positively linked to household asset preferences for vacation homes, closely held businesses and investment real estate.

This paper investigates the impact of home equity loans on portfolio balancing decision by examining the relative shares of cash holdings, principal residence, business/other real estate

[88] Jones (1993b) also analyzes the mortgage debt demand for Canadian households, and finds that the proportion of young Canadian households with excess mortgage debt is of the same order of magnitude found for young U.S. households. The proportion of mortgage debt used for financing nonhousing assets is about 40% for young Canadian households.

assets, financial assets, and illiquid nonhousing assets in total assets. The hypothesis is that the ability to borrow against locked-up housing equity through home equity loans encourages homeowners to hold less cash (in saving and checking accounts, and IRA/Keogh) due to reduced precautionary needs. Further, *if* portfolio diversification is the prime motivation behind investment of home equity borrowings, one expects the households to diversify from housing asset towards nonhousing assets. This is to reduce portfolio risks associated with the dominance of housing asset in the household wealth portfolio. The nonhousing assets could be business assets, other forms of real estate[89] and/or risky financial assets, such as stocks/bonds/mutual funds/money market instruments.

3.5.2 Methodology

If the decision to hold home equity loans is tied in with the household portfolio balancing decisions, it would be simultaneously linked to the portfolio shares of various asset groups. In other words, portfolio asset shares could have been affected by whether one chooses to use home equity loans to facilitate active portfolio management. To account for this simultaneity and censoring problem arising from zero holdings of some assets by some households, this paper adopts Maddala's (1983) two-stage probit/tobit estimation method. It is a simultaneous equation model in which the censoring of one dependent variable (e.g., desired portfolio asset shares) is of the tobit type, and the other dependent variable (e.g., desire to hold home equity loan) is observed only as a dichotomous variable. In this case, the simultaneous model is formulated as

[89] These include vacation home, investment apartment building, commercial property, including properties owned in partnership with other people (but excluding business assets).

$$S^* = \gamma_1 D^* + X_1\beta_1 + u_1 , \tag{66}$$

$$D^* = \gamma_2 S^* + X_2\beta_2 + u_2 . \tag{67}$$

S^* is an (Nx1) vector for household desired portfolio share for an asset, and D^* is an (Nx1) vector for household latent desire to hold debt (* denotes a latent variable). X_1 and X_2 are the (k_1x1) and (k_2x1) vectors for the independent variables influencing S^* and D^*, respectively. β_1 and β_2 are the (k_1x1) and (k_2x1) vectors of structural parameters corresponding to X_1 and X_2, respectively. γ_1 and γ_2 are the parameters relating to D^* and S^*.

Censoring arises as one observes the actual household portfolio asset share S only when the desired portfolio share S^* is positive. Such censoring is of the tobit type wherein:

$$\begin{aligned} S &= S^* \qquad \text{if } S^* > 0 \\ S &= 0 \qquad \text{otherwise} \end{aligned} \tag{68}$$

The household's desire to hold home equity debt is observed as a binary outcome in which:

$$\begin{aligned} D &= 1 \qquad \text{if } D^* > 0, \\ D &= 0 \qquad \text{otherwise}. \end{aligned} \tag{69}$$

D is a dummy variable indicating the observed usage of home equity loan by the household. It is observed when the latent desire to hold debt D^* is greater than zero.

The reduced forms are

$$\begin{aligned} S^* &= X\Pi_1 + v_1 , \\ D^* &= X\Pi_2 + v_2 , \end{aligned} \tag{70}$$

where X includes all the exogenous variables in X_1 and X_2. Π_1 and Π_2 are vectors of reduced-form parameters corresponding to X in the two reduced-form equations.

The two-stage estimation method involves estimating the reduced-form equation for D^* by the probit method at the first stage. Next, it estimates the structural equation for S by the tobit method at the second stage, using $\hat{D}^*$ obtained from the first-stage reduced-form probit for D^*.

3.5.3 Database

This paper analyzes specifically the portfolio share decisions of households that use the second, third mortgages, or the HELOC. As these households report the primary purpose of usage for these types of loans, it will facilitate interpretations of results. A dummy variable (HEL=1) is defined for these households if they use any of the above three types of loans. There are 357 households that hold any one or more of the above three home equity loans.

Table 3.1 shows the mean portfolio shares of five asset groups in total assets, and the mean dollar amount of each asset group for different subsamples of households. The shares of asset categories in total assets[90] are denoted, with a brief description of the asset components within each category, as:

(1) *SCASTA* - cash holdings

(saving and checking account, IRA/Keoghs, cash value of life insurance policies),

(2) *SHATA* - housing asset,

(3) *SSTKBTA* - financial assets

(stocks/bonds/mutual funds/trust funds/money market instruments),

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[90] Portfolio shares are expressed as proportions of total assets, instead of net worth as is commonly done in past research. To analyze how households allocate the borrowed funds among different assets, the use of total assets as the basis is more appropriate, as the allocation behaviour is not clouded by the confounding negative values often encountered in book values of net worth. The impact of loan size could be separately analyzed by incorporating regressors relating to various home equity loans into the portfolio share equations.

(4) *SBZRETA* - business/other real estate,

(5) *SNHATA* - all non-housing asset, but excluding principal residence car/special vehicles.[91]

From Table 3.1, households that use second/third mortgages or HELOC appear to have a slightly lower *SCASTA, SSTKBTA*, and *SNHASTA*, than the corresponding means for the whole sample. They have a slightly higher *SHATA*, and very much higher *SBZRETA*. Non-HEL households have portfolio shares which are close to the average. It appears that HEL-holders have lesser concern for holding cash, and have invested HEL funds primarily in business investment, and housing improvement, rather than in risky financial assets. These summary statistics provide some support for the proposed hypothesis. However, it is misleading to conclude based on comparison of sample means. One needs to control for differences in household attributes, and the level of home equity loan exposure that affects these portfolio shares. That is the main focus of the following section.

3.5.4 Empirical Implementation

In analyzing the third question, this paper employs Maddala's (1983) two-stage probit/tobit method. At the first stage, reduced-form probit analysis of whether a household uses any of the 3 specified home equity loans (*HEL*=1 or 0) is conducted to obtain the predicted probabilities (*HELPRED*). The reduced-form probit estimation uses all the exogenous variables in the system of equations. The first-stage probit results are shown in Appendix 3.16. Predicted values for *HELPRED* are later used in five separate sets of second-stage tobit regressions of portfolio shares of households.

[91] For consistency, we have excluded car and special vehicles, as we have defined these purchases to be consumption earlier.

The relative shares of asset categories in total assets to be used as dependent variables in the 5 sets of tobit regressions at the second stage are:

(1) *SCASTA*

(2) *SHATA*

(3) *SSTKBTA*

(4) *SBZRETA*

(5) *SILQNTA* - all illiquid non-housing assets (including antiques, works of art, jewellery) other than principal residence and car/special vehicles.

The following basic form of structural equations is estimated for most of the asset categories:

RELATIVE SHARE OF A PARTICULAR ASSET GROUP IN TOTAL ASSETS

$$= f\ (HELPRED,\ NWPRED,\ AGE,\ MALE,\ WHITE,\ HHSIZE,\ RAVERSE,\ HEALTH,\ WIDOWED,\ RETIRED,\ RLACQM,\ RLREFIN,\ CRLMORT2,\ CRLMORT3,\ CRMHLOCA). \quad (71)$$

This paper tries to further minimize the simultaneity problem between household net wealth and portfolio shares, by using the predicted household net worth (*NWPRED*) as a regressor. The ols regression for *NWPRED* is shown in Appendix 3.8. The variables *HEALTH, WIDOWED,* and *RETIRED* are used only in the *SCASTA* (cash holding) tobit, as these are considered states in which the household might be induced to hold more cash for precautionary purposes.

The tobit regression could not be applied to *SHATA* (housing share), as the observations for *SHATA* are all positive in this sample, which comprises homeowners. In this case, the

appropriate methodology should be the two-stage probit/OLS method proposed by Heckman (1976, 1979) and Lee (1976). This is to control for selection bias arising from the use of only homeowners in the regression. This method involves obtaining the Inverse Mills Ratios from the first-stage reduced-form probit estimation of the HEL usage criterion function. In the second stage, *SHATA* is estimated by the OLS regression method, which includes the Inverse Mills Ratio as a regressor. The above procedure yields consistent parameter estimates. The Heckman's two-stage procedure is discussed in Appendices 3.17 and 3.18. The reduced-form probit shown in Appendix 3.16 is used to obtain the Inverse Mills Ratios (*MILLHEL*).

This paper postulates that while household portfolio share decisions are affected by whether they hold home equity loans (*HELPRED*), they are also directly influenced by the loan amounts that can be secured, and whether these funds are ultimately invested or not. One needs to control for these influences. For the loan amounts, the *predicted* initial loan amounts for the five home equity loans are used, so as to reduce possible simultaneity with portfolio shares. These are obtained from reduced-form tobit estimations done earlier. Since loan purposes are reported only for second/third mortgages and HELOC, one distinguishes between the impact that investment or consumption of these loans have on portfolio decisions, by using interaction variables (*CRLMORT2, CRLMORT3, CRMHLOCA*). The reduced-form predicted values of the three home equity loans (*RLMORT2, RLMORT3, RMHLOCA*) are interacted with a dummy variable, which equals 1 if the loans are invested. Thus, *CRLMORT2*=(*M2INV*)*(*RLMORT2*), *CRLMORT3*=(*M3INV*)* (*RLMORT3*), and *CRMHLOCA*=(*HQ1INV*)*(*RMHLOCA*), where *M2INV, M3INV*, and *HQ1INV* are the investment dummy indicators. The coefficients of the interaction variables are interpreted to be the impact on portfolio shares, conditional on the particular home equity loan being invested.

Under the presumption that the availability of home equity loans improves the liquidity of housing investment, households with higher propensity to borrow home equity loans are expected to have *lower* share of cash holdings due to reduced precautionary needs. If portfolio diversification motive exists in the usage of home equity loans, these HEL-users will have a *lower* share of housing asset in total assets, but *higher* nonhousing asset shares in terms of *SBZRETA, SSTKBTA*, or *SILQNTA*, after having controlled for other factors that influence portfolio mix. Thus, *HELPRED* is expected to be negative in the *SCASTA* and *SHATA* equations, but positive in any of *SBZRETA, SSTKBTA*, or *SILQNTA* equations.

3.5.5 Results

Table 3.4 presents the second-stage ols results for SHATA. Tables 3.5 to 3.8 present the second-stage tobit regressions for the remaining portfolio shares under investigation. These are respectively *SCASTA, SBZRETA, SSTKBTA*, and *SILQNTA*. The variables that are of particular interest are those pertaining to *MILLHEL* (the Inverse Mills Ratio), *HELPRED*, and the five home equity loans (*RLACQM, RLREFIN, CRLMORT2, CRLMORT3, CRMHLOCA*).

Based on the coefficients on *HELPRED*, the overall results indicate that home equity loans have significant impacts on household portfolio share decisions. Having controlled for net wealth, risk attitude and household characteristics, the results show that HEL-holders have significantly *lower* shares of cash holdings, housing asset as well as financial assets, but *higher* shares of business/other real estate assets as well as illiquid nonhousing assets (excluding car/special vehicle). The empirical evidence is in support of the hypothesis under test. It appears that the ability to tap housing equity conveniently through home equity loans improves the liquidity of housing investment, and reduces the household need to hold more liquid assets for

precautionary reasons. Further, HEL-holders have used home equity loans to rebalance their portfolios. Households reduce their housing share, and channel the home equity funds into business/other real estate and illiquid nonhousing assets. However, HEL-users appear to be cautious by not overextending themselves in debt commitment against their principal residence for financial investments. The tendency to channel home equity loans into business/other real estate rather than financial assets could also reflect the market preference of lenders to have their loans collaterized by tangible rather than paper assets.

Focusing first on the share of housing asset in the household's total assets, Table 3.4 highlights the second-stage *SHATA* results derived from Heckman's two-stage probit/ols method. The *MILLHEL* coefficients in the HEL-user and non-HEL user ols regressions are respectively $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$. One observes that $\sigma_{1\varepsilon} < 0$ (insignificant) and $\sigma_{2\varepsilon} > 0$ (significant). Referring to Appendix 3.18, the insignificant $\sigma_{1\varepsilon}$ implies that HEL-users have average, if not *lower* than average, expected share of housing in their total assets. Since $\sigma_{2\varepsilon}$ is significantly positive, non-HEL households indeed have an expected *SHATA* share that is *less* than the average based on their current non-HEL usage, but *above average* share if otherwise. To further analyze if the presence of home equity loans has encouraged portfolio balancing, the two groups' actual *SHATA* share based on their existing HEL usage decision, and the conditional housing share if they have decided otherwise, are compared. The HEL-users have an actual average housing share of 0.51, and a conditional expected average share of 0.96 if they had otherwise *not* used home equity loans. In comparison, the non-HEL households have an actual mean housing share of 0.47 and a conditional expected average share of 0.59, if they were to use home equity loans. Relative to non-HEL households, HEL-users appear to have reduced a greater proportion of their housing asset share through home equity loans.

NWPRED is significantly negative in both HEL and non-HEL *SHATA* regressions. This implies that housing share decreases with higher wealth, a result that is consistent with Ioannides' (1989). Shorrocks (1982) has identified, instead, an inverted U-shaped relationship between housing asset share and wealth level. The results in this paper further show that *SHATA* generally decreases with the age of the household head (*AGE*). This is similar to Shorrocks'(1982) findings. Ioannides (1989) has a different result in that the relative share of housing equity in net worth has an inverted U-shaped relationship with age. It increases with age up to 50 and decreases thereafter.

It is interesting to note that risk-averse households (*RAVERSE*) are likely to have a larger SHATA. Larger households (*HHSIZE*) tend to have higher *SHATA*. The coefficients of the race variable (*WHITE*) differ for the HEL and non-HEL households. White non-HEL user is likely to have a lower housing share. The variables relating to the home equity loans are highly significant. First/second/third mortgages and HELOC have negative effects on the *SHATA* share. Similarly, Manchester and Poterba (1989) concur that refinanced and second mortgages are significantly associated with a lower share of housing equity in net worth.

Examining Table 3.5 for the impact of home equity loan usage on the share of cash holdings in the household total assets (*SCASTA*), one notes that *HELPRED* has a significant negative coefficient, as hypothesized. HEL-users tend to have a *lower* SCASTA. The remaining coefficients generally indicate that household heads who are male, white, healthy, or retired, tend to hold a greater share of cash. Although it is postulated that *RAVERSE* and *WIDOWED* heads hold more cash for precautionary needs, their negative coefficients indicate otherwise. This could be suggestive of a cash-strapped situation for widowed heads. The same explanation

applies to *HHSIZE*, whose sign is unexpectedly negative. *NWPRED* has an insignificant negative coefficient, while *AGE* is insignificantly positive. Although insignificant, these signs are in congruence with Shorrocks' (1982) conclusions that cash holdings is negatively related with wealth, but positively related with age. Using simulations, Perraudin and Sorensen (1993) also demonstrate that increasing age is particularly important in shifting households from the "stock/bond/money" regime to the "money only" regime. Individually, the home equity loans do not significantly affect *SCASTA*.

As expected, the *SBZRETA* tobit regression in Table 3.6 shows that HEL-holders have a *higher* share of business/other real estate assets relative to non-HEL holders. *HELPRED* is significantly positive at $\alpha=0.10$. It appears that loan funds have been channelled into this asset category, as reflected in the significant positive coefficients of first and refinanced mortgages. The results are in line with the findings of Manchester and Poterba (1989) and Jones (1993b). M & P establish that the first and refinanced mortgages have significant positive impact on business equity/other real estate shares. Jones (1993b) estimates that about half the mortgage debt of young U.S. households and about three-quarters of the older cohort's are used to finance nonhousing asset positions. Jones (1994a) provides further evidence that the demand for mortgage debt is positively linked to household asset preferences for vacation homes, closely held businesses and investment real estate.

It is noted that *SBZRETA* increases significantly with *NWPRED*. Thus, wealthier households tend to have a greater share of their total assets held in business/other real estate assets. Households with heads who are older, male, and white, tend to have higher *SBZRETA*. As expected, larger and risk-averse households have lower *SBZRETA*. In Shorrocks' (1982)

study, assets held in private business show a strong tendency to increase with wealth, but to decline with age. For this paper, the results differ in the age effect.

The findings pertaining to household financial asset share are interesting. In Table 3.7, the significantly negative *HELPRED* in the *SSTKBTA* tobit regression suggests that HEL-users have *lower* financial asset share. In conjunction with the earlier findings on higher *SBZRETA* for HEL-users, these results affirm Ioannides' (1989) conclusions that financial assets compete with other real estate for a position in the household portfolio. He notes that financial asset share is negatively related to the presence of other real estate. *NWPRED* has a significant positive impact on financial assets, as found in Uhler and Cragg (1971), Shorrocks (1982), Perraudin and Sorensen (1993). This differs from Ioannides' (1989) results that the relative share of financial assets in net wealth is insensitive to net wealth, but depends positively and significantly on earned income. The *SSTKBTA* share increases if the heads are older, male, and white, but declines with household size and greater risk averseness. The result on age concurs with Shorrocks' (1982) conclusion that financial share increases with age. In Uhler and Cragg's (1971) results, the dollar amount of financial assets held increases with wealth and age, but decreases with household size. First mortgages are seen to have significant positive impact.

Proceeding to Table 3.8, which focuses on the share of illiquid nonhousing assets (*SILQNTA*), one notes that *HELPRED* is positive, but insignificant, in the *SILQNTA* regression. While reducing housing share, HEL-users have directed the funds towards increasing the share of illiquid nonhousing assets. The *SILQNTA* share increases with net wealth and age. Male and white heads are likely to hold higher *SILQNTA*. Again, larger and risk-averse households tend to have lower SILQNTA. As evidenced by their signs, refinanced and third mortgages are used

for illiquid nonhousing investment.

In summary, this section concludes that households have used home equity loans for portfolio balancing purposes. HEL-users have undertaken active portfolio management by shifting portfolio weight from housing to more nonhousing assets such as business/other real estate assets. Households are less inclined to use home equity funds for highly risky financial investments such as stocks/bonds/mutual funds/money market instruments. This may reflect conservatism on the part of household in not overextending itself in debt secured against its principal residence for highly risky investment, but only for tangible investment that capitalizes on its human capital.

3.6 CONCLUSIONS

This paper addresses three issues arising from the rapid growth of home equity loans. First, it investigates the impact of home equity loans on the consumption/investment behavior through their manifestations in household net worth. Second, it examines whether household consumption/investment behavior with respect to home equity loans is governed by the life-cycle model, bequest motive model, or the precautionary savings model. Third, this paper examines whether home equity loans play a role in household portfolio decisions.

Having controlled for endogeneity in the loan balances and possible zero loan positions, the paper finds that first mortgages and HELOC adversely affect household net worth as of 1989. The negative coefficients suggest that the borrowed funds are likely to have been consumed, or that the funds have been invested in assets that do not generate positive *net* returns. Unlike the results of Manchester and Poterba (1989), refinanced, second and third

mortgages have no significant impacts on net wealth.

As to the motivating behavioral model underlying the household consumption/investment decisions of borrowed funds, the results indicate that the 'life-cycle model' provides the best description of the household behavior. Households do not borrow against housing wealth for consumption purposes, but rather use the borrowed funds for investment over their productive years, and even till the age of 75. HELOC is distinctly used for consumption only by households whose heads are above 75 years old. The 'precautionary savings model' is partially supported, while the 'bequest motive model' is not a valid model.

In examining the impact of home equity loans on household portfolio decision, the results reveal that portfolio considerations do prevail in the usage of HEL by households. Based on the premise that HEL vastly improves the liquidity of housing investment, the need for homeowner to hold cash for precautionary purposes is reduced, as evidenced by a lower share of cash holdings for HEL households. HEL-users have undertaken active portfolio management by shifting portfolio weight from housing to more nonhousing assets such as business/other real estate assets, but not highly risky financial assets such as stocks/bonds/mutual funds/money market instruments. This may reflect conservatism on the part of household in not overextending itself in debt secured against its principal residence for highly risky investment, but only for tangible investment that capitalizes on its human capital.

The overall perspective is that home equity loans reduce household net wealth, and do affect household portfolio decisions. The trend towards increased usage of home equity loans is likely to decrease household sector wealth, and in turn, affect aggregate savings. The

prevalence of the 'life-cycle model' as the motivating force in the consumption/investment of home equity loans implies that demographic shift may be an important factor in determining aggregate saving, as life stages affect the likelihood that the borrowed funds are consumed or invested. Innovations in the capital market, such as convenient tapping of home equity through HELOC, have changed the nature of housing investment, by improving its liquidity through lower transaction costs. The ability to easily convert housing equity into other forms of nonhousing investments allows the re-channelling of locked-up resources from the household to the private sector, which may be a desirable objective from the perspective of economic planning.

TABLE 3.1

SUMMARY STATISTICS ON PORTFOLIO SHARES AND DOLLAR AMOUNTS OF VARIOUS ASSET GROUPS IN HOUSEHOLD PORTFOLIO.

VARIABLE NAME	WHOLE SAMPLE		HHOLDS WITH HOME EQUITY LOANS		HHOLDS WITHOUT HOME EQUITY LOANS		HHOLDS USING HELOC						HHOLDS WITHOUT HELOC	
							ALL		INVEST		CONSUME			
	NO.	MEAN	NO.	MEAN	NO.	MEAN	NO	MEAN	NO	MEAN	NO	MEAN	NO.	MEAN
NETWORTH	1991	$2840100	357	$2380000	1634	$2940600	121	$512120	64	$2056600	57	-$1222000	1870	$2990700
AGE	1991	52.64	357	48.29	1634	53.59	121	48.983	64	49.766	57	48.105	1870	52.879
EARN	1991	$78693	357	$86341	1634	$77022	121	$83957	64	$81170	57	$87087	1870	$78352
YTRF	1991	$6438.2	357	$2919.6	1634	$7206.9	121	$3650.8	64	$4457.7	57	$2744.9	1870	$6618.5
SHATA	1991	0.4772	357	0.5062	1634	0.4709	121	0.50524	64	0.48021	57	0.53335	1870	0.4754
SNHASTA	1991	0.4647	357	0.4400	1634	0.4701	121	0.4442	64	0.4728	57	0.4122	1870	0.4660
SCASTA	1991	0.0988	357	0.0851	1634	0.1019	121	0.0996	64	0.0943	57	0.1055	1870	0.0988
SBZRETA	1991	0.2094	357	0.2538	1634	0.1996	121	0.2434	64	0.2660	57	0.2180	1870	0.2072
SSTKBTA	1991	0.0783	357	0.0575	1634	0.0828	121	0.0608	64	0.0772	57	0.0423	1870	0.0794
ASSTOT	1991	$3510200	357	$3450900	1634	$3523200	121	$1958000	64	$2823600	57	$986150	1870	$3610700
VRESID	1991	$304750	357	$377470	1634	$288860	121	$389200	64	$449950	57	$320980	1870	$299280
NHA	1991	$3180300	357	$3039200	1634	$3211200	121	$1535000	64	$2332000	57	$640050	1870	$3286800
CASH	1991	$157280	357	$122870	1634	$164790	121	$122100	64	$138860	57	$103290	1870	$159550
BZRE	1991	$2280600	357	$2500700	1634	$2232500	121	$1038000	64	$1605000	57	$401290	1870	$2361000
STKB	1991	$376420	357	$266800	1634	$400370	121	$275580	64	$466500	57	$61202	1870	$382950

TABLE 3.2
OLS REGRESSION OF HOUSEHOLD NETWORTH.
(CORRECTED FOR SELECTION-BIAS & ENDOGENEITY OF LOAN AMTS)
(1991 HOMEOWNERS)

VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 1965 DF
MILLOWN	2256100	1.069
EARNPR	44.416	7.845
YTRFPR	-37.866	-0.599
CHILDHU	-21270	-0.086
MALE	906800	0.806
WHITE	1682300	1.978
MARR	660020	0.544
BQUEST	1772100	3.748
INHPST	2.0727	14.740
EXPINH	-1409900	-2.336
EXPPEN	-1266300	-2.186
LC30L	115360	0.240
LC3039	156470	0.773
LC4049	166640	1.118
LC5059	136710	1.150
LC6075	857270	2.901
LC6075SQ	-68202	-3.269
LC75G	1232900	2.117
LC75GSQ	-86774	-1.885
HGAINLT	-262000	-0.366
RLACQM	-17.038	-3.141
RLREFIN	2.4596	0.534
RLMORT2	14.812	1.495
RLMORT3	1.1387	0.100
URMHLOCA	-11.782	-2.300
CONSTANT	-7761900	-0.938

R-SQUARE ADJUSTED = 0.1692

TABLE 3.3

MULTINOMIAL LOGIT ANALYSES OF HHOLD CONSUMPTION/INVESTMENT BEHAVIOR WITH RESPECT TO HELOC AND 2ND MORTGAGE.

BASE ALTERNATIVE=NHCON (NONHOUSING CONSUMPTION)

	HELOC (121 CASES)				MORT2 (127 CASES)			
	HINV		NHINV		HINV		NHINV	
	$\ln\left[\frac{Prob(HINV)}{Prob(NHCON)}\right]$		$\ln\left[\frac{Prob(NHINV)}{Prob(NHCON)}\right]$		$\ln\left[\frac{Prob(HINV)}{Prob(NHCON)}\right]$		$\ln\left[\frac{Prob(NHINV)}{Prob(NHCON)}\right]$	
VARIABLE	COEF.	T-RATIO	COEF.	T-RATIO	COEF.	T-RATIO	COEF.	T-RATIO
CONSTANT	0.099826	0.117	-12.471	-12.256	-12.602	-7.836	-92.943	-101.600
NWPRED	0.00000011	1.001	0.00000011	0.803	0.00000001	0.119	0.0000001	0.644
CHILDHU	-0.32861	-1.217	0.46595	1.648	-0.83553	-3.052	-0.73313	-2.153
MALE	1.2135	0.632	19.872	19.335	-0.55353	-0.539	1.5857	1.734
WHITE	-1.5755	-1.879	-0.43469	-0.343	0.0087577	0.012	-0.55021	-0.584
MARR	0.21221	0.115	-2.8459	-1.889	1.5317	1.737	32.516	35.545
BQUEST	-0.43852	-0.836	-0.046611	-0.077	-0.1922	-0.397	-0.1093	-0.158
NOJOB	0.15976	0.138	-0.067152	-0.049	53.161	53.161	-25.67	-25.670
HEALTH	-27.602	-32.348	-19.468	-19.132	14.305	7.670	30.818	33.689
WIDOWED	0.3446	0.186	-28.776	-28.781	27.267	27.267	-3.5041	-3.504
D3039	27.79	36.827	13.323	16.175	-0.38932	-0.241	29.129	33.240
D4049	27.988	42.638	13.155	17.970	-0.40263	-0.253	29.086	38.753
D5059	26.708	41.076	12.901	18.916	-0.71732	-0.422	28.839	37.143
D6075	27.66	33.893	15.04	14.828	-0.64271	-0.304	29.58	24.652
D75G	-0.042402	-0.042	-2.0812	-2.081				

TABLE 3.4

2ND-STAGE OLS REGRESSION OF SHATA
(SHARE OF HOUSING ASSET IN TOTAL ASSETS)

(SELECTION-BIAS CORRECTED)

VARIABLE NAME	HEL HHOLDS (357 OBS.)		NON-HEL HHOLDS (1634 OBS.)	
	ESTIMATED COEF.	T-RATIO 344 DF	ESTIMATED COEF.	T-RATIO 1624 DF
CONSTANT	0.85583	7.401	0.95789	14.630
MILLHEL	-0.035106	-1.504	0.43436	2.756
NWPRED	-7.99e-09	-2.800	-1.48e-08	-9.884
AGE	-0.002195	-1.444	-0.004796	-6.402
MALE	-0.25151	-4.831	-0.16303	-8.071
WHITE	-0.029413	-0.640	-0.10332	-5.065
HHSIZE	0.030905	2.745	0.024261	4.303
RAVERSE	0.13986	4.187	0.13549	9.132
RLACQM	-5.02e-07	-1.900	0.0000003	2.138
RLREFIN	-4.80e-08	-0.214	-1.22e-07	-0.923
CRLMORT2	-7.50e-07	-2.024		
CRLMORT3	-8.35e-07	-2.472		
CRMHLOCA	-4.62e-07	-2.251		
R-SQUARE ADJUSTED		0.241		0.295

TABLE 3.5

2ND-STAGE TOBIT REGRESSION OF SCASTA
(SHARE OF CASH HOLDINGS IN TOTAL ASSETS)

(58 LIMIT OBSERVATIONS & 1933 NON-LIMIT OBSERVATIONS).

VARIABLE	REGRESSION COEFFICIENT	ASYMPT. T-RATIO	ELASTICITY OF INDEX	ELASTICITY OF E(Y)
HELPRED	-0.044167	-2.373	-0.080	-0.056
NWPRED	-0.00000000091	-1.381	-0.026	-0.018
AGE	0.00025975	0.860	0.138	0.098
MALE	0.017502	1.675	0.154	0.108
WHITE	0.028382	3.357	0.250	0.176
HHSIZE	-0.0043008	-1.904	-0.127	-0.090
RAVERSE	-0.013549	-2.195	-0.047	-0.033
HEALTH	0.015306	1.105	0.148	0.104
WIDOWED	-0.019298	-1.409	-0.013	-0.010
RETIRED	0.018492	2.084	0.040	0.029
RLACQM	0.00000007829	1.398	0.033	0.023
RLREFIN	0.000000007281	0.146	0.001	0.001
CRLMORT2	0.000000015723	0.094	0.001	0.000
CRLMORT3	-0.00000010265	-0.661	-0.002	-0.001
CRMHLOCA	0.00000011604	1.239	0.006	0.005
CONSTANT	0.049509	1.908		

PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X (I) = 0.7905

OBSERVED FREQUENCY OF Y > LIMIT IS = 0.9709

AT MEAN VALUES OF ALL X(I), E(Y) = 0.1108

LOG-LIKELIHOOD FUNCTION= 1308.1347

TABLE 3.6

2ND-STAGE TOBIT REGRESSION OF SBZRETA
(SHARE OF BUSINESS/REAL ESTATE ASSETS IN TOTAL ASSETS)

(889 LIMIT OBSERVATIONS & 1102 NON-LIMIT OBSERVATIONS).

VARIABLE	REGRESSION COEFFICIENT	ASYMPT. T-RATIO	ELASTICITY OF INDEX	ELASTICITY OF E(Y)
HELPRED	0.11677	1.768	0.100	0.062
NWPRED	0.000000018197	8.314	0.247	0.152
AGE	0.0029016	3.136	0.730	0.450
MALE	0.26589	7.146	1.104	0.680
WHITE	0.065593	2.004	0.272	0.168
HHSIZE	-0.011429	-1.360	-0.159	-0.098
RAVERSE	-0.19768	-8.492	-0.320	-0.197
RLACQM	0.00000034469	1.740	0.069	0.042
RLREFIN	0.00000077417	4.463	0.071	0.044
CRLMORT2	0.00000043609	0.750	0.008	0.005
CRLMORT3	0.00000082379	1.570	0.006	0.004
CRMHLOCA	0.00000008392	0.260	0.002	0.001
CONSTANT	-0.3927	-5.116		

PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X (I) = 0.5526

OBSERVED FREQUENCY OF Y > LIMIT IS = 0.5535

AT MEAN VALUES OF ALL X(I), E(Y) = 0.1877

LOG-LIKELIHOOD FUNCTION= -1128.5483

TABLE 3.7

2ND-STAGE TOBIT REGRESSION OF SSTKBTA
(SHARE OF FINANCIAL ASSETS IN TOTAL ASSETS)

(895 LIMIT OBSERVATIONS & 1096 NON-LIMIT OBSERVATIONS).

VARIABLE	REGRESSION COEFFICIENT	ASYMPT. T-RATIO	ELASTICITY OF INDEX	ELASTICITY OF E(Y)
HELPRED	-0.066472	-1.848	-0.152	-0.074
NWPRED	0.000000003571	3.122	0.130	0.063
AGE	0.0027808	5.767	1.870	0.915
MALE	0.070245	3.845	0.780	0.381
WHITE	0.12796	6.838	1.421	0.695
HHSIZE	-0.019636	-4.348	-0.732	-0.358
RAVERSE	-0.13918	-11.247	-0.603	-0.295
RLACQM	0.00000027678	2.662	0.148	0.072
RLREFIN	0.00000017365	1.898	0.043	0.021
CRLMORT2	0.00000017353	0.557	0.008	0.004
CRLMORT3	0.000000084605	0.311	0.002	0.001
CRMHLOCA	0.00000026919	1.556	0.019	0.009
CONSTANT	-0.2402	-5.958		

PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X (I) = 0.4794

OBSERVED FREQUENCY OF Y > LIMIT IS = 0.5505

AT MEAN VALUES OF ALL X(I), E(Y) = 0.0767

LOG-LIKELIHOOD FUNCTION= -335.58921

TABLE 3.8

2ND-STAGE TOBIT REGRESSION OF SILQNTA
(SHARE OF ILLIQUID NONHOUSING ASSETS IN TOTAL ASSETS)

(586 LIMIT OBSERVATIONS & 1405 NON-LIMIT OBSERVATIONS).

VARIABLE	REGRESSION COEFFICIENT	ASYMPT. T-RATIO	ELASTICITY OF INDEX	ELASTICITY OF E(Y)
HELPRED	0.056953	1.023	0.040	0.029
NWPRED	0.000000014464	7.743	0.160	0.116
AGE	0.0036345	4.797	0.746	0.541
MALE	0.14247	5.074	0.482	0.350
WHITE	0.11005	4.116	0.373	0.270
HHSIZE	-0.015334	-2.207	-0.174	-0.127
RAVERSE	-0.14763	-7.824	-0.195	-0.141
RLACQM	0.00000026794	1.605	0.044	0.032
RLREFIN	0.00000062365	4.229	0.047	0.034
CRLMORT2	0.00000053808	1.083	0.008	0.006
CRLMORT3	0.00000086231	1.907	0.005	0.004
CRMHLOCA	0.0000000088199	0.032	0.000	0.000
CONSTANT	-0.21232	-3.424		

PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X (I) = 0.6998

OBSERVED FREQUENCY OF Y > LIMIT IS = 0.7057

AT MEAN VALUES OF ALL X(I), E(Y) = 0.2476

LOG-LIKELIHOOD FUNCTION= -965.16379

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APPENDIX 3.1
VARIABLE DEFINITIONS

NETWORTH	'HOUSEHOLD NONPENSION NET WEALTH'.
NWPRED	'PREDICTED HOUSEHOLD NONPENSION NET WEALTH'.
EARNPR	'PREDICTED HOUSEHOLD LABOR EARNINGS'.
YTRFPR	'PREDICTED HOUSEHOLD TRANSFER INCOME'.
OWN	'DUMMY FOR OWNERSHIP STATUS (1=OWN)'.
MALE	'DUMMY FOR SEX (1=MALE)'.
WHITE	'DUMMY FOR RACE (1=WHITE)'.
MARR	'DUMMY FOR MARITAL STATUS (1=MARRIED)'.
AGE	'AGE OF RESPONDENT'.
YRSFULR	'NO. OF YRS WORKED FULL TIME - RESPONDENT R'.
YRSFULS	'NO. OF YRS WORKED FULL TIME - SPOUSE S'.
NJOBHR	'NO. OF FULL-TIME JOBS HELD - RESPONDENT'.
NJOBHS	'NO. OF FULL-TIME JOBS HELD - SPOUSE'.
YRSEDUC	'YRS OF EDUCATION - RESPONDENT'.
YRSEDUCS	'YRS OF EDUCATION -SPOUSE'.
YRSCJOB	'NO. OF YRS AT CURRENT JOB -RESPONDENT'.
YRSCJOBS	'NO. OF YRS AT CURRENT JOB -SPOUSE'.
NOJOB	'DUMMY=1 IF NO OCCUPATION - RESPONDENT'.
MGTPROF	'DUMMY=1 FOR MANAGEMENT/PROF JOBS - RESPONDENT'.
TECSCLRK	'DUMMY=1 FOR TECHNICIANS/SALES/CLERICAL JOBS- RESPONDENT'.
SERVICE	'DUMMY=1 FOR SERVICE-RELATED JOBS - RESPONDENT'.
PRODCRFT	'DUMMY=1 FOR PRODUCTION/CRAFT JOBS - RESPONDENT'.
OPERATOR	'DUMMY=1 FOR MACHINE OPERATORS/LABORERS - RESPONDENT'.
FARMFISH	'DUMMY=1 IF FARM OR FISHERIES-RELATED JOBS - RESPONDENT'.
HHSIZE	'HOUSEHOLD SIZE'.
CHILDHU	'NUMBER OF CHILDREN STAYING IN HOME'
EARN	'EARNED HOUSEHOLD INCOME FROM CURRENT AND EXTRA JOBS'.
YTRF	'HOUSEHOLD TRANSFER INCOME:SOCIAL SECURITY BENEFITS, PENSION INCOME, UNEMPLOYMENT COMPENSATION, WELFARE INCOME'.
BQUEST	'DUMMY=1 IF RESPONDENT AND SPOUSE HAVE STRONG BEQUEST MOTIVE'.
INHER	'DUMMY=1 IF HOUSEHOLD EVER RECEIVES INHERITANCE IN THE PAST'.
INHPST	'DOLLAR AMOUNT OF PAST INHERITANCE RECEIVED'.
EXPINH	'DUMMY=1 IF HOUSEHOLD EXPECTS TO RECEIVE INHERITANCE'.
EXPPEN	'DUMMY=1 IF EITHER R OR S EXPECTS FUTURE PENSION INCOME'.
RAVERSE	'DUMMY=1 IF HOUSEHOLD IS AVERSE TO RISK'.
CONSUMP	'DUMMY=1 IF ALRIGHT TO BORROW MONEY FOR VACATION'.
EMERG	'DUMMY=1 IF ALRIGHT TO BORROW MONEY FOR LIVING EXPENSES'.

LUX	'DUMMY=1 IF ALRIGHT TO BORROW MONEY FOR LUXURY GOODS PURCHASE'.
DUR	'DUMMY=1 IF ALRIGHT TO BORROW MONEY FOR CAR PURCHASE'.
HEALTH	'DUMMY=1 IF HOUSEHOLD HEAD HAS EXCELLENT/GOOD/FAIR HEALTH'.
WIDOWED	'DUMMY=1 IF HOUSEHOLD HEAD IS WIDOWED'.
RETIRED	'DUMMY=1 IF HOUSEHOLD HEAD IS RETIRED'.
WELFAR	'DUMMY=1 IF HOUSEHOLD IS RECEIVING WELFARE ASSISTANCE'.
BADCRD	'DUMMY=1 IF HOUSEHOLD IS EVER BEHIND IN DEBT PAYMENTS BY MORE THAN 2 MONTHS'.
D30L (D1)	'DUMMY FOR 1ST STAGE OF LIFE-CYCLE FOR $AGE<30$'.
D3039 (D2)	'DUMMY FOR 2ND STAGE OF LIFE-CYCLE FOR $30\leq AGE<40$'.
D4049 (D3)	'DUMMY FOR 3RD STAGE OF LIFE-CYCLE FOR $40\leq AGE<50$'.
D5059 (D4)	'DUMMY FOR 4TH STAGE OF LIFE-CYCLE FOR $50\leq AGE<60$'.
D6075 (D5)	'DUMMY FOR 5TH STAGE OF LIFE-CYCLE FOR $60\leq AGE\leq 75$'.
D75G (D6)	'DUMMY FOR 6TH STAGE OF LIFE-CYCLE FOR $AGE>75$'.
LC30L (LC1)	'NO. OF YRS INTO 1ST STAGE OF LIFE-CYCLE FOR $AGE<30$, FROM ASSUMED ACTIVE WORKING AGE OF 15 YEARS OLD. VALUES RANGING FROM 3 TO 15, SINCE MINIMUM AGE IN SAMPLE=18'.
LC3039 (LC2)	'NO. OF YRS INTO 2ND STAGE OF LIFE-CYCLE FOR $30\leq AGE<40$, VALUES RANGING FROM 0 TO 10'.
LC4049 (LC3)	'NO. OF YRS INTO 3RD STAGE OF LIFE-CYCLE FOR $40\leq AGE<50$, VALUES RANGING FROM 0 TO 10'.
LC5059 (LC4)	'NO. OF YRS INTO 4TH STAGE OF LIFE-CYCLE FOR $50\leq AGE<60$, VALUES RANGING FROM 0 TO 10'.
LC6075 (LC5)	'NO. OF YRS INTO 5TH STAGE OF LIFE-CYCLE FOR $60\leq AGE\leq 75$, VALUES RANGING FROM 0 TO 15'.
LC6075SQ (LC6)	'QUADRATIC EFFECT OF NO. OF YRS INTO 5TH STAGE OF LIFE-CYCLE, VALUES RANGING FROM 0 TO 225'.
LC75G (LC7)	'NO. OF YRS INTO 6TH STAGE OF LIFE-CYCLE FOR $AGE>75$, VALUES RANGING FROM 0 TO 16, SINCE MAXIMUM AGE IN SAMPLE=91'.
LC75GSQ (LC8)	'QUADRATIC EFFECT OF NO. OF YRS INTO 6TH STAGE OF LIFE-CYCLE, VALUES RANGING FROM 1 TO 256'.
STRMORT1	'DUMMY=1 IF HOUSEHOLD HAS STRICTLY 1ST MORTGAGE, BUT NOT REFINANCING'.
REFIN	'DUMMY=1 IF HOUSEHOLD REFINANCED (MORTGAGE TAKEN UP AFTER YRBUY)'.
MORT2	'DUMMY=1 IF HOUSEHOLD HAS 2ND MORTGAGE'.
MORT3	'DUMMY=1 IF HOUSEHOLD HAS 3RD MORTGAGE'.
HELOCA	'DUMMY=1 IF HOUSEHOLD HAS ANY HOME EQUITY LINES OF CREDIT'.

AHEL	'DUMMY=1 IF HOUSEHOLD HAS ANY OF REFINANCED/2ND/3RD MORTGAGES OR HELOC'.
AHELPRED	'PREDICTED VALUES FROM 1ST-STAGE REDUCED-FORM PROBIT OF AHEL'.
MILLPHEL	'INVERSE MILLS RATIOS FROM 1ST-STAGE REDUCED-FORM PROBIT OF AHEL'.
HEL	'DUMMY=1 IF HOUSEHOLD HAS ANY OF 2ND/3RD MORTGAGES OR HELOC'.
HELPRED	'PREDICTED VALUES FROM 1ST-STAGE REDUCED-FORM PROBIT OF HEL'.
MILLHEL	'INVERSE MILLS RATIOS FROM 1ST-STAGE REDUCED-FORM PROBIT OF HEL'.
HGAINLT	'LIFETIME HOUSING CAPITAL GAINS =1989 HOUSING PRICE INDEX *LESS* HOUSING PRICE INDEX AT YEAR WHEN AGE IS 35 YEARS. FOR YOUNGER HOMEOWNERS LESS THAN 35 YEARS, THIS IS EQUAL TO 1989 HOUSING PRICE INDEX *LESS* HOUSING PRICE AT TIME OF HOME PURCHASE. USING PEEK & WILCOX'S (1991) NOMINAL NATIONAL HOUSE PRICE SERIES ADJUSTED FOR NET UPGRADING'.
MORTHST	'DUMMY=1 IF HOUSEHOLD HAS ANY MORTGAGE BEFORE 1986'.
HEQNMORT	'HOUSING EQUITY NET OF MORTGAGES, BUT BEFORE DEDUCTING THE OUTSTANDING BALANCES ON ALL HELOCS'.
NBKCRD	'NUMBER OF BANK CREDIT CARDS'.
LACQMORT	'LOAN AMOUNT INITIALLY SECURED AT TIME OF ACQUISITION OF 1ST MORTGAGE'.
LREFIN	'LOAN AMOUNT INITIALLY SECURED AT TIME OF ACQUISITION OF REFINANCED MORTGAGE'.
LMORT2	'LOAN AMOUNT INITIALLY SECURED AT TIME OF ACQUISITION OF 2ND MORTGAGE'.
LMORT3	'LOAN AMOUNT INITIALLY SECURED AT TIME OF ACQUISITION OF 3RD MORTGAGE'.
MHELOCA	'TOTAL MAXIMUM CREDIT INITIALLY SECURED AT TIME OF ACQUISITION OF ALL HOME EQUITY LINES OF CREDIT'.
RLACQM	'CONDITIONAL EXPECTED INITIAL LOAN AMOUNT ON 1ST MORTGAGE'.
RLREFIN	'CONDITIONAL EXPECTED INITIAL LOAN AMOUNT ON REFINANCED MORTGAGE'.
RLMORT2	'CONDITIONAL EXPECTED INITIAL LOAN AMOUNT ON 2ND MORTGAGE'.
RLMORT3	'CONDITIONAL EXPECTED INITIAL LOAN AMOUNT ON 3RD MORTGAGE'.
RMHLOCA	'CONDITIONAL EXPECTED TOTAL MAXIMUM CREDIT ON ALL HELOCs'.
UHELOC1	'DUMMY=1 IF HOUSEHOLD DRAWS ON 1ST HELOC'.
UHELOCA	'DUMMY=1 IF HOUSEHOLD DRAWS ON ANY HELOC'.

URMHLOCA	'INTERACTION VARIABLE: (UHELOCA)*(RMHLOCA)'.
RLACQM	'LOAN PROXY FOR INITIAL LOAN AMT OF FIRST ACQUISITION MORTGAGE'.
RLREFIN	'LOAN PROXY FOR INITIAL LOAN AMT OF REFINANCED MORTGAGE'.
RLMORT2	'LOAN PROXY FOR INITIAL LOAN AMT OF SECOND MORTGAGE'.
RLMORT3	'LOAN PROXY FOR INITIAL LOAN AMT OF THIRD MORTGAGE'.
RMHLOCA	'LOAN PROXY FOR MAXIMUM CREDIT ALLOWED FOR ALL HELOCS'.
SCASTA	'SHARE OF CASH HOLDINGS (SAVING & CHECKING ACCOUNT, IRA/KEOGHS, CASH VALUE OF LIFE INSURANCE POLICIES) IN TOTAL ASSETS'.
SHATA	'SHARE OF HOUSING ASSET IN TOTAL ASSETS'.
SBZRETA	'SHARE OF BUSINESS/OTHER REAL ESTATE IN TOTAL ASSETS'.
SSTKBTA	'SHARE OF FINANCIAL ASSETS (STOCKS/BONDS/MUTUAL FUNDS/TRUST FUNDS/MONEY MARKET INSTRUMENTS) IN TOTAL ASSETS'.
SILQNTA	'SHARE OF ALL ILLIQUID NON-HOUSING ASSETS, INCLUDING ANTIQUES, WORKS OF ART, JEWELLERY, OTHER THAN PRINCIPAL RESIDENCE AND CAR/SPECIAL VEHICLES, IN TOTAL ASSETS'.
SNHASTA	'SHARE OF ALL NON-HOUSING ASSETS, OTHER THAN PRINCIPAL RESIDENCE AND CAR/SPECIAL VEHICLES, IN TOTAL ASSETS'.
ASSTOT	'TOTAL ASSETS OF HOUSEHOLD'.
VRESID	'CURRENT VALUE OF PRINCIPAL RESIDENCE'.
NHA	'NONHOUSING ASSETS OF HOUSEHOLD'.
CASH	'CASH HOLDINGS OF HOUSEHOLD'.
BZRE	'BUSINESS & OTHER REAL ESTATE ASSETS'.
STKB	'STOCKS/BONDS/MUTUAL FUNDS/TRUST FUNDS/MMKT INSTRUMENTS'.
ILQNH	'ILLIQUID NONHOUSING ASSETS OF HOUSEHOLD'.
HQ1HINV	'DUMMY=1 IF PRIMARY PURPOSE OF HELOC1 IS FOR HOUSING RENOVATION OR HOUSING-RELATED INVESTMENT'.
HQ1NHINV	'DUMMY=1 IF PRIMARY PURPOSE OF HELOC1 IS FOR NONHOUSING INVESTMENT INCLUDING OTHER REAL ESTATE INVESTMENT'.
HQ1NHCON	'DUMMY=1 IF PRIMARY PURPOSE OF HELOC1 IS FOR NONHOUSING CONSUMPTION'.
M2HINV	'DUMMY=1 IF PRIMARY PURPOSE OF MORT2 IS FOR HOUSING RENOVATION OR HOUSING-RELATED INVESTMENT'.
M2NHINV	'DUMMY=1 IF PRIMARY PURPOSE OF MORT2 IS FOR NONHOUSING INVESTMENT INCLUDING OTHER REAL ESTATE INVESTMENT'.
M2NHCON	'DUMMY=1 IF PRIMARY PURPOSE OF MORT2 IS FOR NONHOUSING CONSUMPTION'.

M2INV	'DUMMY=1 IF MORT2 USED FOR EITHER HOUSING OR NONHOUSING INVESTMENTS, NOT CONSUMPTION'.
M3INV	'DUMMY=1 IF MORT3 USED FOR EITHER HOUSING OR NONHOUSING INVESTMENTS, NOT CONSUMPTION'.
HQ1INV	'DUMMY=1 IF HELOC1 USED FOR EITHER HOUSING OR NONHOUSING INVESTMENTS, NOT CONSUMPTION'.
CRLMORT2	'INTERACTION VARIABLE: (M2INV)*(RLMORT2)'.
CRLMORT3	'INTERACTION VARIABLE: (M3INV)*(RLMORT3)'.
CRMHLOCA	'INTERACTION VARIABLE: (HQ1INV)*(RMHLOCA)'.

APPENDIX 3.2

SUMMARY STATISTICS

	ALL OBSERVATIONS (1991 CASES)		HEL-HOLDERS (357 CASES)		NON HEL-HOLDERS (1634 CASES)	
VARIABLE	MEAN	ST. DEV	MEAN	ST. DEV	MEAN	ST. DEV
OWN	1	0	1	0	1	0
NETWORTH	2840100	11379000	2380000	11021000	2940600	11456000
HPRICE	137790	338810	173060	428700	130090	315430
HGAIN	166960	390220	204410	372990	158770	393520
HGAINLT	3.6061	1.0949	3.4666	0.99066	3.6366	1.1143
EARN	78693	285450	86341	199140	77022	301050
YTRF	6438.2	19812	2919.6	9907	7206.9	21298
YREP	330620	2377900	280820	779780	341500	2599400
HHSIZE	2.9186	1.4285	3.2269	1.4089	2.8513	1.4243
CHILDHU	0.98845	1.2053	1.2549	1.1872	0.93023	1.2017
AGE	52.642	13.917	48.291	10.396	53.593	14.402
MALE	0.86891	0.33758	0.90476	0.29396	0.86108	0.34597
WHITE	0.86941	0.33703	0.89076	0.31238	0.86475	0.3421
MARR	0.80261	0.39813	0.85154	0.35605	0.79192	0.40606
BQUEST	0.49774	0.50012	0.51821	0.50037	0.49327	0.50011
INHER	0.34154	0.47434	0.33053	0.47107	0.34394	0.47517
INHPST	118090	1672700	177700	2186400	105070	1538400
EXPINH	0.20994	0.40737	0.2381	0.42652	0.20379	0.40294
EXPPEN	0.32295	0.46772	0.40896	0.49233	0.30416	0.46019
SAVER	0.78553	0.41055	0.77871	0.4157	0.78703	0.40953
OWNBIZ	0.36113	0.48045	0.44538	0.49771	0.34272	0.47476
WELFAR	0.023606	0.15186	0.0056022	0.074743	0.02754	0.1637
RAVERSE	0.33903	0.4735	0.2549	0.43642	0.35741	0.47938

VARIABLE	MEAN (ALL)	ST.DEV (ALL)	MEAN (HEL=1)	ST.DEV (HEL=1)	MEAN (HEL=0)	ST.DEV (HEL=0)
CONSUMP	0.12104	0.32626	0.16807	0.37445	0.11077	0.31394
EMERG	0.37971	0.48544	0.37815	0.48561	0.38005	0.48555
LUX	0.073832	0.26156	0.11204	0.31586	0.065483	0.24745
DUR	0.78152	0.41332	0.86275	0.3446	0.76377	0.4249
BROKACC	0.29533	0.45631	0.32493	0.46901	0.28886	0.45337
INVRE	0.44601	0.4972	0.48179	0.50037	0.43819	0.49632
NJOBHR	3.6926	3.034	3.6891	2.1163	3.6934	3.2001
YRSCJOB	10.551	11.212	11.894	9.6288	10.258	11.51
YRSFULR	27.882	12.924	25.471	10.198	28.409	13.391
YRSEDUC	13.847	3.1949	14.496	2.6144	13.705	3.2919
AGEW	25.136	26.936	23.683	24.378	25.453	27.46
NJOBHW	1.7524	2.0756	2.0168	2.1671	1.6946	2.0512
YRSCJOBW	3.7127	6.4839	4.5938	6.28	3.5202	6.5136
YRSFULW	9.3732	10.036	9.7815	9.0403	9.284	10.241
YRSEDUCW	10.927	5.9163	12.031	5.4805	10.686	5.9818
MGTPROF	0.3998	0.48998	0.51541	0.50046	0.37454	0.48415
TECSCLRK	0.16223	0.36875	0.19888	0.39972	0.15422	0.36127
SERVICE	0.030638	0.17238	0.02521	0.15698	0.031824	0.17558
PRODCRFT	0.097941	0.29731	0.10364	0.30522	0.096695	0.29563
OPERATOR	0.062783	0.24263	0.072829	0.26022	0.060588	0.23865
FARMFISH	0.011552	0.10688	0.0028011	0.052926	0.013464	0.11529
RETIRED	0.21597	0.4116	0.07563	0.26478	0.24663	0.43118
D30L	0.030638	0.17238	0.022409	0.14822	0.032436	0.17721
D3039	0.16173	0.36829	0.16807	0.37445	0.16034	0.36704
D4049	0.24661	0.43115	0.37815	0.48561	0.21787	0.41293
D5059	0.23305	0.42288	0.27451	0.44689	0.22399	0.41704
D6075	0.2677	0.44287	0.15126	0.35881	0.29315	0.45534

VARIABLE	MEAN (ALL)	ST.DEV (ALL)	MEAN (HEL=1)	ST.DEV (HEL=1)	MEAN (HEL=0)	ST.DEV (HEL=0)
D75G	0.060271	0.23805	0.0056022	0.074743	0.072215	0.25892
LC30L	14.904	0.63193	14.924	0.54298	14.9	0.64981
LC3039	8.9116	2.5942	9.0056	2.4055	8.8911	2.6339
LC4049	6.6364	4.2792	5.8768	4.2296	6.8023	4.2734
LC5059	4.3129	4.5399	2.6667	3.8326	4.6726	4.6036
LC6075	2.5736	4.7188	0.79552	2.5207	2.9621	4.9907
LC6075SQ	28.879	64.061	6.9692	28.083	33.666	68.565
LC75G	0.30387	1.48	0.022409	0.33445	0.36536	1.6199
LC75GSQ	2.2818	15.604	0.11204	1.9165	2.7558	17.166
STRMORT1	0.45957	0.49849	0.60784	0.48892	0.42717	0.49482
REFIN	0.13963	0.34669	0.17087	0.37692	0.1328	0.33947
MORT2	0.063787	0.24443	0.35574	0.47941	0	0
MORT3	0.02662	0.16101	0.14846	0.35605	0	0
LACQMORT	41678	125290	58737	112520	37950	127630
LREFIN	19054	89814	29308	123390	16814	80516
LMORT2	4583.1	45587	25560	105260	0	0
LMORT3	1939.2	26643	10815	62223	0	0
ACQMORTB	35534	115800	49592	106180	32463	117600
OSREFIN	17435	85977	26922	119660	15363	76566
OSMORT2	3827.1	41534	21344	96270	0	0
OSMORT3	1438.5	16387	8022.3	38054	0	0
MHELOCA	14122	103520	78757	234090	0	0
UHELOC1	0.060773	0.23897	0.33894	0.47401	0	0
UHELOC2	0.0015068	0.038798	0.0084034	0.091412	0	0
UHELOC3	0	0	0	0	0	0
UHELOCA	0.061276	0.2399	0.34174	0.47496	0	0
OSHELOC1	3668	40093	20457	92956	0	0

VARIABLE	MEAN (ALL)	ST.DEV (ALL)	MEAN (HEL=1)	ST.DEV (HEL=1)	MEAN (HEL=0)	ST.DEV (HEL=0)
OSHELOC2	44.199	1693.9	246.5	3998.7	0	0
OSHELOC3	0	0	0	0	0	0
OSHELOCA	3712.2	40126	20703	92991	0	0
HEL	0.17931	0.38371	1	0	0	0
HQ1INV	0.032145	0.17643	0.17927	0.38412	0	0
HQ1HINV	0.02009	0.14034	0.11204	0.31586	0	0
HQ1NHINV	0.012054	0.10916	0.067227	0.25077	0	0
HQ1NHCON	0.028629	0.1668	0.15966	0.36681	0	0
HQ2HINV	0	0	0	0	0	0
HQ2NHINV	0	0	0	0	0	0
HQ2NHCON	0.0015068	0.038798	0.0084034	0.091412	0	0
HQ3HINV	0	0	0	0	0	0
HQ3NHINV	0	0	0	0	0	0
HQ3NHCON	0	0	0	0	0	0
M2INV	0.045706	0.2089	0.2549	0.43642	0	0
M2HINV	0.036665	0.18799	0.20448	0.40389	0	0
M2NHINV	0.0090407	0.094676	0.05042	0.21912	0	0
M2NHCON	0.018081	0.13328	0.10084	0.30154	0	0
M3INV	0.016072	0.12579	0.089636	0.28606	0	0
M3HINV	0.0090407	0.094676	0.05042	0.21912	0	0
M3NHINV	0.0070316	0.083581	0.039216	0.19438	0	0
M3NHCON	0.010547	0.10218	0.058824	0.23562	0	0
NBKCRD	1.6384	1.7778	2.1373	2.0895	1.5294	1.6833
MORTHST	0.36565	0.48173	0.52661	0.49999	0.33048	0.47053
HEQNMORT	245780	545920	271180	504540	240230	554540

APPENDIX 3.3

USES OF HOME EQUITY LINES OF CREDIT,
BY ORDER OF USE, 1987.

Percent of account users

USE	FIRST USE[1]	ALL LATER USES[2]	MEMO
Pay off other debt	53	7	
Home improvement	25	19	
Automobile purchase	12	16	
Education & Medical Care	8	13	
Other[3]	48	21	
MEMO			
Never used account			18
Used account only once			55

1. Percentages add to more than 100 because some account holders reported more than one type of first use.

2. Percentages do not add to 100 because some account users reported only a first use.

3. Includes real estate purchases, vacations, business investments, and financial investments such as individual retirement accounts.

Source: Federal Reserve Bulletin, June 1988, page 365.

APPENDIX 3.4

USES OF LIQUIDATED HOUSING EQUITY,
BY TYPE OF LOAN.

Proportion of debtors citing use[1]

USE	HOME EQUITY LINES OF CREDIT		TRADITIONAL HOME EQUITY LOAN	REFINANCING RESULTING IN LIQUIDATED EQUITY
	Initial Draw	All other draws[2]		
Home improvement	38	58	45	46
Repayment of other debts	40	28	35	36
Education	11	20	1	3
Real estate	10	2	16	17
Auto, truck	7	30	5	5
Medical	3	16	0	2
Business	4	7	6	8
Vacation	1	11	0	2
Other[3]	11	23	5	7

1. Proportions add to more than 100 percent because multiple uses could be cited for a single loan or drawdown and because a number of draws could be cited for one line of credit.

2. One-third of account users made no drawdown after the original one.

3. Includes purchases of furniture or appliances, tax payments, personal financial investments, and purchases of boats or other recreational vehicles.

Sources: For refinancings, see Surveys of Consumer Attitudes, June, July, September 1989, Survey Research Center, University of Michigan. For home equity loans, see Surveys of Consumer Attitudes, July-December 1988.

Source: Federal Reserve Bulletin, August 1990, "Mortgage Refinancing", page 609.

APPENDIX 3.5

USES OF BORROWED FUNDS,
BY TYPE OF CREDIT, 1993-94.

Percentage of borrowers citing uses

USE	HOME EQUITY LINES OF CREDIT	TRADITIONAL HOME EQUITY LOANS
Home improvement	64	38
Repayment of other debts	45	68
Education	21	4
Real estate	12	8
Auto or truck	30	3
Medical expenses	5	1
Business expenses	28	1
Vacation	6	1
Other[1]	1	3

Note: Percentages sum to more than 100 percent because respondents were allowed to cite multiple uses for a single loan or drawdown and more than one draw for one line of credit.

1. Includes purchase of furniture or appliance, purchase of boat or other recreational vehicle, payment of taxes, and personal financial investments.

Source: 1993-94 Surveys of Consumers.

Source: Federal Reserve Bulletin, July 1994, "Home Equity Lending: Evidence from Recent Surveys", page 577.

APPENDIX 3.6

OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD LABOR EARNINGS.

(DEPENDENT VARIABLE = EARN, PROXY = EARNPR).

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 1973 DF	PARTIAL P-VALUE	CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
AGE	1064.9	930.7	1.144	0.253	0.026	0.0519	0.7124
MALE	-10818.	0.2931E+05	-0.3691	0.712	-0.008	-0.0128	-0.1194
WHITE	-3799.2	0.1952E+05	-0.1946	0.846	-0.004	-0.0045	-0.0420
YRSCJOB	-678.71	763.8	-0.8886	0.374	-0.020	-0.0267	-0.0910
YRSFULR	-607.49	857.2	-0.7087	0.479	-0.016	-0.0275	-0.2152
YRSEDUC	3794.2	2544.	1.492	0.136	0.034	0.0425	0.6676
RETIRED	-59071.	0.2495E+05	-2.368	0.018	-0.053	-0.0852	-0.1621
MGTPROF	92300.	0.2769E+05	3.333	0.001	0.075	0.1584	0.4689
TECSCLRK	25363.	0.2873E+05	0.8827	0.377	0.020	0.0328	0.0523
SERVICE	15309.	0.4233E+05	0.3617	0.718	0.008	0.0092	0.0060
PRODCRFT	16198.	0.3268E+05	0.4957	0.620	0.011	0.0169	0.0202
OPERATOR	10532.	0.3514E+05	0.2997	0.764	0.007	0.0090	0.0084
FARMFISH	-12515.	0.6260E+05	-0.1999	0.842	-0.005	-0.0047	-0.0018
AGEW	280.71	283.9	0.9888	0.323	0.022	0.0265	0.0897
YRSCJOBW	-697.19	1113.	-0.6266	0.531	-0.014	-0.0158	-0.0329
YRSFULW	-254.15	786.5	-0.3232	0.747	-0.007	-0.0089	-0.0303
YRSEDUCW	5544.7	1767.	3.137	0.002	0.070	0.1149	0.7699
CONSTANT	-86604.	0.6179E+05	-1.402	0.161	-0.032	0.0000	-1.1005

R-SQUARE ADJUSTED = 0.0532

APPENDIX 3.7

OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD TRANSFER INCOME.

(DEPENDENT VARIABLE = YTRF, PROXY = YTRFPR).

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 1983 DF	PARTIAL P-VALUE	CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
AGE	167.67	39.35	4.261	0.000	0.095	0.1178	1.3710
MALE	871.01	1950.	0.4467	0.655	0.010	0.0148	0.1176
MARR	448.96	1725.	0.2602	0.795	0.006	0.0090	0.0560
WHITE	1591.4	1247.	1.276	0.202	0.029	0.0271	0.2149
RETIRED	12953.	1265.	10.24	0.000	0.224	0.2691	0.4345
WELFAR	293.95	2758.	0.1066	0.915	0.002	0.0023	0.0011
AGEW	87.056	18.39	4.735	0.000	0.106	0.1184	0.3399
CONSTANT	-9881.7	2555.	-3.867	0.000	-0.087	0.0000	-1.5349

R-SQUARE ADJUSTED = 0.1591

APPENDIX 3.8

OLS REGRESSION TO OBTAIN PROXY FOR HOUSEHOLD NET WEALTH.
(1991 OBSERVATIONS)

(DEPENDENT VARIABLE = NETWORTH, PROXY = NWPRED).

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 1971 DF	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
MILLOWN	0.24836E+07	0.2108E+07	1.178	0.239	0.027	0.0632	0.2442
EARNPR	38.670	5.088	7.600	0.000	0.169	0.2216	1.0611
YTRFPR	-56.376	62.82	-0.8974	0.370	-0.020	-0.0353	-0.1311
CHILDHU	-14373.	0.2461E+06	-0.5841E-01	0.953	-0.001	-0.0015	-0.0050
MALE	0.99077E+06	0.1128E+07	0.8784	0.380	0.020	0.0294	0.3031
WHITE	0.15806E+07	0.8519E+06	1.855	0.064	0.042	0.0468	0.4838
MARR	0.83150E+06	0.1208E+07	0.6886	0.491	0.016	0.0291	0.2350
BQUEST	0.17324E+07	0.4739E+06	3.656	0.000	0.082	0.0761	0.3036
INHPST	2.0924	0.1409	14.85	0.000	0.317	0.3076	0.0870
EXPINH	-0.13661E+07	0.6053E+06	-2.257	0.024	-0.051	-0.0489	-0.1010
EXPPEN	-0.12961E+07	0.5801E+06	-2.234	0.026	-0.050	-0.0533	-0.1474
LC30L	0.10849E+06	0.4835E+06	0.2244	0.822	0.005	0.0060	0.5693
LC3039	0.16150E+06	0.1529E+06	1.057	0.291	0.024	0.0368	0.5068
LC4049	0.15206E+06	0.1072E+06	1.418	0.156	0.032	0.0572	0.3553
LC5059	0.16404E+06	0.1181E+06	1.389	0.165	0.031	0.0654	0.2491
LC6075	0.89144E+06	0.2950E+06	3.022	0.003	0.068	0.3697	0.8078
LC6075SQ	-69248.	0.2093E+05	-3.309	0.001	-0.074	-0.3899	-0.7041
LC75G	0.12135E+07	0.5846E+06	2.076	0.038	0.047	0.1578	0.1298
LC75GSQ	-84856.	0.4621E+05	-1.836	0.066	-0.041	-0.1164	-0.0682
CONSTANT	-0.90294E+07	0.8277E+07	-1.091	0.275	-0.025	0.0000	-3.1793

R-SQUARE ADJUSTED = 0.1622

APPENDIX 3.9

To obtain the loan proxies, the Heckman's (1976) 2-stage PROBIT/OLS procedure is used. The followings are the first-stage PROBIT specification for whether household holds any of 4 home equity loans (AHEL=1 if household has any Refinanced/2nd/3rd Mortgages, or HELOC), and the second-stage OLS specifications for the initial loan amounts of each type of home equity loans. Unlike the single-stage TOBIT procedure, this method allows the processes governing the household borrowing decision and its debt demand decision to be different. Having controlled for selection bias, the predicted loan values from the second-stage ols debt demand regressions are then used as explanatory variables in the final OLS regression of NETWORTH structural equation shown in Table 3.2.

********** FIRST-STAGE REDUCED-FORM PROBIT (AHEL=1 or 0) **********

probit AHEL = F (NWPRED EARNPR YTRFPR &
AGE MALE WHITE MARR HHSIZE &
RAVERSE EHPRATIO HGAINLT &
CONSUMP EMERG LUX DUR &
WELFAR BADCRD NBKCRD)

Note: The Inverse Mills Ratios (MILLPHEL), obtained from the PROBIT first stage, are the selection-correction variables used in each of the second-stage OLS debt demand regressions.

(A) FIRST MORTGAGE: PROXY FOR INITIAL LOAN AMOUNT LACQMORT = RLACQM *****

********** 2ND-STAGE OLS for LACQMORT **********

ols LACQMORT= F (MILLPHEL NWPRED EARNPR YTRFPR &
AGE MALE WHITE MARR CHILDHU &
CONSUMP EMERG LUX DUR &
WELFAR BADCRD &
HGAINLT NBKCRD)

*****(B) REFINANCED MORTGAGE: PROXY FOR INITIAL LOAN AMOUNT LREFIN = RLREFIN ******

********** 2ND-STAGE OLS for LREFIN **********

ols LREFIN = F (MILLPHEL NWPRED EARNPR YTRFPR &
AGE MALE WHITE MARR CHILDHU &
CONSUMP EMERG LUX DUR &
WELFAR BADCRD &
HGAINLT NBKCRD)

******(C) SECOND MORTGAGE: PROXY FOR INITIAL LOAN AMOUNT LMORT2 = RLMORT2 ********
********** 2ND-STAGE OLS for LMORT2 **********
ols LMORT2 = F (MILLPHEL NWPRED EARNPR YTRFPR &
AGE MALE WHITE MARR CHILDHU &
CONSUMP EMERG LUX DUR &
WELFAR BADCRD &
HGAINLT NBKCRD)

*******(D) THIRD MORTGAGE: PROXY FOR INITIAL LOAN AMOUNT LMORT3 = RLMORT3 *******
********** 2ND-STAGE OLS for LMORT3 **********
ols LMORT3 = F (MILLPHEL NWPRED EARNPR YTRFPR &
AGE MALE WHITE MARR CHILDHU &
CONSUMP EMERG LUX DUR &
WELFAR BADCRD &
HGAINLT NBKCRD)

****(E) HELOC: PROXY FOR MAXIMUM CREDIT ON ALL HELOC (MHELOCA) = RMHLOCA ****
********** 2ND-STAGE OLS for MHELOCA **********
ols MHELOCA = F (MILLPHEL NWPRED EARNPR YTRFPR &
AGE MALE WHITE MARR CHILDHU &
CONSUMP EMERG LUX DUR BADCRD &
HGAINLT NBKCRD MORTHST)

Note: Estimation results of each regressions are shown in the following Appendices 3.7 to ?.

APPENDIX 3.10

1ST-STAGE REDUCED-FORM PROBIT ESTIMATION
OF WHETHER HOUSEHOLD HAS ANY OF 4 TYPES OF HOME EQUITY LOANS.
(TO OBTAIN MILLPHEL FOR USE IN 2ND-STAGE OLS ESTIMATION OF DEBT DEMAND)

(AHEL=1 IF HHOLD HAS ANY OF REFINANCED/2ND/3RD MORTGAGES OR HELOC)
574 OBSERVATIONS AT ONE
1417 OBSERVATIONS AT ZERO

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO	ELASTICITY AT MEANS	WEIGHTED AGGREGATE ELASTICITY
NWPRED	0.62732E-08	0.79795E-08	0.78617	0.22614E-01	0.13926E-01
EARNPR	0.18777E-05	0.72131E-06	2.6032	0.18574	0.12754
YTRFPR	-0.63314E-05	0.85368E-05	-0.74165	-0.53064E-01	-0.24348E-01
AGE	-0.21058E-01	0.67339E-02	-3.1271	-1.4070	-0.79046
MALE	0.93017E-02	0.16234	0.57297E-01	0.10259E-01	0.62854E-02
WHITE	0.11776E-01	0.10237	0.11504	0.12995E-01	0.77256E-02
MARR	-0.42776E-02	0.14780	-0.28942E-01	-0.43577E-02	-0.26924E-02
HHSIZE	0.42115E-01	0.27367E-01	1.5389	0.15601	0.99064E-01
RAVERSE	-0.68700E-01	0.75424E-01	-0.91085	-0.29562E-01	-0.15181E-01
EHPRATIO	-0.99992	0.91421E-01	-10.938	-0.67683	-0.30809
HGAINLT	0.34160	0.58615E-01	5.8278	1.5635	0.89969
CONSUMP	0.18786	0.10212	1.8396	0.28862E-01	0.19889E-01
EMERG	0.78860E-01	0.66691E-01	1.1825	0.38006E-01	0.23287E-01
LUX	0.12324	0.12392	0.99449	0.11549E-01	0.82707E-02
DUR	0.19920	0.89579E-01	2.2238	0.19760	0.12568
WELFAR	-0.29220	0.27527	-1.0615	-0.87550E-02	-0.32312E-02
BADCRD	0.24175	0.21307	1.1346	0.66270E-02	0.47068E-02
NBKCRD	0.50026E-01	0.18861E-01	2.6524	0.10403	0.69763E-01
CONSTANT	-0.79671	0.28869	-2.7598	-1.0112	-0.60107

LOG-LIKELIHOOD FUNCTION = -1022.3
LOG-LIKELIHOOD(0) = -1195.8
LIKELIHOOD RATIO TEST = 347.167 WITH 18 D.F.
PERCENTAGE OF RIGHT PREDICTIONS = 0.74134

MADDALA R-SQUARE 0.1600
CRAGG-UHLER R-SQUARE 0.22886
MCFADDEN R-SQUARE 0.14516
ADJUSTED FOR DEGREES OF FREEDOM 0.13735
APPROXIMATELY F-DISTRIBUTED 0.17924 WITH 18 AND 19 D.F.
CHOW R-SQUARE 0.16086

APPENDIX 3.11

2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF FIRST MORTGAGE.
(915 OBSERVATIONS)

(DEPENDENT VARIABLE = LACQMORT, PROXY = RLACQM).

VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 897 DF
MILLPHEL	-2588.9	-0.327
NWPRED	0.75865E-03	0.436
EARNPR	0.62781	4.995
YTRFPR	1.3189	0.811
AGE	-543.40	-0.412
MALE	613.90	0.023
WHITE	6824.2	0.393
MARR	-3852.6	-0.167
CHILDHU	-4026.3	-0.825
CONSUMP	29272.	1.667
EMERG	10684.	0.910
LUX	32583.	1.606
DUR	-29139.	-1.836
WELFAR	2025.0	0.036
BADCRD	-15616.	-0.462
HGAINLT	-4322.8	-0.437
NBKCRD	8590.5	2.639
CONSTANT	65676.	1.321

R-SQUARE ADJUSTED = 0.0723

APPENDIX 3.12

2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF REFINANCED MORTGAGE.
(278 OBSERVATIONS)

(DEPENDENT VARIABLE = LREFIN, PROXY = RLREFIN).

VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 260 DF
MILLPHEL	-0.12440E+06	-1.644
NWPRED	0.12454E-01	1.796
EARNPR	0.35546	1.107
YTRFPR	8.6996	2.313
AGE	32.226	0.010
MALE	-28294.	-0.449
WHITE	-42041.	-1.106
MARR	-38824.	-0.742
CHILDHU	19271.	1.771
CONSUMP	18012.	0.512
EMERG	-29914.	-1.221
LUX	-12975.	-0.305
DUR	-23893.	-0.646
WELFAR	-43828.	-0.467
BADCRD	-21858.	-0.272
HGAINLT	-26351.	-0.846
NBKCRD	17255.	2.859
CONSTANT	0.29219E+06	1.744

R-SQUARE ADJUSTED = 0.1564

APPENDIX 3.13

2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF SECOND MORTGAGE.
(127 OBSERVATIONS)

(DEPENDENT VARIABLE = LMORT2, PROXY = RLMORT2).

VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 109 DF
MILLPHEL	0.30784E+06	3.230
NWPRED	0.19405E-02	0.942
EARNPR	0.40394	1.204
YTRFPR	1.6922	0.335
AGE	-5995.2	-1.269
MALE	61021.	0.813
WHITE	-7782.9	-0.168
MARR	-12381.	-0.182
CHILDHU	86.495	0.005
CONSUMP	71366.	1.428
EMERG	31730.	0.914
LUX	33270.	0.629
DUR	16902.	0.324
WELFAR	-41723.	-0.238
BADCRD	16830.	0.289
HGAINLT	0.11243E+06	2.549
NBKCRD	19446.	2.665
CONSTANT	-0.48678E+06	-2.396

R-SQUARE ADJUSTED = 0.0367

APPENDIX 3.14

2ND-STAGE OLS REGRESSION FOR INITIAL LOAN AMT OF THIRD MORTGAGE.
(53 OBSERVATIONS)

(DEPENDENT VARIABLE = LMORT3, PROXY = RLMORT3).

VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 35 DF
MILLPHEL	0.19076E+06	2.444
NWPRED	-0.19584E-01	-1.624
EARNPR	1.8570	2.829
YTRFPR	8.3547	1.650
AGE	-7703.4	-1.645
MALE	-15942.	-0.147
WHITE	65981.	0.785
MARR	32172.	0.354
CHILDHU	4665.6	0.238
CONSUMP	0.14579E+06	1.679
EMERG	-21646.	-0.484
LUX	0.13532E+06	1.677
DUR	-83260.	-1.231
WELFAR	-76176.	-0.469
BADCRD	0.12875E+06	0.986
HGAINLT	90875.	2.237
NBKCRD	3928.7	0.520
CONSTANT	-0.27286E+06	-1.180

R-SQUARE ADJUSTED = 0.2801

APPENDIX 3.15

2ND-STAGE OLS REGRESSION FOR INITIAL MAXIMUM CREDIT ALLOWED ON ALL HELOCS.
(192 OBSERVATIONS)

(DEPENDENT VARIABLE = MHELOCA, PROXY = RMHLOCA).

VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO 174 DF
MILLPHEL	61862.	0.6128
NWPRED	0.47307E-01	4.125
EARNPR	-0.79388	-1.232
YTRFPR	-2.4612	-0.3996
AGE	-2102.7	-0.3422
MALE	-49008.	-0.3610
WHITE	-12513.	-0.1580
MARR	44616.	0.4204
CHILDHU	35172.	1.582
CONSUMP	17265.	0.2869
EMERG	0.12961E+06	3.037
LUX	16964.	0.2366
DUR	-91959.	-1.450
BADCRD	0.23015E+06	0.7766
HGAINLT	28178.	0.5700
NBKCRD	2838.6	0.2026
MORTHST	-42760.	-0.8212
CONSTANT	36255.	0.1183

R-SQUARE ADJUSTED = 0.1540

APPENDIX 3.16

1ST-STAGE REDUCED-FORM PROBIT ESTIMATION
OF WHETHER HHOLD USES 2ND/3RD MORTGAGES OR HELOC (HEL=1).
(TO OBTAIN HELPRED AND MILLHEL
FOR USE IN 2ND-STAGE TOBIT OR OLS ESTIMATION OF PORTFOLIO SHARES)

357 OBSERVATIONS AT ONE
1634 OBSERVATIONS AT ZERO

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO	ELASTICITY AT MEANS	WEIGHTED AGGREGATE ELASTICITY
NWPRED	-0.10014E-07	0.16129E-07	-0.62089	-0.37687E-36	-0.17572E-01
AGE	-0.26385E-02	0.50873E-02	-0.51865	-0.18405E-35	-0.85615E-01
MALE	-0.22155	0.15270	-1.4509	-0.25509E-35	-0.13000
WHITE	0.19100	0.13213	1.4455	0.22004E-35	0.11240
HHSIZE	0.41208E-01	0.31913E-01	1.2913	0.15937E-35	0.85941E-01
HEALTH	0.35333	0.27879	1.2674	0.44750E-35	0.22946
WIDOWED	-0.53509	0.26390	-2.0276	-0.48788E-36	-0.92438E-02
RETIRED	-0.41940	0.15579	-2.6921	-0.12002E-35	-0.30135E-01
RAVERSE	-0.97024E-01	0.95003E-01	-1.0213	-0.43586E-36	-0.18334E-01
EHPRATIO	-0.49395E-02	0.14683	-0.33641E-01	-0.34905E-37	-0.14969E-02
RLACQM	0.88754E-06	0.99906E-06	0.88837	0.49160E-36	0.28200E-01
RLREFIN	0.10194E-05	0.86126E-06	1.1836	0.26004E-36	0.16410E-01
CRLMORT2	0.68696E-03	0.49031E-03	1.4011	0.34276E-34	0.20891E-03
CRLMORT3	0.53266E-02	0.26970E-02	1.9750	0.10883E-33	0.12229E-02
CRMHLOCA	0.57132E-03	0.36646E-03	1.5590	0.41085E-34	0.28682E-03
CONSTANT	-1.4575	0.44362	-3.2855	-0.19313E-34	-0.96486

LOG-LIKELIHOOD FUNCTION = -596.50
LOG-LIKELIHOOD(0) = -936.45
LIKELIHOOD RATIO TEST = 679.889 WITH 15 D.F.
PERCENTAGE OF RIGHT PREDICTIONS = 0.90206

MADDALA R-SQUARE 0.2893
CRAGG-UHLER R-SQUARE 0.47452
MCFADDEN R-SQUARE 0.36301
ADJUSTED FOR DEGREES OF FREEDOM 0.35818
APPROXIMATELY F-DISTRIBUTED 0.60789 WITH 15 AND 16 D.F.
CHOW R-SQUARE 0.41904

APPENDIX 3.17

In estimating the impact of HEL usage on household's SHATA portfolio share in a simultaneous framework, the paper uses the "switching regression model with endogenous switching" as suggested by Maddala and Nelson (1975), while incorporating Heckman's (1976, 1979) two-stage probit/ols method.[92] Depending on whether household i takes up HEL or not, its observed portfolio share for the SHATA asset category S_i is described by one of the two regimes:

Regime 1 (HEL Household):

$$S_{1i} = X_{1i}\beta_1 + u_{1i} \qquad for \quad \varepsilon_i > -Z_i\gamma \,, \tag{72}$$

Regime 2 (Non-HEL Household):

$$S_{2i} = X_{2i}\beta_2 + u_{2i} \qquad for \quad \varepsilon_i \leq -Z_i\gamma \,. \tag{73}$$

X_{1i}, X_{2i} and Z_i are vectors of exogenous variables. β_1, β_2 and γ are the corresponding vectors of coefficients for the parameters. It is assumed that the random errors u_{1i}, u_{2i} and ε_i have a trivariate normal distribution, with mean vector zero and covariance matrix Σ,

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_2^2 & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{bmatrix} . \tag{74}$$

Var $(\varepsilon_i) = \sigma_\varepsilon^2$ has been normalized to 1.

The criterion function (HEL-usage equation) that determines the appropriate regime to which the household belongs, is specified as:

$$I_i^* = Z_i\gamma + \varepsilon_i \,. \tag{75}$$

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[92] Switching regression models were first considered by Goldfeld and Quandt (1973), and later extended by Maddala and Nelson (1975), and Lee and Trost (1978). In such models, the behavior of the agents is governed by one of two regimes (regression equations), the classification of which is determined by a criterion function. The term "endogenous" arises when the error term in the criterion function is correlated with the error terms in the two regression equations.

$$\textit{HEL-holder:} \quad I_i = 1 \quad \textit{iff} \quad I_i^* > 0 \quad (\textit{or} \quad \varepsilon_i > -Z_i\gamma) , \tag{76}$$

$$\textit{Non-HEL:} \quad I_i = 0 \quad \textit{iff} \quad I_i^* \leq 0 \quad (\textit{or} \quad \varepsilon_i \leq -Z_i\gamma) . \tag{77}$$

I_i^* is an unobservable latent index measuring the household's net utility gained from the decision to hold HEL relative to that of not having HEL, and I_i is a dummy variable indicating the observed HEL usage status of the household.

If ε_i is correlated with u_{1i} and u_{2i}, an ordinary least squares estimation of either the HEL or non-HEL household's portfolio share equations will give biased and inconsistent estimates. This is the case since $E(u_{1i}/I_i=1)\neq 0$ and/or $E(u_{2i}/I_i=0)\neq 0$. The selection process results in expected values of u_{1i} and u_{2i} that differ from zero after households sort into the two regimes. With the assumption that ε_i is normally distributed, it can be shown that,

$$E(u_{1i}/I_i=1) = \sigma_{1\varepsilon}\left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)}\right] = \sigma_{1\varepsilon}M_{1i} , \tag{78}$$

and

$$E(u_{2i}/I_i=0) = -\sigma_{2\varepsilon}\left[\frac{\phi(Z_i\gamma)}{1-\Phi(Z_i\gamma)}\right] = \sigma_{2\varepsilon}M_{2i} , \tag{79}$$

where M_{1i} and M_{2i} are the Inverse Mills Ratios:

$$M_{1i} = \frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)} > 0, \quad \textit{and} \quad M_{2i} = -\frac{\phi(Z_i\gamma)}{[1-\Phi(Z_i\gamma)]} = \frac{\phi(Z_i\gamma)}{[\Phi(Z_i\gamma)-1]} < 0 . \tag{80}$$

$\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the density function and the distribution function of the standard normal variable $Z_i\gamma$.

Substituting $E(u_{1i}/I_i=1)$ and $E(u_{2i}/I_i=0)$ into the respective portfolio share equations for SHATA, the expected SHATA portfolio share for the HEL and non-HEL households after selection would then be

$$\textit{HEL Household:} \quad E(S_{1i}/I_i = 1) = X_{1i}\beta_1 + \sigma_{1\varepsilon}M_{1i} , \tag{81}$$

$$\textit{Non-HEL Household:} \quad E(S_{2i}/I_i = 0) = X_{2i}\beta_2 + \sigma_{2\varepsilon}M_{2i} , \tag{82}$$

The two regimes' SHATA portfolio asset share equations (72) and (73) can be rewritten as:

$$\textit{HEL Household } (I_i = 1): \quad S_{1i} = X_{1i}\beta_1 + \sigma_{1\varepsilon}M_{1i} + \eta_{1i}, \tag{83}$$

$$\textit{Non-HEL Household } (I_i = 0): \quad S_{2i} = X_{2i}\beta_2 + \sigma_{2\varepsilon}M_{2i} + \eta_{2i}, \tag{84}$$

with $E(\eta_{1i}/I_i=1)=0$ and $E(\eta_{2i}/I_i=0)=0$.

Selectivity bias, therefore, exists if there is correlation between the error terms in the HEL usage and portfolio share equations. In this case, inconsistent parameter estimates are obtained if one simply estimates the original portfolio share equations (72) and (73) for *separate* samples of HEL-holders and non-HEL households. To correct for selectivity bias, the two-stage probit/ols method proposed by Heckman (1976, 1979) and Lee (1976) is used.

In the first stage, one obtains consistent estimates of γ ($\hat{\gamma}$) from the probit maximum-likelihood estimation of the HEL usage (criterion function) equation, and compute estimates of the Inverse Mills Ratios using $\hat{\gamma}$. In the second stage, the HEL and non-HEL households' SHATA portfolio share equations (83) and (84) are estimated by Ordinary-Least-Squares (OLS) regression method, which includes the estimated Inverse Mills Ratios obtained from the first stage probit estimation. The above procedure yields consistent estimates of β_1, β_2, $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$. The coefficients of the Inverse Mills Ratios are the values for $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$. Any significance in the Inverse Mills Ratios in the portfolio share equations is indicative of the presence of selectivity bias, i.e., there is a correlation between ε_i and u_{1i} (if $\sigma_{1\varepsilon}$ is significantly different from zero), and/or a correlation between ε_i and u_{2i} (if $\sigma_{2\varepsilon}$ is significantly different from zero).

While it is of interest to test whether selectivity bias exists, a more important issue is to examine the signs and magnitudes of the covariances, $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$. There are four possible situations:

a) $\sigma_{1\varepsilon}>0$ and $\sigma_{2\varepsilon}>0$ (both positive).
Given that $M_{1i}>0$ in equation (83) and $M_{2i}<0$ in equation (84), the expected SHATA portfolio share of the HEL households after selection is *greater* than the unconditional mean under random assignment. The non-HEL households have an expected SHATA portfolio share that is *below* average after selection.

b) $\sigma_{1\varepsilon}<0$ and $\sigma_{2\varepsilon}<0$ (both negative).
This is the reverse of case (a). In this case, the HEL households have an expected

SHATA portfolio share that is *less* than the average, while that of the non-HEL households is *above* average.

c) $\sigma_{1\varepsilon} > 0$ and $\sigma_{2\varepsilon} < 0$.

This implies that both the HEL and non-HEL households have *above* average expected SHATA portfolio share after selection.

d) $\sigma_{1\varepsilon} < 0$ and $\sigma_{2\varepsilon} > 0$.

In this case, the expected SHATA portfolio share of both groups after selection is *less* than the average under random assignment.

Further insight could be obtained on the effects of self-selection when one compares the actual SHATA portfolio share held by each HEL household against its expected portfolio share, had it not used HEL.

The expected SHATA portfolio share of the HEL household, had it *not* used HEL, would be

$$E(S_{2i} / I_i = 1) = X_{2i}\beta_2 + \sigma_{2\varepsilon} M_{1i}, \tag{85}$$

where HEL household's values for X_{2i} and M_{1i} are substituted into the non-HEL portfolio share equation (82). Given $M_{1i} > 0$, the HEL household's conditional expected SHATA portfolio share if otherwise not using HEL, is above the average non-HEL SHATA portfolio share under random assignment if $\sigma_{2\varepsilon} > 0$, and vice versa if $\sigma_{2\varepsilon} < 0$.

The effects of HEL usage decision on household's SHATA portfolio share under the four cases can be summarized in Appendix 3.15. The signs and magnitudes of the covariances yield interesting interpretations to the SHATA portfolio share equations. These form the bases for analyzing the impact of HEL usage on the SHATA portfolio share held by households.

APPENDIX 3.18

EFFECTS OF HEL USAGE DECISION ON SHATA PORTFOLIO SHARE

CONDITIONAL EXPECTED SHATA PORTFOLIO SHARE	$\sigma_{1\varepsilon}>0$, $\sigma_{2\varepsilon}>0$	$\sigma_{1\varepsilon}<0$, $\sigma_{2\varepsilon}<0$	$\sigma_{1\varepsilon}>0$, $\sigma_{2\varepsilon}<0$	$\sigma_{1\varepsilon}<0$, $\sigma_{2\varepsilon}>0$
1ST REGIME (HEL hholds): $E[S_1/(I_i=1)]=X\beta_1+\sigma_{1\varepsilon}M_1$	$> X\beta_1$	$< X\beta_1$	$> X\beta_1$	$< X\beta_1$
HEL hholds alternatively not using HEL: $E[S_2/(I_i=1)]=X\beta_2+\sigma_{2\varepsilon}M_1$	$> X\beta_2$	$< X\beta_2$	$< X\beta_2$	$> X\beta_2$
2ND REGIME (Non-HEL hholds): $E[S_2/(I_i=0)]=X\beta_2+\sigma_{2\varepsilon}M_2$	$< X\beta_2$	$> X\beta_2$	$> X\beta_2$	$< X\beta_2$
Non-HEL hholds alternatively using HEL: $E[S_1/(I_i=0)]=X\beta_1+\sigma_{1\varepsilon}M_2$	$< X\beta_1$	$> X\beta_1$	$< X\beta_1$	$> X\beta_1$
Implications:	HEL-holders have *higher* than average expected SHATA portfolio share, in their current & alternative decisions. Non-HEL hhold's expected SHATA portfolio share is *below* average.	HEL hholds have *lower* than average expected SHATA portfolio share in their current and alternative decisions. Non-HEL hhold's expected SHATA portfolio share is *above* average.	Both HEL & non-HEL hholds have *above* average expected SHATA portfolio share based on their current HEL usage decisions, but *below* average share if otherwise.	Both HEL & non-HEL hholds have *below* average expected SHATA portfolio share based on their current HEL usage decisions, but *above* average share if otherwise.

By construction, $M_1 > 0$, and $M_2 < 0$.