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The effects of selected family characteristics on interrelated components of household asset portfolios over a three-year time period were investigated. Specifically, this study attempted to conceptually define mental accounts, to identify own-adjustment and cross-adjustment characteristics of these mental accounts, to explore influences of selected family characteristics on these mental accounts, and to examine substantial effects of income on family portfolio behavior.

Based on the behavioral life-cycle hypothesis, consumer demand theory, household production theory, and the stock adjustment hypothesis, a family portfolio behavior model was formulated for studying family saving behavior as reflected in household asset portfolios. A tobit model was utilized to estimate own- and cross-adjustment coefficients of the portfolio components, and short-term and equilibrium effects of family characteristics. The data were from the Survey of

Consumer Finances conducted in 1983 and 1986.

Findings strongly support the mental account hierarchy hypothesis which was reflected in the own- and cross-adjustment coefficients estimated. In addition, family income and education of the household head showed positive influences on various mental accounts. Age of the household head, employment status, family life cycle stage, house mortgage, home value, other assets, and other debts showed effects on some mental accounts. Income had a substantial influence on family portfolio behavior. The behavior of middle-income families was more consistent with the hypothesis of a mental account hierarchy than the other income groups, which implies diverse preferences for asset characteristics and varying financial needs of families at different income levels.

This study has contributed to the body of knowledge of family saving behavior and increased the understanding of adaptivity and dynamics of family saving behavior. The research findings could be utilized by family finance educators and consultants, financial service marketers, and public policy makers in working successfully with different family types, marketing various financial instruments, and designing effective savings policies. In addition, this study has provided empirical evidence to assess existing theoretical models and to inspire the building of new theories.

Effects of Selected Family Characteristics on Interrelated Components of Household Asset Portfolios

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EFFECTS OF SELECTED FAMILY CHARACTERISTICS ON INTERRELATED COMPONENTS OF HOUSEHOLD ASSET PORTFOLIOS

INTRODUCTION

Concepts of family saving and investment are usually considered to be interchangeable when discussed in related literature. For example, saving has been defined as either net worth change or total net investment change (Hefferan, 1982). Savings and investments formulate a household asset portfolio. A portfolio is any combination of tangible and intangible assets (Winger and Frasca, 1986, p.509). Tangible assets are anything that can be used or enjoyed while being owned. Intangible assets (also called financial or paper assets) are actually claims to tangible assets or the earnings those assets produce (Winger and Frasca, 1986, p.432). Due to the focus of this study, portfolio will be defined here as the composition of intangible household assets.

Components of household asset portfolios display one aspect of family saving behavior. Changes in the share of any particular component or type of financial asset owned by U. S. households are frequent occurrences. For example, during the 1977-83 period, the portion of families with savings accounts, savings bonds, and stocks substantially decreased, and the holdings of other assets such as individual retirement accounts (IRAs), certificates of deposit, and money market accounts have increased. This is a different pattern from the

situation during 1970-77 (Avery et al, 1984a). Why did these changes happen? To answer this question, some other questions should be asked first: what are consumers trying to accomplish financially when they acquire and hold household asset portfolios? Do changes in some components influence other components of the portfolios? If so, how? Research to answer these questions is scarce.

That certain family characteristics influence portfolio behavior has been shown in many empirical studies. For example, a survey of consumer finances reveals that age of family head, education of family head, house ownership, and life-cycle stage of family head, have influenced the dollar amount and/or the percentage of each type of asset owned (Avery et al, 1984a). Previous studies (Bryant, 1986; Zick and Gerner, 1987) have incorporated some family characteristics into empirical models to investigate their influences on family financial portfolios. However, no research has been found which formulates a theoretical framework to systematically explore determinants of household asset portfolios.

Strong evidence has also shown that income plays a pivotal role in the composition of household assets. First, it may be expected that, in given years, families with incomes lower than the amount needed to meet minimum living standards are unable to save; therefore, no changes or even negative changes in their portfolios will be anticipated, assuming they

exist at all. Secondly, some empirical evidence shows that families at various income levels have different portfolio behaviors. For instance, on average, holders of money market mutual fund accounts (in brokerage firms) had substantially higher incomes and financial assets than did owners of market deposit accounts (in depository institutions) (Avery et al, 1984b). Ownership of every type of asset is shown as an increasing function of income (Avery et al, 1984a). Income has been used as a determinant in numerous empirical studies of family savings and always show an effect. However, previous studies never treat income as a variable that is substantially different from other family characteristics.

What do components of household asset portfolios represent in terms of family ability to function? Do these components influence each other? What are the systematic effects of family characteristics on the composition of intangible household assets? Does income have substantial, overall effects on family portfolio behavior? This study attempts to address these questions and seeks evidence to shape future direction for research.

Theoretical Background

The whole process of family saving can be summarized in three major decisions: whether or not to save (timing of saving), why to save (goals of saving), and how to save (financial instruments of saving). Relevant theoretical

frameworks for systematic investigation of this issue are the life-cycle hypothesis, the new consumer demand theory, the household production theory, and the stock adjustment hypothesis.

Modigliani and Brumberg (1954; 1963) formulated a life-cycle hypothesis, which was later improved by Tobin (1963). They model family saving behavior by stating that saving is mainly done for retirement, and people save throughout their lifetime except during young adulthood and retired years. Numerous empirical studies have tested this influential hypothesis and the results are not satisfactory, especially when using microdata (Courant at al, 1986). While one reason may be related to one's inability to predict duration and cost of retirement living, other factors may also influence saving behavior. An important improvement of this traditional hypothesis was proposed by Shefrin and Thaler (1988). Incorporating the work done by psychologists and other social scientists into the traditional life-cycle hypothesis for saving, they developed a behavioral life-cycle hypothesis addressing three distinct features in saving behavior: self-control, mental accounting, and framing. According to this model, people at different income levels have different saving orientations. They behave according to both economic rules and socio-psychological rules. The behavioral life-cycle hypothesis seems more appealing than its forerunner and is supported indirectly by some empirical studies. However,

direct testing is still in the beginning stage.

Lancaster (1966) has revolutionized utility theory by proposing a new consumer demand theory. He maintains that it is not the goods themselves, but characteristics embedded in goods which provide utility for consumers. His model allows investigation of reasons for the purchase of the goods, to which the traditional utility theory fails to apply. For example, traditional utility theory views characteristics, other than quantities, of various financial products (which may be components of savings) as identical, but Lancaster's theory considers that they are different and takes account of these different characteristics of the products.

Household production theory is rooted in Becker's seminal article (1965), and enriched later with a series of articles treating the family as a production unit and researching family issues with economic approaches. The most revolutionary contribution of Becker's theory to utility theory is that he incorporates time into the analytical framework and views time as well as goods as inputs in household production. The interaction of these inputs and family members generates household-produced output, i.e. "commodities" (Becker, 1981, pp.7-8). In the context of household portfolios, the components of household assets could be viewed as different "commodities" produced by family members and may reflect different financial needs of the household. Purchases of various financial products may imply

steps toward meeting these needs.

The stock adjustment hypothesis originates from the econometric estimation of distributed lag models. The first model (also called partial adjustment model) has been formulated by Nerlove (1956). Many economists and consumer economists have used this model to examine the composition of family savings, investment, wealth, and expenditures and gained some insights about interrelationships of household asset portfolios. Even though this model itself provides very little specific prediction without considering other frameworks, its sophisticated estimation procedure is attractive in such an empirical study. Utilizing this procedure, own-adjustment coefficients (influence of the previous period asset on the present period asset) and cross-adjustment coefficients (influence of one asset on another asset) can be estimated.

This study will use the behavioral life-cycle hypothesis as a theoretical framework, integrate the new consumer demand theory, household production theory, and the stock adjustment hypothesis to formulate a family portfolio model for investigating family saving behavior as reflected in household asset portfolios.

Research Purpose and Objectives

The purpose of this study is to investigate the effects of selected family characteristics on interrelated components

of household asset portfolios over one period of time.

Specifically, this study attempts:

(1) to define mental account hierarchy conceptually in the context of family portfolios;

(2) to identify the own-adjustment and cross-adjustment characteristics of these mental accounts over one period of time (three years);

(3) to investigate possible short-term (three year) and equilibrium effects of selected family characteristics on these mental accounts;

(4) to examine substantial effects of income on family portfolio behavior.

Justifications

Studying this topic can be justified in two ways. First of all, this study will contribute to the body of knowledge of family saving behavior, which will be helpful for households, public policy makers, and financial businesses. Households have provided well over 90 percent of aggregate net saving in the United States since 1951, and the composition of household saving crucially affects the allocation of U.S. capital stock among human capital, household capital, and industrial capital (Hendershott, 1985, p.3). The proportion of families in the so-called middle class of the U.S. has shifted somewhat toward the upper class in recent years, at least in terms of income (Horrigan and Haugen, 1988). This may suggest a potential

change in overall distribution of household assets. The deregulation of financial services has resulted in an explosion of varieties of financial products and aggravated the confusion among families that tend to save, and also increased competition among financial businesses. Given these factors, demand for knowledge of family saving behavior has increased in family economics and finance education, public policy, and financial business sectors.

Secondly, this study will provide empirical evidence to assess existing theoretical models and to inspire the building of new theories. For example, this study will directly test hypotheses generated on the basis of the behavioral life-cycle model, which will provide empirical results to begin assessing the validity of this model. Another aim of this study is to incorporate several theoretical frameworks to describe the family saving process. This may offer hints for the creation of a comprehensive model to systematically address family saving behavior from short to long run, and from a disequilibrium to an equilibrium state.

In summary, this study will increase the understanding of the adaptive and dynamic processes of family saving behavior. The research findings will have immediate implications for family finance educators and researchers, financial service marketers, and public policy makers.

Definitions

Terms that are often used in this study are defined as follows.

Portfolios The composite of intangible household assets held by a family.

Savings The increase of dollar values in household assets over a stated time period.

Behavioral life-cycle hypothesis A revision of the traditional life-cycle hypothesis, whereby Shefrin and Thaler (1988) add several behavioral features such as self-control, mental accounting, and framing to improve explanation power (for more details see related sections in Chapter 2, "Review of Literature", and Chapter 3, "Model").

New consumer demand theory An improvement of the traditional economic utility model, in which Lancaster (1966) addresses consumer choice as a selection process among characteristics of goods rather than the goods themselves (for more details see the related section in Chapter 3, "Model").

Household production theory A revolutionary improvement of the traditional utility model, in which Becker (1965) adds time to goods, as inputs of household production, to produce family preferred "commodities" (for more details see the related section in Chapter 3, "Model").

Stock adjustment hypothesis A hypothesis that assumes consumers continually adjust their portfolios toward desired amounts of household assets based on perceived current and

future financial needs, and that relationships between currently owned stocks and desired stocks of household assets exist (for more details see the related section in Chapters "Review of Literature" and "Model").

The following terms are often used in the behavioral life-cycle hypothesis.

Willpower A psychological factor which represents the individual's perceived cost of savings in terms of current satisfaction foregone.

Self-control An assumed process in which consumers voluntarily refrain from spending to some degrees.

Mental accounting A conceptualization of financial assets. The process assumes that assets are grouped according to their relative ability to satisfy different types of financial needs. Further, individuals are assumed to assign different marginal propensities to consume to these different "groups" or accounts.

Framing A conceptualization of income. It assumes that income from different sources may carry specific meanings which will influence the manner in which it is stored. For example, income from current earnings may be saved in a different mental account(s) than inherited income, and be subject to different marginal propensities to consume.

Terms often used in the stock adjustment hypothesis are the following.

Own-adjustment coefficient The effect of one household

asset in the present period on itself in a future period.

Cross-adjustment coefficient The effect of one household asset in the present period on another asset in a future period.

Short-term effect The effect of one family characteristic on one household mental account over a stated period of time (three years in this study).

Equilibrium effect (also called long-term effect) The effect of one family characteristic on the desired demand for assets in a particular mental account, assessed by analysis at one point in time.

REVIEW OF LITERATURE

This chapter reviews the conceptual development and related empirical studies of the life-cycle hypothesis for saving, then looks at the theory of portfolio selection and relevant empirical research, and finally, examines the empirical research about interrelated components of household assets.

Life-cycle Hypothesis: Theory and Evidence

Traditional saving theories mentioned here refer to the life-cycle hypothesis and the proportionality principle. This section first briefly reviews these two traditional hypotheses and some related empirical studies. Then the behavioral life-cycle hypothesis is examined and direct and indirect tests of this hypothesis are discussed.

The life-cycle hypothesis

The life-cycle hypothesis (LH), which is the most influential hypothesis modeling family saving behavior, was developed in two seminal papers, one on utility analysis and the consumption function (Modigliani and Brumberg, 1954), and a later one on utility analysis and the aggregate consumption function (Ando and Modigliani, 1963; Modigliani and Brumberg, 1963). This model was originally proposed to explain aggregate saving behavior and it seems successful. Modigliani

(1986) excellently and concisely introduced this model in his Nobel lecturate when he was awarded the Nobel Economics Prize in 1985.

The LH states that current consumption spending depends on current wealth and life-time income so that the maximum stock of assets is reached at the beginning of retirement. Then the assets are drawn down toward zero during retirement to finance consumption. Tobin (1967) has contributed to the theory by introducing the possibility that a family may dissave in young adulthood, and save later in working life to cater to retirement when savings are drawn down.

Attempts to test traditional saving models have met with mixed success. Courant and his colleagues (1986) summarize that "the life-cycle model has not tested out very well ... Nor have efforts to test the life-cycle model with cross-sectional microdata worked out very successfully". Various alterations to the theory have been proposed to help it accommodate the data, but often appear to be ad hoc (Shefrin and Thaler, 1988). Failure to confirm this traditional hypothesis implies that people who save follow not only economic rules, but maybe others as well, such as socio-psychological rules.

The proportionality principle

The proportionality principle is a component of the permanent income hypothesis (Friedman, 1957). As an

assumption for simplicity, the proportionality principle states that tastes are independent of the stock of (human plus nonhuman) wealth (Mayer, 1972, p.34). It implies that consumption is smoothed, no matter what the level of permanent income happens to be (Shefrin and Thaler, 1988).

When Friedman (1957) investigates proportionality, he finds that the assumption is violated, but argues that the observed behavior could be explained by measurement error. Diamond and Hausman (1984) find that the saving rate increases with permanent income which is contrary to Friedman's explanation. A thorough survey on the proportionality issue is made by Mayer (1972). He has also conducted five tests of his own. His conclusion is that there are many tests which refute the proportionality hypothesis, and that this hypothesis is "definitely invalidated" (p.348). The empirical rejection of the proportionality hypothesis suggests that tastes may play a role in savings behavior, and socio-psychological factors may need to be considered in developing a saving behavior model.

The behavioral life-cycle hypothesis

Aware of the limitations of traditional saving theories, Shefrin and Thaler proposed a behavioral life-cycle hypothesis incorporating research done by psychologists and other social scientists into the traditional life-cycle hypothesis (Shefrin and Thaler, 1988; Thaler and Shefrin, 1981). This model

explicitly addresses three important behavioral features that are usually missing in economic analysis: self-control, mental accounting, and framing. According to this hypothesis, consumer saving behavior follows not only economic rules (such as utility maximizing), but also socio-psychological rules. From a socio-psychological perspective, consumers treat their wealth as several unfungible mental accounts. By framing, they are expected to spend/save incomes, from different sources or in different forms, from/in the various different mental accounts. When they save in the mental accounts, they would experience a self-control process. This self-control process is psychologically costly and the psychological costs vary with different mental accounts (for more details of this hypothesis, see section "Behavioral life-cycle hypothesis" in the next chapter).

The behavioral life-cycle hypothesis seemly can predict saving behavior more realistically than its pioneer life-cycle hypothesis. Authors of this model have formulated ten testable hypotheses based on their model and cited numerous supportive, but indirect empirical studies (Shefrin and Thaler, 1988; Thaler, 1990).

One inference from the behavioral life-cycle hypothesis is that families at different income levels will have fundamentally dissimilar saving patterns. This prediction is supported indirectly by a number of empirical studies.

The Survey of Consumer Finances conducted in 1983 (Avery

et al, 1984a) reveals some patterns in the ownership of household assets: (1) Families with various incomes have different portfolio structures. For example, families with higher incomes are more likely to have stocks, bonds and other financial assets; (2) Families with higher incomes are more likely to own, and have a larger median dollar amount of financial assets.

Hefferan (1982) uses the data from 1972-1973 Consumer Expenditure Survey to investigate determinants and patterns of family savings, and finds that female-headed families possess significantly lower mean values of investment assets than reference families (one-earner couple with children). The female-headed family's average annual income is $6,817 while the reference family's $14,119. This study suggests that different behavior patterns exist for families at various income levels and, perhaps, for different family compositions.

When investigating family saving behavior, Wolff (1981) suggested a three-class model to predict family saving behavior: (1) The first class is the capitalist class, whose wealth takes the form of capital wealth; (2) The second class may be called the primary working class, whose wealth takes the form of life-cycle wealth; (3) The third class may be called the secondary work force, whose lifetime income is too low to permit any significant accumulation, except in the form of durables. In terms of the possession of intangible household assets, Wolff's notion implies that the capitalist

class is most likely to have financial assets, the secondary work force has almost no savings, and the acquired assets of the primary working class is in between.

Another inference of the behavioral life-cycle hypothesis is that people consume from different mental accounts in different ways[1]. Specifically, the consumption propensities from different mental accounts are different. This infers a mental account hierarchy. A small, informal survey has been conducted to confirm the mental account hypothesis (Shefrin and Thaler, 1988). Only one direct testing of this prediction is undertaken by Levin (1991). He uses data from the Longitudinal Retirement History Survey between 1969 and 1979. He finds that the point estimates of the marginal propensity to consume are usually highest for current income and lowest for future wealth, with the coefficient on current assets being in between. This is consistent with the prediction based on the behavioral life-cycle hypothesis.

The third inference of the life-cycle hypothesis is that the marginal propensity to consume out of different assets will change when the individual's life circumstances change. Levin's (1991) findings support this prediction and give evidence of significant change in spending propensities for the different assets at retirement. Strong support for this

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[1] Mental accounts could be defined in different ways. Shefrin and Thaler (1988) define mental accounts as current income accounts, assets accounts, and future income accounts. For detailed discussion of mental accounts, see the section "mental accounts" in next chapter.

prediction also comes from empirical studies of pension behavior. Pensions can be classified in a "future income account". Sherfin and Thaler (1988) cite numerous studies to show that pension saving behavior depends on age, income, and wealth of individuals, and follows patterns predicted by the behavioral life-cycle hypothesis.

Summary

Numerous empirical studies fail to confirm the validity of the traditional life-cycle hypothesis and the proportionality principle. The behavioral life-cycle hypothesis is appealing in its additional socio-psychological features and strong support from empirical studies which provide indirect evidence that at least age, income, and wealth affect saving behavior, but not in the traditional hypotheses predicted ways. However, extensive testing of this hypothesis is rare. As of the writing of this dissertation, only one scholar is known to be working on this topic (Levin, 1991). Further, no testing of this hypothesis has been conducted in the setting of intangible family assets. This research will accomplish these two tasks, i.e. to assess the validity of the behavioral life-cycle model by testing hypotheses directly generated from it in the context of household asset portfolios.

Characteristics of Portfolios

Considering characteristics of various financial products is the start point of portfolio selection. Characteristics of household asset portfolios are often expressed implicitly or explicitly in popular articles and textbooks, and in economic literature.

Popular articles and textbooks

Textbooks (Gitman and Joehnk, 1987; Winger and Frasca, 1986) on personal finance categorize intangible portfolios as liquid assets and financial assets (or investment assets), implying that savings and investment characteristics are distributed among various financial products. Popular articles (Pare, 1988; 1989; Tai, 1984) teach people to allocate money into different types of financial products considering the stages of life cycle, suggesting distinct characteristics embedded in various groups of financial products. Droms (1987) has developed a "scoring system" to guide personal financial planning clients to allocate portfolio assets by considering several characteristics of financial products, such as equilibrium total return, accumulation of deferred capital gains, tax advantages, current income, total return fluctuation, single-period loss probability, and degree of liquidity. Popular articles and family finance textbooks address characteristics of financial assets from a family point of view, and suggest the potential

connection of characteristics of assets to financial needs of families.

Economic literature

In economic literature, the portfolio selection theory usually starts with expected characteristics of portfolios. Several approaches differ in their focus and the number of characteristics considered.

Only considering expected return rates, Fisher (1930) has proposed an investment decision theory under certainty, which is systematically reiterated by Hirshleifer (1965). Fisher believes that the investment decision is the decision about when to consume (now vs. later), which is called a time-preference approach. Based on Fisher's theory, many theories of portfolio selection considering uncertainty are developed.

The asset-preference approach (Hirshleifer, 1961; Pye, 1963) postulates that assets themselves are the desired objects of choice. The state-preference approach (Hirshleifer, 1965; 1966) postulates that the underlying objects of choice are contingent consumption opportunities or claims defined over a complete listing of all possible "states of the world". These two approaches explore portfolio selection behaviors considering uncertainty, but do not explicitly express portfolio characteristics.

The mean-variability approach (Markowitz, 1959; Tobin, 1958a; 1966), which is also well known as the modern portfolio

theory, assumes that the objects of choice for investment are based on expected returns and variability of returns. Two characteristics of portfolios, profitability and riskiness, are taken into account in this approach. This approach provides a guideline in selection of portfolios from financial products with different expected returns and riskiness, without considering other characteristics.

Sharpe (1985, pp.177-178) suggests a hyperplane of characteristics, in which expected return, risk, and liquidity are included. He offers the relationships between these characteristics: expected return can be viewed as a trade off with the other two attributes, or risk as a trade off with liquidity, and so forth. In an unpublished manuscript, Tobin has conceptually developed several characteristics of household asset portfolios such as total return, liquidity, divisibility, predictability, and reversibility. It implies that, as more characteristics are considered, it becomes more difficult to model the portfolio selection behavior relative to less sophisticated theoretical models.

Empirical research of characteristics of assets in view of family characteristics is limited. Two relevant studies are Schiano's (1987) household asset portfolios research and Simon's (1985) Individual Retirement Accounts (IRAs) study.

On the basis of a framework proposed by Lancaster (1966), Schiano (1987) has quantified five of the asset characteristics proposed by Tobin, utilizing historical data

from various business periodicals. Then, using the data from the 1983 Survey of Consumer Finances, with a hedonic technique he has estimated the shadow prices for these characteristics and used them to examine the demand relationships describing the effect of net worth and family characteristics on "expenditures" for these characteristics. He finds that net worth, household size, number of dependents, age of oldest child, life cycle stages, work status, unemployment rate, self-employment status, household head's education, and retirement status determine the relative preferences for some characteristics. For instance, life cycle stage of the family is an important determinant of households' relative preferences for portfolio liquidity and divisibility, and the predictability of expected returns. Household size has negative influences on the liquidity and divisibility indexes. His findings indirectly reflect the relationship of asset characteristics and family financial needs.

Following Ironmonger's (1972) modification of Lancaster's theory, Simon (1985) examines the extent to which the actual IRAs held by households match the characteristics of their "ideal" IRAs. She defines seven characteristics of IRAs that are important to investors: convenience in purchase, familiarity with the depository institution, transaction costs, whether the account is federally insured, stability of interest rate, the flexibility in transferring of liquidating IRA funds, risk, and the required management on the part of

the investor. This study explicitly relates the asset characteristics with reported consumers' preferences, which might be directly connected with their financial needs. However, her study is fundamentally different from this one because of her focus on just one financial instrument instead of household asset portfolios.

Summary

Definitions of characteristics of portfolios are diverse but several points are very consistent among two lines of literature. First, distinct characteristics of portfolios are embedded in various financial products. Second, people who save probably pursue these characteristics instead of the products themselves. Conceptual development and empirical investigation suggest the existence of a potential connection between family financial needs and household asset characteristics. Family characteristics are most often seen as indicators of different financial needs.

Interrelated Portfolio Components

The interrelationships between components of household asset portfolios are often investigated by using a stock adjustment model. A basic assumption of this model is that families always adjust their stock of various household assets to achieve the desired composition of their portfolios. In a sense, this model offers opportunities to explore the dynamic

and adaptive nature of family saving behavior.

Research at micro level

Several scholars have utilized the stock adjustment model at the micro level. Watts and Tobin (1960) are the first scholars who use this framework with household data. They examine the holdings of households and the adjustments in these holdings as household demographic characteristics changed. They conclude that the correlations are positive between assets and negative between assets and debts, and much of the interdependence among asset stocks turns out to be the common dependence of asset stocks on the explanatory variables of the regressions. Their study is limited in its ability to provide generalizations about the dynamics of capital account changes in response to altered external or life-cycle situations, because of the one period cross-section data which they used.

Two studies aim at examining the interrelationships of family assets and debts: Dunkleberg and Stafford (1971) study consumer installment credit, and Taylor (1974) researches the effects of price expectations on the demand for assets. However, both studies fail to investigate the interrelationships between different types of financial products. Bryant and Hager (1976) study the interrelationships between assets and debts of poor rural families, but their study is on a small, idiosyncratic segment

of the population.

Zick and her colleague (Zick, 1982; Zick and Gerner, 1987) attempt to incorporate human capital into the household assets portfolio and to investigate the saving behavior of husband-wife and female-headed households. Their data are from Waves II and V of the Panel Study of Income Dynamics (PSID) collected in 1969 and 1972. They used house value, financial assets, car value, consumption expenditures, number of children, and female's wage as components of the portfolio. Financial assets are defined as the dollar value of the household's stocks, bonds, trusts, property, and savings. In addition, they used permanent income, transitory income, head's race, geographical location, and marital history as independent variables. They use ordinary least squares to estimate the parameters and find that estimated own-adjustment coefficients of financial assets are positive in both husband-wife households and female-headed households. In the husband-wife sample, house value, car value, and consumption negatively influence financial assets; while in the female-headed sample, only consumption expenditure shows a weak positive effect. From this study, some results about relationships between components of durable goods, consumption, savings, and human capital are gained, but no information about interactions between various intangible household assets are revealed because of the limitations of the data set used.

Based on the stock adjustment model, Bryant (1986) uses data from the 1977-78 Survey of Consumer Credit to assess asset and debt relationship in a consumer portfolio. A sample of 2,191 primary families is selected in which respondents are neither students nor retired. The dependent variables in his study are house value, home mortgage, other debt, car stock, and car debt. He uses checking accounts and other liquid assets as independent variables. Other liquid assets include savings accounts, bonds, stocks, mutual funds, money in investment clubs, and certificates of deposit. Independent variables also include family income, perceived well-being, geographical location, race, marital status, age of head, family size, other owned real estate, and other real estate debts. Ordinary least squares are used to estimate the parameters. His conclusion is that saving adjustment depends not only on disequilibrium in the item itself, but also depends on disequilibria elsewhere in the portfolio. He also finds that current family income has the most pervasive effects on families' holdings of assets and debts. His findings indicate that other liquid assets have a positive influence on car stocks in the total sample, and on home mortgage in the married couple sample, but a negative effect on home mortgage and car stocks in the female head sample. Checking accounts do not show any effect on house value, home mortgage, other debt, car stock, and car debt in the total sample and several subsamples. Because of limitations of the

data set used, he does not estimate the "equilibrium effects" of family characteristics on the adjustment of household assets accumulation. For the same reason, he fails to investigate interaction between checking accounts and other liquid assets.

Review of previous studies on the interrelationships of various household assets using stock adjustment models at the micro level reveals several gaps which needed to be filled. Previous studies neither comprehensively cover and investigate interrelationships between components of intangible household assets, nor estimate equilibrium effects of family characteristics on the asset portfolios[2]. This study tries to accomplish these tasks.

Research at macro level

Two studies of household asset portfolios using a stock adjustment model have been done at the macro level. Motley (1970) employs this model with aggregate time series data and concludes that asset adjustments are not made independently but rather, in most cases, they negatively interact with each other. Wachtel (1972) provides portfolio adjustment models with several assets including expenditures and arrives at the same conclusion as Motley.

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[2] Long term effects of family characteristics refers to the influences which family characteristics have on the desired stock of household assets. For details see section "Formal Description" in next chapter.

Motley (1970) uses data from the Flow of Funds of the Federal Reserve, 1953-1965. He defines money, saving deposits, debt, and real assets as his dependent variables. The independent variables in his study are expected income, user cost, saving deposit yield, and transitory income. He uses a procedure developed by Parks (1967) to estimate the parameters and finds that own-coefficients of money and saving deposits are positive, money is competitive for debt and real assets, and savings deposits are competitive for money, debt and real assets. Relative transitory income, which is defined as the ratio of current to expected income, shows a positive effect on saving deposits. Debts in previous periods weakly affect saving deposits.

Wachtel (1972) uses the data also from the Flow of Funds of the Federal Reserve and the equations are estimated for quarterly observations, 1953-1967. Four asset variables are used in his study: durable goods stock, consumption expenditures, liquid assets, and credit loans. The independent variables are permanent income, transitory income, rental price of durables, and corporate bond rate. He employs general least squares (GLS) to estimate the parameters. His findings indicate that both permanent income and transitory income have positive effects on liquid assets, while durable stocks and credit liabilities have negative effects. Later in his paper, he removes consumption expenditure as a dependent variable from the model, combines two income variables into

one, estimates the parameters again and gains the same results.

Several differences between studies at the macro level and at the micro level should be noted. Usually, studies at the macro level use time series, thus reflecting portfolio behavior of the "average family" over a relative long period (over 10 years). Micro studies often use survey data, and document family behavior over a relatively short-term period (1-3 years). In addition, micro studies typically incorporate more family characteristics into the empirical model in order to investigate family portfolio behavior. These differences are important when comparisons are made between results from these different types of studies.

Summary

Scholars utilizing the stock adjustment model tend to cover successively broader dimensions in household asset portfolios. Starting with Watts and Tobin (1960) who research interrelationships of components of household assets, Wachtel (1972) adds expenditures, and Zick (1982) adds human capital variables into household asset portfolios. The results of incorporating more components with substantially different properties into family portfolios have not clarified the "picture" of saving behavior, but rather have added to its vagueness. After adding consumption and human capital variables into family portfolios, it becomes more difficult to

examine behavior patterns of different saving components. In addition, several limitations exist in previous studies. They neither estimate equilibrium effects of family characteristics because of the limitations of data used, provide the theoretical foundation to explain changes in components of household asset portfolios, nor identify reasons for formulation of the portfolios. This study tries to overcome these shortcomings by using a longitudinal nationwide survey of consumer finances over a three-year period, integrating the behavioral life-cycle hypothesis, household production theory, and the new consumer demand theory into the stock adjustment model. It also narrows down the coverage of family wealth by only including intangible household assets, in order to "crack open" this saving behavior "black box".

Summary of the Review of Literature

The review of literature reveals several points. Families at various income levels appear to have much different saving patterns. They pursue characteristics of household asset portfolios which are reflected in the composition of the portfolios in different ways. These characteristics might be connected with family financial needs. The stock adjustment model based on other theoretical frameworks can be used to address this issue by investigating determinants of changes in composition of household asset portfolios over time.

MODEL

This chapter briefly describes several related theoretical frameworks. Based on these frameworks, a conceptual model systematically addressing family portfolio behavior is then presented. Finally, testable hypotheses are generated from the conceptual model.

Related Theoretical Frameworks

Theoretical frameworks relevant to this study are Shefrin-Thaler's behavioral life-cycle hypothesis, Lancaster's new consumer demand theory, Becker's household production theory, and the stock adjustment hypothesis. These frameworks' basic conceptions and implications to the purpose of this study are discussed as follows.

Behavioral life-cycle hypothesis

The behavioral life-cycle hypothesis (Shefrin and Thaler, 1988) attempts to incorporate some socio-psychological features into the traditional life-cycle hypothesis. This effort results from witnessing the failure of the traditional life-cycle hypothesis to explain saving and spending behavior of individuals. Based on the economic theory of self-control (Thaler and Shefrin, 1981), the behavioral life-cycle hypothesis starts with a duel-preference assumption. It assumes that a consumer acts as two persons, a doer and a

planner. As a doer, one tends to spend all income available, while as a planner, one tries to save as much as possible for future consumption. Saving for future consumption is a process of self-control. Self-control is the exercising of willpower which will result in a psychological cost. Willpower is assumed to be positively related to psychological cost. In order to reduce the pain of exercising willpower, the consumer seeks devices to facilitate the saving process. Mental accounts are proposed as such a device. This hypothesis assumes that consumers consider that money put in different components of savings, say, savings accounts and checking accounts, stock and bonds, etc. are not exchangeable, and these different savings components are named mental accounts. Many testable hypotheses are derived from this model (Shefrin and Thaler, 1988). The following are several which are relevant to this study.

(1) Marginal psychological costs will be different for people with different income levels. Higher-income people tend to save more because they will need to exercise less willpower than lower-income people when saving the same amount. To the poor, saving is a luxury (Shefrin and Thaler, 1988).

(2) Marginal psychological costs will be different for people when spending their money from different mental accounts. This hypothesis assumes that consumers use three mental accounts: a current income account (C), an asset

account (A), and a future income account (F). The marginal propensity to consume (MPC) from the different types of mental accounts is seen as a variable, thus affecting the rate of asset accumulation in each account. The MPC from C will be close to unity, the MPC from F will be close to zero, and the MPC from A will be somewhere in between (Thaler, 1990).

(3) Marginal psychological costs will be different for spending from different income sources. The saving rate can be affected by the way in which increments to wealth are "framed". This model predicts that income paid in the form of a lump sum bonus will be treated differently from regular income even if the bonus is completely anticipated (Shefrin and Thaler, 1988).

Because the behavioral life-cycle hypothesis addresses saving behavior and is consistent with the purpose of this study, it will serve as a basic theoretical framework, and testable hypotheses will be generated on the basis of above predictions in the context of intangible household assets.

New consumer demand theory

Traditional utility theory views quantities of market goods as input. Subject to income constraints, the final output is the composition of quantities of different goods. Lancaster (1971, p.1) has observed that traditional utility theory "is the result of a long process of eliminating excess input and making the theory efficient", but fails to make full

use of more informational inputs to explain consumer behavior from a broader perspective.

Instead of viewing only the quantity of goods as input, Lancaster (1966) takes account of the properties of goods. His assumption is that it is not the goods themselves, but the characteristics of goods that give utility. This provides for more widespread applicability of the utility model. He conceives that his theory would result in "a full-blooded theory of consumer behavior with respect to assets" (Lancaster, 1966, p.148). Robert (1975, p.45) further explores the possibility of the application of Lancasterian theory to portfolio analysis, and predicts "a cross-fertilization".

Lancaster's theory has implications for the study of saving behavior because investigating saving behavior can be done through examining portfolio behavior. The saving behavior can be viewed as consumer purchases of financial products and services. The reason that they put their money into different financial vehicles is not their blind liking of certain financial products but their preference for some characteristics imbedded in these financial products.

Household production theory

Becker (1965, 1981) has revolutionized utility theory in a fundamental way. He views the purchase and consumption of consumer goods as a household production process and adds

time, along with goods, as inputs into the process. In his theory, the output of household production is no longer "quantities of goods" as proposed by traditional utility theory, nor "characteristics of goods" as proposed by Lancaster (1966), but "commodities" resulting from the incorporation of goods and time as inputs, and the interaction of family members. These "commodities" could be special entities (children, health) or socio-psychological feelings (prestige and esteem, altruism, envy, and pleasures of the senses) (Becker, 1981, p.8).

Based on Becker's theory, saving behavior can be viewed as consumers' spending of time and money to purchase financial products and services in order to produce their own "commodities". These "commodities" are produced in such a way as to maximize consumers' utility from a range of savings activities, or achieve the greatest degree of satisfaction in meeting their financial needs.

Stock adjustment hypothesis

The stock adjustment hypothesis originates from the econometric estimation of distributed lag models (also called partial adjustment model) which has first been formulated by Nerlove (1956). Many economic analyses using this model have been done to examine the composition of family saving, investment, wealth, and expenditure, and some insights about family economic behavior have been gained. This model's basic

premise is the existence of some kinds of adjustment costs which, in turn justify the observed inertia in the responsiveness of entrepreneurs and consumers to economic stimuli (Griliches, 1967). However, this hypothesis has a weak theoretical underpinning since it is hard to distinguish the relative importance of (marginal) out-of-equilibrium costs to the (marginal) adjustment costs (Griliches, 1967).

Griliches views that the adjustment process results from the cost minimizing. It is possible to understand this adjustment process by considering consumer's socio-psychological behavior patterns. Consumers' saving behavior could be described as continuous mindfulness of desired stocks of assets, and continuous striving to achieve saving goals. The model can be used to investigate behavior patterns by quantitatively estimating the extent to which the gap between the desired state and the existing state is filled, and effects of family characteristics on this adjustment process. However, without other theoretical frameworks addressing saving processes, no specific predictions can be made in terms of adjustment parameters.

Summary

Four frameworks discussed above are relevant to the family saving behavior. However, utilizing them separately can not address the whole process of family saving. The behavioral life-cycle hypothesis addresses several socio-

psychological characteristics of saving behavior and proposes certain theoretical predictions, but does not provide a guideline for answering how family saving is accomplished in the process from financial product purchases to financial satisfactions. Lancaster's theory provides part of the process: consumers purchase financial products because they prefer characteristics embedded in these products. Becker's theory gives another part of the process: consumers purchase financial products which will be incorporated with family members' time to achieve the highest degree of financial satisfaction. The stock adjustment hypothesis builds a bridge to connect the static state with the dynamic nature of family saving behavior. Thus an integration of these frameworks seems to be fruitful.

Conceptual Model

This section presents a conceptual model which integrates the behavioral life-cycle hypothesis, the new consumer demand theory, household production theory, and the stock adjustment hypothesis, to systematically address family portfolio behavior from both a static and a dynamic perspective. This newly developed conceptual model is named the family portfolio model. The concept of mental accounts will be discussed first. The family portfolio model is then described and presented.

Mental account

The mental account is a very critical concept in the behavioral life-cycle hypothesis. Because of the existence of mental accounts, the assumption of fungibility of family saving, suggested by the traditional life-cycle hypothesis, is relaxed.

Originally, mental accounting was proposed as a decision-making pattern by psychologists when they were researching decision behavior. Kahneman and Tversky (1984) categorize mental accounting as minimal, topical, or comprehensive. The minimal account includes only the differences between the two options, gains and losses, and disregards the features that they share. The topical organization of mental accounts leads people to evaluate gains and losses in relative rather than in absolute terms. In the comprehensive account, the saving would be evaluated in relation to a broader dimension, say, monthly expenses. Kahneman and Tversky (1984) conducted a survey and found that the results support the notion of topical organization of accounts. The significance of topical accounts for consumer behavior is confirmed by another empirical study (Pratt et al, 1979).

Shefrin and Thaler (1988) also proposed three mental accounts when presenting their behavioral life-cycle hypothesis: a current income account, an asset account, and a future income account. These accounts correspond roughly to regular income, asset income, and retirement income (pension

and social security benefits). However, the mental accounts proposed by Shefrin and Thaler are different per se from those by Kahneman and Tversky. The former specifies the contents of mental accounts, but the later emphasizes the rules of the decision making process.

Mental accounts as used in this study refer to their content, but it is proposed here that they are constructed in a somewhat different way. For a middle-aged consumer, Shefrin and Thaler's division of mental accounts may be correct and empirically practical. However, if the sample includes people of all ages, the division may be less appropriate, because for a retired person the retirement is reality, but for a young adult, retirement may not yet be considered. Secondly, this study covers a much narrower range of household assets than that discussed by Shefrin and Thaler, and includes only current intangible assets. More importantly, Shefrin and Thaler fail to answer why people have various mental accounts. The following will provide a theoretical foundation for mental accounts, and then develop the concept of mental account as used in this study.

Mental accounts are hypothesized as a reflection of consumers' financial needs. Thus the unique characteristics of various financial needs will be manifested as a series of mental accounts. A conceptualization of financial needs may be derived from information obtained through consumer surveys. Before the discussion proceeds, two points should be noted.

First of all, consumer-reported financial needs from survey data usually do not cover all potential financial needs. Thus they serve only as an indication of "true" financial needs used for theoretical development. Secondly, this study attempts to develop the concept of mental accounts merely for empirical analysis, and does not pretend to develop a comprehensive system of mental accounts to cover all "potential" and "true" financial needs.

The respondents of the Surveys of Consumer Finances (SCF) were asked "what are the most important reasons for savings?" Common answers were the following: retirement, emergencies, children's education, ordinary living expenses, purchase or travel plans, better life, and so on (Table 1). One usual way to categorize these needs is to consider the time dimension. Savings put in checking accounts may always be used to meet consumer's daily living expenses, but many other financial needs vary with time. Saving for retirement may be a long-term plan for young consumers but a shorter-term plan for middle-aged consumers. Saving for children's education probably depends on the children's ages and number. Saving for emergencies is hard to classify either in a present, short-term, or equilibrium category. If we knew exactly when the event would happen, it would not be called an emergency. Therefore, only in terms of time, it is difficult to categorize the financial needs into a uniform conceptual framework based on time frame.

Table 1

Important Reasons for Saving (N=2822)

Reason	Frequency
retirement; old age	658
emergencies; "rainy days"; other unexpected needs; for security	634
"to get ahead"; for the future; to advance standard of living; live comfortably/enjoy life	209
children's (grandchildren's) education	178
to travel; take vacations	161
in case of illness; medical/dental expenses	122
ordinary living expenses/bills	120
"for the children/family", "to help the kids out"; "to have children/baby"	104
buy durable household goods, appliances, home furnishings; baby items; for other purchases; "to buy things when we need/want them"	102

Source: Avery and Kennickell, 1988

Maslow (1955) proposes a hierarchy of needs. He identifies five ascending needs: physical needs, safety needs, belongingness and love needs, esteem needs, and self-actualization needs. Comparing Maslow's needs hierarchy with consumers' reported financial needs from SCF, a good match is

Maslow's Needs (level)	Consumer Needs
Physical needs (I)	Ordinary living expenses Purchase or travel plans
Safety needs (II)	Emergencies Retirement
Belongingness and love needs (III)	Children's education Bequest motive
Esteem needs (IV)	Better life
Self-actualization needs (V)	

found. Thus it seems reasonable to consider consumer's financial needs as a special form of Maslow's needs hierarchy.

Maslow (1955) also proposes the dynamic nature of human needs. He writes that "the most basic consequence of satiation of any need is that this need is submerged and a new and higher need emerges". Katona (1960, p.131) agrees with Maslow's notion and adds that "need is not necessarily a higher need". It suggests the two-way movement of needs, from lower- to higher-levels, or in a reverse direction.

In summary, these financial needs could be characterized as: 1) hierarchical; 2) dynamic; 3) increasing or decreasing in numbers (or levels); 4) moving up to a higher-level need after the lower-level need has been met, or down to a lower-

level need if that lower-level need has failed to be sustained. Different mental accounts may roughly correspond to these hierarchical needs, which implies that, along with an increase of income, consumers will move to higher levels of needs, and tend to have a wider variety of financial assets.

Based on Maslow's theory, as adjusted to family financial needs, and considering simplicity of variable specification for empirical study, all these needs are categorized into three mental accounts. These mental accounts are called ACCT1, ACCT2, and ACCT3, corresponding roughly to: 1) survival needs, 2) security needs, and 3) social/developmental needs. Examples of these accounts are as follows.

Mental Account	Example
ACCT1	Ordinary living expenses Purchase or travel plans Emergencies
ACCT2	Retirement
ACCT3	Children's education Bequest motive Better life

ACCT1 is characterized as meeting daily and emergency financial needs, ACCT2 as meeting future financial needs, and ACCT3 as meeting social and personal developmental needs. Saving for emergencies is put in ACCT1 because the consumer is hypothesized as risk averse, preparing for an emergency that might happens any time. Saving for a better life is put in ACCT3 because the consumer is assumed to put money into this

account after he/she has put enough money into the first two accounts.

The rest of this section discusses marginal propensities to consume from mental accounts. Shefrin and Thaler (1988) identified three mental accounts; a current income account (I), an assets account (A), and a future income account (F). Their hypothesis states that the aggregate consumption function must incorporate at least three different income or wealth measures corresponding to the three mental accounts. That is, $C=f(I,A,F)$, where I, A, and F stand for their aggregate counterparts. The model suggests that,

(0) $$1 \approx \partial C/\partial I > \partial C/\partial A > \partial C/\partial F \approx 0.$$

This MPC hypothesis makes two points. The first suggests the existence of a MPC hierarchy. Consumers are assumed to consume more from current income accounts than from the assets account, and to consume the least from the future income account. This assumption will be held in this study. The second point made by inequality (0) is that, over a given time period, consumers consume almost all of the current income account, but hardly consume from the future income account. This notion may be reasonable, because their future income account covers savings in pensions and payments to social security. However, it is less realistic in this study since the range of assets covered is narrower than that defined by Shefrin and Thaler, and corresponds most closely to their current income and assets account. Thus the assumption about

marginal propensities to consume from three mental accounts in this study is weaker than theirs. Assume that the aggregate consumption function is, C=f(ACCTi), where ACCTi (i=1,2,3) are mental accounts. And assume that a MPC hierarchy exists in such a manner,

(0a) $\partial C/\partial(ACCT1) > \partial C/\partial(ACCT2) > \partial C/\partial(ACCT3)$.

Inequality (0a) suggests that the marginal propensities to consume (MPC) from ACCT1, ACCT2, and ACCT3 are different. More specifically, the MPC from ACCT1 is the largest, the MPC from ACCT3 is the smallest, and the MPC from ACCT2 is somewhere in between.

Saving is the complement to consumption, keeping income and wealth constant. Different marginal propensities to consume from various mental accounts imply that savings in these mental accounts would be different, and the saving increments for ACCT1, ACCT2, and ACCT3 would be the smallest, in between, and the largest, respectively.

Literal description

The family portfolio model can be described literally as follows. All assumptions about the consumer in a utility model are held. The consumer is informed, rational, and utility maximizing. At a given income level, consumers purchase various financial products. The purpose of purchasing these financial products is to pursue desirable characteristics embedded in these products. The

characteristics of these financial products match the properties of their discrete mental accounts. Consumers save in their various mental accounts to meet different financial needs. From a dynamic perspective, consumers will put money into their various mental accounts to pursue their financial goals. Their behavior will follow the characteristics of mental accounts as discussed above.

Formal description

The formal model consists of three parts: basic assumptions, an equilibrium model, and a stock adjustment model. The stock adjustment model is an extension of the equilibrium model.

(1) Basic assumptions.

The heart of utility theory is the combined assumption of maximizing behavior, market equilibrium, and stable preferences (Becker, 1976). The assumption will be held in this study.

Two other assumptions are added: (1) an increase in willpower effort is necessary to reduce consumption (Shefrin and Thaler, 1988), and (2) marginal propensities to consume from ACCT1, ACCT2, and ACCT3 are the largest, in between, and the smallest, respectively. This assumption is derived from Shefrin and Thaler's (1988) similar assumptions.

(2) The equilibrium model.

Lancaster's consumer demand theory and Becker's household production theory will provide the basis for the equilibrium model. Based on Becker's assumption, and incorporating a Lancasterian point of view, the only reason that a family purchases and owns a variety of household assets is to acquire characteristics embedded in components of a household asset portfolio it prefers. If characteristics of portfolios preferred by families are the input, the composition of portfolios possessed by families can be viewed as output that reflects the "commodities" produced by the various inputs of goods and time and the collaboration of family members. In this study, "commodities" refer to mental accounts.

Given income level and range of portfolio varieties, a utility model based on Lancaster's consumer demand theory and Becker's household production theory, is presented as follows.

At one period in the family life cycle, a utility function is

(1) $U=U(Z_k;D)$,

which the family maximizes, subject to the income and time constraint on the purchase of financial products,

(2) $\sum_j p_j Q_j \leq I$

$t_p \leq T-t_o$

and two sets of production relationships which transform the goods into the desired characteristics, and transform the desired characteristics into "commodities" (refer to mental

accounts here)

(3) $$Y_n=\Sigma_j b_{jn}Q_j$$

(4) $$Z_k=\Sigma_i c_{ik}Y_i.$$

where: Z_k=the kth commodity (mental account),

Y_n=the nth attribute of portfolios,

Q_j=the jth financial product purchased at price, p_j,

I=the family's income,

b_{jn}=a technical coefficient indicating the amount of the nth attribute contained in the jth product,

c_{ik}=a technical coefficient indicating the amount of the kth commodity in the ith attribute,

D=a vector of family characteristics influencing tastes and preferences,

T=total time of a period,

t_p=time used in activities for portfolio purchasing such as information search, transaction, transportation and so on.

t_o=time used in other activities, such as market work, housework, physical maintenance, leisure, and so on.

The transformations between quantities of products and attributes of products, and between attributes of products and commodities (mental accounts) produced could be linear or nonlinear. Here linear relationships are assumed. The number of products, attributes, and commodities could be the same or different. Lancaster (1966, 1971) discusses different

situations when the number of products is different from number of attributes. The analysis will be greatly complicated if the numbers of these three groups are different.

If the number of products, attributes, and commodities are the same (one product having one attribute reflects one commodity produced in the household), a demand function can be derived,

(5) $Q_k=f(p_k,p,t_p, t_o,I; D)$.

In equation (5), one product represents one mental account which may consists of several assets. One attribute of that product can be viewed as an index of several characteristics of that mental account.

(3) The stock adjustment model.

Q_k in equation (5) can be viewed as the desired stock of item k in year t by an individual family, denoting Q^d_{kt} from now on. In most aggregate time series models, Q^d_{kt} is specified to be a function of the rates of return for all stocks in the portfolios and permanent household income. But in desegregated models, such as the one estimated here, it is virtually impossible to calculate rates of return for each household's portfolio of stocks. To solve this problem, Bryant (1986) assumes that prices, interest rates, and other economic conditions (e.g., credit restraints) vary with a household's demographic characteristics. In addition, based

on the behavioral life-cycle hypothesis, family characteristics will influence decision makers' self-control process. Consequently, related family characteristics will have effects on the desired stock of household assets (here refer to mental accounts).

Assuming that the linear relationship between the desired demand for mental account k in period t and its influencing factors exists, it follows that,

(6) $$Q^d_{kt}=\beta_{kt}D_{kt}+e_{kt}$$

where, Q^d_{kt}=the desired demand for mental account k in year t,

β_{kt}="long-run" or "equilibrium" effects of the family characteristics (exogenous variables) on demands,

D_{kt}=exogenous variables (family characteristics, including family income) determining desired demand[3],

e_{kt}=a vector of random error terms.

Equilibrium effects refer to the effects of certain family characteristics as exogenous variables on the desired demands of mental accounts. It should be noted that the assumption expressed implicitly is that these family characteristics remain the same during the period.

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[3] Time as an influential factor is not included explicitly here. However, a time constraint is implicitly addressed in some family characteristics. For example, a couple with children will have less time spent for portfolio purchasing than another couple without a child, ceteris paribus.

Assuming that disequilibrium exists in terms of the desired stock and real stock of mental account k, that the family always adjusts real stocks of portfolio components toward the desired state, and that the stocks of portfolio components interact with each other, the difference of the real stock of mental account k between two points of time will reflect the changing state of the disequilibrium. Specifically, the following equation postulates,

$$(7) \qquad (Q_{kt}-Q_{k(t-1)})=\alpha_{kk}(Q^{d}_{kt}-Q_{k(t-1)})+\Sigma\alpha_{kj}(Q^{d}_{jt}-Q_{j(t-1)})+v_{it}.$$

where Q_{kt}, $Q_{k(t-1)}$=real stocks of mental account k in period t and t-1[4],

α_{kk}=the parameter reflecting own adjustment of mental account k,

α_{kj}=the parameter reflecting cross adjustment between mental account k and j,

Q^{d}_{kt}, Q^{d}_{jt}=the desired stocks of mental account k and j in year t,

$Q_{j(t-1)}$=the real stock of mental account j in period t-1,

v_{it}=a vector of random error terms.

Equation (7) implies that the difference in real stocks

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[4]In this study, three years are treated as one period, i.e. t=1986 and t-1=1983, because only these two years' data are available in the data set used. Considering three years as one period will simplify the model specification. This treatment can be found in a previous study (Zick and Gerner, 1987). Actually, considering three years as three periods will be more accurate and more realistic. To do this, the model specification will be much more complicated but is possible. However, an estimation difficulty will be caused since usable longitudinal data in three consecutive years are not available.

of mental account k between period t-1 and t reflects both the difference of the desired demand of mental account k in period t and the real stock of mental account k in period t-1, and the differences of the desired demand of mental account j in period t and the real stock of mental account j in period t-1. To put it in another way, the savings in one mental account over a period are affected by both the adjustment of this mental account and the adjustment of other mental accounts. The α_{kk} is called the own-adjustment coefficient, which reflects the degree of own-adjustment of one mental account. If, for instance, $\alpha_{kk}=.6$, then 60% of the gap between the desired demand in period t and the real stock in period t-1 in terms of mental account k closed because of the change of real stocks of mental account k during period t-1 and t. α_{kj} is called the cross-adjustment coefficient, it reflects the interaction between mental accounts. More specifically, it measures the extent to which the adjustment of one mental account effects the adjustment of another mental account. If α_{kj} is positive (negative), it indicates that the adjustment of mental account j has a positive (negative) effect on the adjustment of mental account k. If the effect is positive, it displays the idea that both adjustment processes are complementary, while if the effect is negative, it suggests that the two processes are competitive[5].

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[5] Cross-adjustment coefficients might be negative, which suggests possible transfers between mental accounts, but savings in these accounts are usually increasing in absolute

Why do disequilibria between the desired stocks and the real stocks of mental accounts exist? Bryant (1987) suggests the reason is because of transactions costs and household inertia. The stock adjustment model does not answer why families always proceed with an adjustment process, but previous studies imply that this process is on-going. Also, the stock adjustment model does not give any hint about the direction of own- and cross-adjustment. Thus without considering other theoretical frameworks, the understanding of stock adjustment of household assets is incomplete.

The behavioral life-cycle hypothesis can fill the gap left by the stock adjustment model. Incorporated the hypothesis into the stock adjustment model, several things become clear. Desired stock of mental accounts could be viewed as financial goals of families. The reason that families adjust their stock of household assets is that they attempt to meet their financial needs. In addition, based on the behavioral life-cycle hypothesis, several specific predictions about own- and cross-adjustment coefficients can be made.

(1) An own-adjustment coefficient could be viewed as the speed of adjustment of the desired stock and the real stock of one mental account, and it could be positively related to the marginal increment of savings in that mental account.

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terms, perhaps at different rates. Transfers between mental accounts imply financial needs of families are changing.

Recalling the discussion about the different marginal increments of savings in various mental accounts, the relationship between own-adjustment coefficients of three accounts could be: $\alpha_{ACCT1}<\alpha_{ACCT2}<\alpha_{ACCT3}$.

(2) Cross-adjustment coefficients reflect the interactions between mental accounts. The interaction could be understood as the psychological influence on saving behavior. If the self-control assumption (Thaler and Shefrin, 1981) holds, the extent to which families save depends on the psychological cost needed in exercising willpower. If the degrees of exercising willpower are different when saving in different accounts, the psychological influence of saving in one mental account would be different from that in another account. Considering the existence of mental account hierarchy, the influence of saving in one account on another account will be different from the impact given by the another account, which depends on the relative positions of these two accounts in the mental account hierarchy. For example, a family saving in ACCT1 will exercise larger willpower than when saving in ACCT2. If this family could save a certain amount money in ACCT1, it would save more in ACCT2, over a period of time. Assuming that the cross-adjustment coefficient is positively related to these interactions, the relationship between cross-adjustment coefficients should be expected as: $\alpha_{ACCTi\rightarrow j}>\alpha_{ACCTj\rightarrow i}$, $\quad i,j=1,2,3;\ i<j$.

The above discussion assumes that all other factors

remain the same. Actually, the adjustment processes are influenced by more than just the self-control factor. Many environmental factors such as the economic situation, market conditions, and social and technical changes would influence the adjustment processes. Another point which needs to be noted is that the influences of environment factors will be different on varying financial products. For example, social norm changes may greatly influence consumers' saving accounts and checking accounts because of their possible changing consumption patterns, while the stock market conditions would have its greatest effect on stock accounts. The third thing to be noted is that the adjustments in dollar values of various accounts shown in the real world are not necessary achieved by the voluntary saving or dissaving of consumers. Some increments (or decrements) may be achieved automatically, such as the increasing (or decreasing) of bonds and stock values, and the others may be access constrained because of lower liquidity or other restrictions imposed by financial institutions or government agencies. Thus, assumptions about the adjustment process based on the self-control model will be weakened somewhat by unmeasured variances.

The following will discuss the estimation of adjustment coefficients. Because the household's desired holdings of any stock at a point of time are not observed, estimation of the adjustment process can be done only after substituting the determinants of the demand for desired stocks directly into

the stock adjustment equation. Substituting equations (6) into equations (7) yields,

(8) $(Q_{kt}-Q_{k(t-1)})=\alpha_{kk}(\beta_{kt}D_{kt}-Q_{k(t-1)})+\Sigma\alpha_{kj}(\beta_{jt}D_{jt}-Q_{j(t-1)})+v_{it}$.

Reorganized (8), it becomes,

(9) $(Q_{kt}-Q_{k(t-1)})=\tau_{kt}D_{kt}-\alpha_{kk}Q_{k(t-1)}-\Sigma\alpha_{kj}Q_{j(t-1)}+v_{it}$.

In equation (9), $\tau_{kt}=\alpha_{kk}\beta_{kt}$, and it can be interpreted as "short-term" effects on changes of the real stock of asset k (Bryant, 1986).

The "long-run" or "equilibrium" effect on the desired stock of asset k (Bryant, 1986) can be estimated by,

(10) $\beta_{kt}=\alpha_{kk}^{-1}\tau_{kt}$.

Hypotheses

Based on the family portfolio model and above discussions, several hypotheses are proposed:

H1: Among families at any income level, the own-adjustment coefficient of ACCT1 is the smallest one, of ACCT3 is the largest, and of ACCT2 is in between.

Based on the stock adjustment hypothesis, families always intend to fill the gap between the desired stock and the real stock of mental accounts. Thus they will save a certain amount of income into different mental accounts over a period of time. Own-adjustment coefficients measure the degree to which they accomplish this process. According to the second basic assumption, the marginal propensity to consume (MPC)

from ACCT1 is the smallest, the MPC from ACCT3 is the largest, and the MPC from ACCT2 is in between. It suggests that marginal increments of savings are the smallest in ACCT1, in between in ACCT2, and the largest in ACCT3. If this behavior pattern is true, it will be indicated in both the equilibrium state and in the process of moving toward equilibrium.

H2: The cross-adjustment coefficient of ACCT1 to ACCT3 is larger than that of ACCT3 to ACCT1, ACCT1 to ACCT2 is larger than ACCT2 to ACCT1, and ACCT2 to ACCT3 is larger than ACCT3 to ACCT2.

The cross-adjustment coefficients indicate the interactions of mental accounts to achieve family financial goals (moving toward desired stock of mental accounts). The first and second basic assumptions suggest these interactions are different from each other. The adjustment of real stock toward desired stock of a mental account can be viewed as a saving process. A family that saves for ACCTi will need to exercise more willpower than when saving for ACCTj (i,j=1,2,3; i<j). If a family can save a certain amount of money in ACCTi, one will save more in ACCTj. Thus the effect of the adjustment of ACCTi on the adjustment of ACCTj should be larger than the effect of the adjustment of ACCTj on the adjustment of ACCTi.

H3: Family characteristics relevant to the self-control process, and market opportunities and limitations will show significant effects on the change of

stocks of intangible household assets. These family characteristics are: 1) age of household head; 2) employment status; 3) retirement status; 4) family income; 5) life cycle stage; 6) household size; 7) education of household head; 8) home values; 9) house mortgages; 10) other assets; 11) other debts.

Age of household head The traditional life-cycle hypothesis predicts that the relationship of age and savings follows a lying S-shape curve. When consumers move from young to middle age, their savings flow as a share of income increases, while consumers moving from middle age to retirement are decreasing their savings. The behavioral life-cycle hypothesis mainly depends on the willpower and mental account conceptions. No direct empirical evidence shows the relationship between age and willpower, thus nothing can be predicted from the aspect of willpower. In terms of mental accounts, ACCT1 seems to be common in all age groups, thus it should affect savings in a similar way. ACCT2s are different for people at different age groups, and the prediction follows the same pattern as does the traditional hypothesis. Age will affect ACCT3 in different ways, and it is difficult to predict because of different life cycle stages, and diverse life styles, attitudes, and values.

Employment status Employment status is defined as the situation of husband-wife's labor force participation; with

both, either, or neither in the labor force. Given other conditions held constant, the psychic cost of exercising willpower will be higher for families with just one or no one in the labor force. Thus it predicts that duel-earner families will be more likely to save in all three accounts than families with any other employment status.

Retirement status Retirement status is defined as whether or not the respondent is retired from the paid labor force. The traditional hypothesis predicts that retired people will only dissave. However, mental accounts suggest different scenarios. In terms of ACCT1, there is no reason to believe that retired people are different from working people. Retired people may dissave from ACCT2, which is consistent with the traditional hypothesis. However there is no evidence that retired people will only dissave from ACCT3. While it may be true if their financial need is only to enjoy life, it may be wrong if they have other financial needs, such as for children's or grandchildren's well-being, future charitable giving, and so on.

Family income[6] The traditional hypothesis assumes that permanent income will decide the consumption level over a life

[6] Income as used here is an aggregate, and is seen as one family characteristic that would influence desired stocks and real stocks of mental accounts. Actually, according to the hypothesized model, incomes from different sources would be put into different mental accounts because of framing. Due to the limitation of the data set used, the framing feature of the behavioral life-cycle hypothesis is not treated formally in this study.

time. The behavioral hypothesis assumes that, because of the existence of self-control process, consumption tracks current income (Shefrin and Thaler, 1988). Thus family income is defined here as current income. Family income level will influence the magnitude of psychic cost negatively, as proposed by the first basic assumption, and thus positively relate to savings in all mental accounts.

Life cycle stage The life cycle concept used in this study will consider marital status and the presence of children, from which four stages of life cycle are formulated: single individual with/without children, and married couple with/without children. It assumes that married couples with children have the highest psychic cost associated with savings in ACCT1 and ACCT2, and thus save less in these two accounts than families in other life cycle stages. However, it is hard to predict the situation in ACCT3. If married couples with children value the presence of children and are concerned about children's well-being in the long run, they may save more in ACCT3. Otherwise, they will save less in this account.

Household size Larger household size is assumed to increase the psychic cost of saving, thus decrease the savings in ACCT1 and ACCT2. For the same reason mentioned in the discussion of life cycle stage, it is hard to predict the situation in ACCT3.

Education of household head Higher educational level is

usually associated with higher income level. On the other hand, education will enhance ability of self-control and decrease the psychic cost of saving. Thus, education level will increase savings in the various mental accounts.

Home value A larger home value will increase opportunity to access broader financial vehicles and enhance financial confidence, thus increasing savings in the different accounts.

House mortgage A larger house mortgage functions opposite to that of house value, thus decreases savings in the three accounts.

Other assets Other assets have the same function as home value, thus increasing savings in different accounts.

Other debts Other debts have the same function as house mortgage, thus decreasing savings in different accounts.

H4: The own-adjustment coefficients of higher-income consumer will be larger than those of lower-income families. The relationships between cross-adjustment coefficients of families with different income levels are determined empirically.

Because higher-income families will need to exercise less willpower to save compared to lower-income families, it is reasonable to predict that higher-income families will save more than lower-income families in all mental accounts over one-period time, assuming that other conditions remain the same. However, the relationships between cross-adjustment coefficients of families with different income levels are hard

to predetermine, because it is unclear whether the various mental accounts at each income level are competitive or complementary.

METHODOLOGY

This chapter first discusses an econometric model used to estimate parameters in equation (9). A data set from a nationwide survey of consumer finances is then described. Finally the research procedure is presented.

Econometric Model

To estimate parameters in equation (9), several issues have to be considered. These issues are: identification, heteroscedasticity, and censored sample.

Identification

Parameters of equation (9) can be fully estimated only if it is identified. A single equation model is exactly identified if it has a one-to-one correspondence between the restricted and the unrestricted parameters, and therefore there is a unique solution for the restricted parameters in terms of the unrestricted coefficients. The model is overidentified if the number of the unrestricted coefficients exceeds the number of the restricted parameters and there is no unique solution. The model is underidentified if the number of unrestricted coefficients is insufficient for the solution. An equation is said to be identified if it is either exactly identified or overidentified (Kmenta, 1971, pp.539-540).

Two conditions can be used to judge whether a set of equations is identified or not. The first is "order condition" and states that if a model consists of k linear equations, then for any equation in that model to be identified, it must exclude at least k-1 of the variables that appear in the model (Asher, 1983, p.56). This is only a necessary but not a sufficient condition for identification. The second is called "rank condition", which is both necessary and sufficient. It states that an equation in a model of k linear equations is identified if and only if at least one nonzero determinant of k-1 rows and columns is contained in the matrix of coefficients of the structural equations remaining after omitting all columns of coefficients not having a zero entry in the equation in question, and omitting the row of coefficients of that equation (Asher, 1983, p.57). Applying these conditions to equation (9) shows that it is exactly identified.

Heteroscedasticity

In equation (9), units of endogenous variables are monetary, which can be viewed as expenditures on various financial products. Expressing endogenous variables as expenditures possibly results in a specification error, heteroscedasticity (Judge et al, 1980, p.125). For example, if Q_t represents expenditure by the tth household on some financial products, and the explanatory variables include some

household demographic characteristics, the variance of Q_t is expected to be low for low income units and high for high incomes units. There are several ways to mitigate the heteroscedasticity. One way is to divide the sample into several subsamples by income levels. Another way is to make a log transformation of the expenditure and income variables. The third way is to use relative expenditure variables, e.g. share of expenditure of certain products. In this study, the first method is used. The reasons are three. First, one of the objectives of this study is to investigate substantial differences of saving behaviors of families at different income levels. Second, using the first method permits much easier and more straightforward calculation of certain kinds of elasticities than other methods. Third, the focus of this study is the change of financial assets in absolute rather than relative terms.

Censored sample

A censored sample is one where the value of the dependent variable, corresponding to some observable values of independent variables, is unobservable (Judge et al, 1980, p.615). The sample used in equation (9) is a censored sample, since dependent variables in it are dollar values of various financial assets, and some families in the sample do not possess certain kinds of assets (Table 2, p.74).

In stock adjustment model literature, estimations of

parameters are conducted by using Ordinary Least Square (OLS) procedure, but this is not appropriate in the context of this study since application of OLS procedure to a censored sample produces biased and inconsistent estimators (Judge et al, 1980, p.615). An appropriate way to estimate parameters of a linear equation with a censored sample is using a tobit model (Maddala, 1983).

The tobit model was originally proposed by Tobin (1958b) as a hybrid of probit analysis and multiple regression to deal with censored samples. In order to use the tobit model, equation (9) can be rewritten as:

(10) $$Q_{kt}=\tau_{kt}D_{kt}+(1-\alpha_{kk})Q_{k(t-1)}-\Sigma\alpha_{kj}Q_{j(t-1)}+v_{it}.$$

In the form of the tobit model, equation (10) can be expressed as:

(11) $$Q_{kt}=\tau_{kt}D_{kt}+\alpha_{kk}'Q_{k(t-1)}+\Sigma\alpha_{kj}'Q_{j(t-1)}+v_{it}. \quad \text{if } Q_{kt}>0$$

$$Q_{kt}=0 \quad \text{otherwise}$$

where, $\alpha_{kk}'=1-\alpha_{kk}$, and $\alpha_{kj}'=-\alpha_{kj}$. Parameters τ_{kt}, α_{kk}', and α_{kj}' in equation (11) can be estimated by using the maximum likelihood procedure (Maddala, 1983, pp.151-156).

In equation (11) lagged dependent variables exist. If the serial correlation in the residuals is ignored, the tobit model still can be used (Maddala, 1983, p.186). Parameters of each tobit equation will be estimated separately. This is not an optimum, but a satisfactory solution.

Estimates of parameters in equation (11) do not directly indicate marginal effects of independent variables in the

stock adjustment model, as would be the case if the ordinary least square routine were used. According to McDonald and Moffitt (1980), marginal effects of independent variables (X_i) on the expected value of the dependent variable (Ey), $\partial Ey/\partial X_i$, is the product of the tobit beta estimate, β'_i, and the probability of being above the limit, F(z), i.e.:

(12) $\partial Ey/\partial X_i = F(z)\beta'_i$.

One feature of using the tobit model is the decomposition of the total change in dependent variables into two parts: changes in the probability of being above the limit and changes in the value of the dependent variable if it is already above the limit (McDonald and Moffitt, 1980). More usefully, the tobit results can be easily converted into elasticities of independent variables for dependent variables, such as income elasticity of checking accounts. Then the elasticity can be decomposed into two parts: the income elasticity of checking accounts among those who are observed currently possessing checking accounts, and the elasticity of the probability of possessing checking accounts with change in income which is called entry/exit elasticity (Kinsey, 1984). Details for calculations of marginal effects of independent variables and elasticity decompositions can be found in Appendix C.

Summary

Equation (9) is exactly identified. To mitigate the

heteroscedasticity, the sample is stratified by income levels. To deal with a censored sample, a tobit model is used to estimate parameters of equation (11).

Data Description

The data are from the Survey of Consumer Finances (Avery et al, 1987). This data set includes two surveys conducted in 1983 and 1986 by the Survey Research Center of the University of Michigan, and consists of 3,665 and 2,822 area probability samples, respectively. The interviewers solicited a detailed inventory of the families' assets and liabilities, standard demographic data, income information, work history, and respondents' use and understanding of credit and other financial services. The 1986 survey reinterviewed respondents to the 1983 survey. If the respondent had been divorced or separated since the 1983 interview, both the original respondent and the former spouse were included in the 1986 sample.

Three features of this data set are especially suitable for this study. First, this data set consists of the most comprehensive household assets information available to date, which makes it possible to investigate saving behavior in a context of paper assets. Second, this data set provides family financial information at two points of time, thus a stock adjustment model can be used to investigate interrelationships of components of household asset portfolios

in a manner that many previous studies could not do. Third, this data set oversamples high income families, which allows sufficient cell size to investigate the fundamental differences of saving behaviors among families at various income levels. High-income families, of special interest, are more likely to possess a wide variety of financial products, and are less often studied due to the scarcity of information.

Two decisions need to be made before the estimation of the parameters can proceed: will the weighted sample or the unweighted sample be used; and will the raw data file, or the cleaned and imputed data file be utilized?

Theoretically, the advantage of using a weighted sample is that the research findings could be generalized to the situation of the national population. However, several facts make this data set hard to use as a weighted sample. Even though this survey has oversampled high-income families, their numbers are not large enough to justify using a weighted sample (Avery et al, 1988). In addition, a stock adjustment model requires family financial information from two years and the relationship of 1983's weights and 1986's weights is complicated because sample designs were different in the two years. Further, the changing family characteristics make the relationship of the two years' weights more complex (Avery and Kennickell, 1988). Consequently, an unweighted sample is used in this study.

Generally speaking, the raw data set is usually preferred because it will decrease the complication of parameter estimation in later stages of the study. However, missing values are common in this data set because of the private nature of family finances, the lack of knowledge of respondents, and other reasons. In terms of household assets, missing information averages around 15 percent for the various asset types in this data set (Avery and Kennickell, 1988).

Three methods were used by the survey's researchers to impute missing data (Avery et al, 1988). The first method computed missing values using formulas based on respondent information that was closely related to the missing items. This method does not influence the reliability of the data set, assuming the information used as the basis for imputation was reliable. The second method assigned missing values on the basis of random draws from conditional frequency distributions. This method was used primarily to impute missing values for categorical variables. This method has a small impact on accuracy of the sample used in this study, because only a few categorical family characteristic variables are utilized. The third method, used to estimate most missing dollar amounts, estimated missing values by regression. Missing values were assigned a value which was predicted using regression plus a random disturbance term. This term was generally assumed to be a truncated log-normal variable with the same variance as the residual term of the regression.

Income and asset regression imputations were done simultaneously, using an iterative technique in order to preserve second moments. This method has the potential to influence the accuracy of information.

This study uses the cleaned and imputed data file. Justifications for using it are several. One advantage of using the imputed data file is that it has been checked for coding and other errors. Another advantage is that the imputed data file will provide more usable observations than the raw data file, and this is very important in the estimation of parameters, especially critical when observations of a particular asset are low for a particular subset. An assumption will be held that, when the imputed file is used, the imputed data represent the "true" situation. Thus caution will be necessary during interpretation of findings given the possibility that this assumption will be violated.

Only families of single adults with or without children, or couples with or without children are included in the sample analyzed. In addition, only single persons without marital changes, or married couples who retain marital status between 1983 and 1986 are chosen. A final sample of 2,419 is used in this study.

Research Procedures

Statistical analyses include the following steps. The

sample is first stratified into three income levels. Then intangible household assets are grouped into three mental accounts, and dependent and independent variables are specified. Finally, a SAS program is used to estimate parameters of equation (11), and influences of family characteristics on the interrelated components of household assets.

Income levels

To investigate different saving patterns between families at various income levels, observations in the sample are stratified according to their 1985 annual family incomes. The three income categories selected are: 1) $19,999 or less, 2) $20,000-$49,999, and 3) $50,000 or more. The income category cutoffs are relatively arbitrary but have some rationale. First, the number of families in these three groups are roughly even, although numbers of low- and middle- income families are slightly higher than the number of high-income families. Such an arrangement will allow noncensored samples in low- and middle-income families large enough for estimation of the parameters, since high-income families are more likely than low- and middle-income families to possess some specific financial assets. Second, the cutoffs approximately correspond to the low 40 percent, middle 40 percent, and high 20 percent of American families in terms of annual money income. In 1985, two fifths of families had incomes of

$22,725 or less, two fifths had incomes from $22,726 to $48,000, and a fifth had incomes over $48,000 (Bureau of the Census, 1989, p.42). Three, the middle income category comprises both mean and median family income of that year. In 1985, the average family annual income was $32,944, and the median income was $27,735 (Bureau of the Census, 1989: p.34,42)[7].

Mental account variables

Household asset variables CHCK, CD, IRA, THRFT, OASST, STCK, and BOND will be grouped into three mental accounts, ACCT1, ACCT2, and ACCT3, and used in the stock adjustment model. Mental account variables with 1986's values are dependent variables, and those with 1983's values are independent variables used in the stock adjustment model. Descriptions and ownership of these variables are in Table 2. Asset variables in 1983 and 1986 used to formulate mental account variables and the relationship of these two years' variables are presented in Table 3. Detailed description of these assets can be found in Appendix A.

Some household assets very easily fit into certain accounts, and others do not. It is conceivable that CHCK can be considered in ACCT1, and IRA and THRFT in ACCT2.

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[7] In this study, an unrelated individual is treated as a one-person family. The definition of family of the Bureau of Census is slightly different. Figures from the Bureau of Census sources refer to families excluding unrelated individuals.

Table 2

Ownerships of Household Assets by Income Levels (%)

Assets	Total	Income I	Income II	Income III
CHCK	94.0	84.0	98.0	100.0
CD	37.8	21.8	29.8	68.4
IRA	37.4	9.5	35.3	73.2
THRFT	19.0	4.2	21.2	33.3
OASST	10.9	4.5	5.3	26.7
BOND	30.1	8.4	27.6	59.2
STCK	30.3	7.1	22.0	69.7
Sample size	2419	780	966	666

Note:

(1) Income levels[8].
Income I: families with 1985 annual income $19,999 or less;
Income II: families with 1985 annual income $20,000-$49,999;
Income III: families with 1985 annual income $50,000 or more.

(2) Household assets (Avery and Elliehausen, 1988; Avery and Kennickell, 1988).

CHCK: checking, statement savings, passbook, share draft, and other savings accounts;

CD: money market accounts including brokerage call money account, and certificates of deposit (short-term, long-term, and all-saver);

IRA: Individual Retirement and Keogh Accounts;

THRFT: employer-sponsored profit sharing, thrift and other savings plans;

OASST: trusts or managed investment accounts, notes and land contracts, and loans owed to the household.

BOND: savings bonds, municipal, corporate, and all other bonds;

STCK: publicly traded stock, including stock in mutual funds, but excluding money market or IRA accounts;

[8] For detailed discussion about the division of income levels, see section "Income level" in Chapter "Methodology".

Table 3

Relationship between Household Asset Variables in 1986 (Cxxxx) and 1983 (Bxxxx) Surveys of Consumer Finances

Name	Relationship	Description
CHCK	C1406=B3401+B3434	B3401=Checking Account B3434=Saving Account
CD	C1410=B3453+B3418	B3453=CD B3418=Money Market Account
IRA	C1408=B3446	B3446=IRA and Keogh Account
THRFT	C1412=B3306	B3306=Thrift-type Account
OASST	C1416=B3477+B3601+B3470	B3477=Loans owed to Household B3601=Land Contract and Notes B3470=Trust Account
BOND	C1404=B3458+B3463+B3457	B3458=All Other Bonds B3463=Tax-free Mutual Funds B3457=U. S. Savings Bonds
STOCK	C1402=B3462-B3463	B3462=Stocks and Mutual Funds

Source: Avery and Elliehausen, 1988; Avery and Kennickell,1988

CD includes money market accounts and certificates of deposit. CD is put into ACCT1 for several reasons. First, popular family finance textbooks (Boone and Kurtz, 1989; Gitman and Joehnk, 1987; Winger and Frasca, 1986) often divide household assets into two categories, savings and investment, and money market accounts and certificates of deposit are usually put in the savings category. Second, money market accounts and certificates of deposit are easily available, along with checking and saving accounts, in commercial banks, thrifts, and credit unions. Third, these two types of assets have higher interest rates than checking and saving accounts, a lower degree of risk than stocks, mutual founds, and bonds, and a higher degree of liquidity than savings bonds. Thus they are ideal instruments for consumers to meet their short-term financial needs.

OASST includes trusts and managed investment accounts, notes and land contracts, and loans owed to the household. A trust is an arrangement whereby the right to property is held by a trustee, to benefit a named beneficiary (Winger and Frasca, 1986, p.617). If a respondent were the beneficiary of a trust, trust would mean future financial security for him/her, then trust would fit into ACCT2. If a respondent were the grantor of a trust, trust would fit into ACCT3 because of the bequest motive. Since no information is available in the data set about the status of respondents having trusts, the trust could be put in either ACCT2 and

ACCT3. Notes and land contracts represent dollar values owed to the respondents when transferring the possession of consumer goods and land, are usually considered as part of one's assets contributing to future financial security, and can be included in ACCT2. Also, loans owed to the household have the same nature as land contracts and notes, and could be put in ACCT2. Considering that a trust is only one aspect of OASST, and perhaps only part of this instrument belongs to ACCT3, OASST is allocated to ACCT2.

STOCK and BOND are classified as ACCT3 for several reasons. First, these two groups do not fit obviously in ACCT1. They might be considered as future security instruments, but IRA, THRIFT, and OASST are often designed as more suitable for this purpose. If the assumption of a third level of financial needs, the social/development needs, is held, there must be a component to reflect savings for these needs. STOCK and BOND seem to be the best candidates. Second, even though no direct consumer survey investigates the reasons for people putting money into stocks and bonds, many personal finance textbooks (Boone and Kurtz, 1989; Gitman and Joehnk, 1987; Winger and Frasca, 1986) treat stocks and bonds as investment vehicles which implies these two groups of financial products will help people to achieve financial goals which are not targeted by savings in ACCT1 and ACCT2.

The way of assigning assets into different mental accounts discussed above is not problem free. One potential

problem is that some families may not behave as suggested. For example, people saving for retirement may not choose IRA or profit-sharing plans, because they have high enough income so that they are not eligible for IRAs, or because profit-sharing plans are not available from their employers. Thus they may choose stocks or bonds as saving vehicles for retirement. Trusts could be classified into either ACCT3 or ACCT2 depending on the status of the respondent having the trust. Another potential problem is differential behavioral patterns between families at various income levels. It is possible that families at different income levels would use different financial vehicles to meet the same financial needs, or use the same financial instrument to achieve diverse goals. Then, assuming that families at various income levels will assign the same financial assets to each mental account may be less than realistic. Because of these potential problems and the unavailability of data representing consumer perception of the fit between various financial instruments and their specific financial needs, caution will be needed in later discussion of findings.

Family characteristics variables

The descriptions of family characteristics variables can be found in Table 4. Data used for these variables are from the 1986 survey. Three dummies, AGE<35, AGE35-54, AGE55-64, and a reference category AGE>64, represent respondents' age

groups of under 35, 35-54, 55-64, and 65 or older. Dummies NOWORK and ONEWORK, and a reference category TWOWORK, represent number of family members working. Dummy RETIRE, and a reference category represent respondents' retirement status. Family life cycle stages are indicated by variable TYPE1, TYPE2, TYPE3, and TYPE4. Definitions of variables HHSIZE, EDYR, INCOME, HOMEVAL, HOUSMTG, OTHEASST, and OTHEDEBT are straightforward and described in Table 4. All monetary variables are measured in 1983 dollars.

Estimation of parameters

Equations (11) and (10) are used to estimate parameters and the following parameters are estimated:

α_{kk}=own-adjustment coefficient,

α_{kj}=cross-adjustment coefficient.

τ_{kt}=short-term effect coefficient,

β_{kt}=equilibrium effect coefficient,

Also, elasticities associated with mental accounts and decomposed conditional elasticities and entry/exit elasticities are calculated.

A LIFEREG procedure in version 6.0 of SAS is used to estimate the parameters of equation (11). Analyses are conducted on the IBM4381 (mainframe) under VM/CMS.

Summary of Methodology

A tobit model designed to deal with a censored sample is

Table 4

Description of Variables

Variable	Description
AGE<35	1 if age of respondent is under 35.
AGE35-54	1 if age of respondent is between 35-54.
AGE55-64	1 if age of respondent is between 55-64.
AGE>64	reference category; age of respondent is 65 or older.
NOWORK	1 if both spouses are unemployed.
ONEWORK	1 if only one spouse works.
TWOWORK	reference category; both spouses work.
NORETIRE	reference category; household head is not retired.
RETIRE	1 if household head is retired.
TYPE1	1 if household head is single with no children.
TYPE2	1 if household head is single with children.
TYPE3	1 if household head married with no children.
TYPE4	reference category; household head married with children.
HHSIZE	Total number of persons in the family.
EDYR	Schooling of household head.
INCOME	Total family income in 1985.
HOMEVAL	Value of primary home.
HOUSMTG	Value of primary home mortgage.
OTHEASST	Value of other assets.
OTHEDEBT	Value of other debts.
ACCT1	Value of checking, statement savings, passbook, share draft, other savings accounts, money market accounts, and certificates of deposit;
ACCT2	Value of Individual Retirement and Keogh Accounts, employer-sponsored profit sharing, thrift and other savings plans, trusts, managed investment accounts, notes and land contracts owed to the household.
ACCT3	Value of savings bonds, municipal, corporate, and all other bonds, publicly traded stock, including stock in mutual funds, but excluding money market or IRA accounts;

be used to estimate parameters of the stock adjustment equation (11). Cleaned and imputed data from the Surveys of Consumer Finances conducted in 1983 and 1986 are selected for use in this study. The sample is stratified into three groups by income level. Mental accounts variables and other independent variables are specified. Estimations are run using a SAS program on the mainframe computer.

RESULTS

This chapter first gives descriptive statistics of the total sample and subsamples. Secondly, estimated own- and cross-adjustment coefficients, and short-term effect coefficients are presented. Then comparisons of these empirical results between families at different income levels are made. Finally, equilibrium effects of family characteristics and elasticities associated with mental accounts are discussed.

Descriptive Statistics

Descriptive statistics of categorical and continuously measured variables are presented in Table 5 and Table 6, respectively. According to the designers of this survey, the head of the family or a financially knowledgeable spouse was selected as a respondent (Avery et al, 1987). Among respondents, four fifths are male and only one fifth are female. When respondents are divided by different income groups, higher-income people are more likely than lower-income people to be male. In the low-income group, the largest portion are people over 64, but in middle- or the high-income groups, the majority are people of ages 35-54. In the low-income group, more than half the families have no worker. In middle- or high-income groups, almost 90 percent of families have at least one worker. Relatively more people in the low-

Table 5

Descriptive Statistics: Categorical Variables (%)

	Total	Income I	Income II	Income III
Sample size	2412	780	966	666
MALE	79.9	55.7	88.2	96.3
FEMALE	20.1	44.3	11.8	3.7
AGE<35	16.7	15.9	24.3	6.7
AGE35-54	39.9	25.2	48.4	45.0
AGE55-64	18.4	16.5	16.3	23.7
AGE>64	25.0	42.4	11.0	24.6
NOWORK	23.8	51.5	10.2	10.6
ONEWORK	42.8	38.6	44.5	45.4
TWOWORK	33.4	9.9	45.3	43.9
RETIRE	21.4	42.9	10.8	11.5
NORETIRE	78.6	57.1	89.2	88.5
TYPE1	20.3	38.7	14.6	6.7
TYPE2	7.8	15.5	5.5	2.1
TYPE3	30.3	25.7	24.8	43.8
TYPE4	41.6	20.1	55.1	47.4

Note:

Income I (low-income group): families with 1985 annual income $19,999 or less;

Income II (middle-income group): families with 1985 annual income $20,000-$49,999;

Income III (high-income group): families with 1985 annual income $50,000 or more.

Table 6

Descriptive Statistics: Continuously Measured Variables

	Total	Income I	Income II	Income III
Sample size	2419	786	966	667
HHSIZE (no.)				
mean	2.8	2.3	3.1	3.0
median	2.0	2.0	3.0	3.0
EDYR (year)				
mean	12.9	10.8	13.0	15.4
median	12.0	12.0	12.0	16.0
INCOME ($)				
mean	75951	9546	28917	221925
median	26836	9634	27921	90719
HOMEVAL ($)				
mean	93334	29165	51416	229661
median	46000	18000	45000	130000
HOUSMTG ($)				
mean	17329	3506	13276	39488
median	0	0	3795	15746
OTHEASST ($)				
mean	334991	19781	52267	1115899
median	10085	2950	9373	115763
OTHEDEBT ($)				
mean	35829	2651	6824	116933
median	1369	77	2217	6814
$ACCT1_{83}$ ($)				
mean	36646	7080	11006	108620
median	3283	800	2200	27000
$ACCT2_{83}$ ($)				
mean	192900	1548	5689	689523
median	0	0	0	26000
$ACCT3_{83}$ ($)				
mean	84414	1783	6547	294559
median	0	0	0	15000
$ACCT1_{86}$ ($)				
mean	57370	8140	12392	180523
median	4464	718	3309	30797
$ACCT2_{86}$ ($)				
mean	222853	1609	6491	796923
median	0	0	0	27174
$ACCT3_{86}$ ($)				
mean	117621	2104	9669	410090
median	0	0	183	27216

income group than in the middle- or high-income group have retired. In terms of life cycle stage, married couples with/without children dominate middle- and high-income groups. Relatively, people in the low-income group are more likely than other groups to be single with/without children.

Low-income families have a smaller household size than the other two income groups. The average education level of the household head in the total sample is about 13 years, but this figure is higher when family incomes are high. The average annual income in 1983 of middle-income families is twice that of low-income families, while still much lower than high-income families. In terms of home values, house mortgages, other assets, or other debts, high-income families possess much higher dollar values than low- or middle-income families.

Intangible household assets present the same situation. Average dollar values of mental accounts held by high-income families are much higher than those held by low- or middle-income families. In terms of median values, these differences are even more disparate. Median values of ACCT1 and ACCT2 of high-income families are $15,000 or over, contrasting with much smaller or zero values in corresponding accounts of middle- or low-income families.

In summary, relative to the other income groups, low-income family units in this sample are likely to be female-headed, older, unemployed, retired, single, have less than a

high school education, and have much lower assets and debts. High-income families appear to be male-headed, middle-aged, working, married with/without children, college educated, and have much higher assets and debts. Middle-income people are likely to have the same characteristics (sex, age, working status, life cycle stage, household size, and education) as high-income people, while they have much lower assets and debts than the rich.

Estimated Coefficients of Stock Adjustment Models

Estimates of own-adjustment coefficients and cross-adjustments of mental accounts for low-, middle-, and high-income families can be found in Table 7 through Table 9. In order to make comparisons, own-adjustment coefficients and cross-adjustment coefficients of mental accounts for the total sample are estimated and can be found in Table 10. In addition, estimates of short-term influences of selected family characteristics are also included in these tables.

Estimates of own-adjustment coefficients lie along the diagonal of the matrixes of ACCTi by ACCTj (i,j=1,2,3) in the tables. Estimates of cross-adjustment coefficients locate off the diagonal of the matrixes. The following chart shows the locations of these estimates in Table 7 through Table 10.

Variable	ACCT1	ACCT2	ACCT3
INTERCEPT	xxxx	xxxx	xxxx
ACCT1	xxxx^{o}	xxxx^{c}	xxxx^{c}
ACCT2	xxxx^{c}	xxxx^{o}	xxxx^{c}
ACCT3	xxxx^{c}	xxxx^{c}	xxxx^{o}
AGE<35	xxxx^{s}	xxxx^{s}	xxxx^{s}
AGE35-54	xxxx^{s}	xxxx^{s}	xxxx^{s}
...	...	...	...

^{o} estimates of own-adjustment coefficients.
^{c} estimates of cross-adjustment coefficients.
^{s} estimates of short-term effects of family characteristics.

Own-adjustment coefficients

Generally speaking, the first hypothesis is strongly supported by findings. The first hypothesis suggests that a previous period mental account would influence its present period counterpart in such a manner that the gap between the desired demand and the real stock of the mental account is filled by a certain percentage, which is indicated by the corresponding own-adjustment coefficient. The results from the total sample and three subsamples are consistent with the hypothesis. During a three-year period, families in the total sample (Table 10) have filled the gaps between desired stocks and real stocks for ACCT1, ACCT2, ACCT3 by 14, 55, and 69 percent, respectively. The situation of the low-income group (Table 7) is similar, in that gaps in ACCT1, ACCT2, and ACCT3 are filled by 11, 87, and 96 percent. The corresponding figures for middle-income families (Table 8) are 45, 81, and 88 percent. The high-income group (Table 9) shows the same

Table 7

Marginal Effects of Independent Variables in the Stock Adjustment Model (Low-income families, N=786)

Variable	ACCT1	ACCT2	ACCT3
INTERCPT	-9439.55	-13836.1*	-9567.47*
ACCT1	.1058826*	-.001805	-.043489*
ACCT2	-.150236+	.8722151*	.0023938
ACCT3	.0013473	-.084627*	.9566148*
AGE<35	-2894.51	328.9811	-1524.99
AGE35-54	-3909.15	10.25974	-1071.18
AGE55-64	-3618.42	1198.104	-246.425
NOWORK	-4050.66	-2443.70+	275.7385
ONEWORK	-1044.87	-1167.60	909.0363
RETIRE	746.2397	-467.609	-673.566
TYPE1	3159.203	3450.301*	-2109.92
TYPE2	-960.023	1744.991	-553.499
TYPE3	4356.788	3216.915*	-1800.95
HHSIZE	-636.465	354.2503	-665.981
EDYR	532.5758+	316.1608*	348.7013*
INCOME	.3363762+	.2937380	.2819165*
HOUSMTG	.0394162	-.013478	-.008287
HOMEVAL	.0659373*	.0128178	.0229193
OTHEASST	-.043796*	-.000134	-.003414
OTHEDEBT	.0352533	-.000851	-.003031

Details for calculations of these estimates see Appendix C.
* p<.05 + p<.1

Table 8

Marginal Effects of Independent Variables in the Stock Adjustment Model (Middle-income families, N=966)

Variable	ACCT1	ACCT2	ACCT3
INTERCPT	10038.72	-23620.0*	-50643.5*
ACCT1	.4500813*	-.048573+	-.176656*
ACCT2	.0139389	.8092927*	-.204897*
ACCT3	-.096209*	-.068376*	.8770940*
AGE<35	-13793.1*	-935.265	11628.71*
AGE35-54	-12745.0*	507.3983	7360.688
AGE55-64	-8306.22*	7942.799*	3820.499
NOWORK	12946.49*	2360.482	7658.038
ONEWORK	2124.543	-348.914	3540.659
RETIRE	-353.775	6550.749	-6496.33
TYPE1	-801.684	-7889.91+	-8790.07+
TYPE2	-3204.88	-12409.4*	-6717.68
TYPE3	277.4400	-11313.8*	-234.292
HHSIZE	-961.671	-3870.72*	-1302.71
EDYR	206.8534	695.1374+	1360.260*
INCOME	.2221834*	.4964340*	.5952398*
HOUSMTG	-.005711	-.057657	-.122498*
HOMEVAL	-.009115	.0084541	.0394685*
OTHEASST	-.029298*	.0592527*	.0074951
OTHEDEBT	.0592233*	-.137158*	-.071413

Details for calculations of these estimates see Appendix C.
* p<.05 + p<.1

Table 9

Marginal Effects of Independent Variables in the Stock Adjustment Model (High-income families, N=667)

Variable	ACCT1	ACCT2	ACCT3
INTERCPT	-73162.5	277418.7	-806631.
ACCT183	.0863665*	1.501044*	1.690972*
ACCT283	-.084682*	.1969731*	.0317454
ACCT383	.0333496*	-.124005*	.3963034*
AGE<35	-74022.1	-39222.3	-421508.
AGE35-54	-88333.7	169554.3	-306497.
AGE55-64	-95775.5	107603.3	-108552.
NOWORK	92088.78	-285841.	304184.4
ONEWORK	126987.5*	-90749.8	252552.6+
RETIRE	-16100.7	-393828.	284247.4
TYPE1	-69000.4	215808.7	-88430.4
TYPE2	-126203.	-544062.	101298.5
TYPE3	76955.79	-114783.	-44949.3
HHSIZE	11897.20	-51238.5	-8374.24
EDYR	857.9713	4027.630	25178.11
INCOME	.3722653*	1.456506*	.6403633*
HOUSMTG	1.661179	-1.93176*	-3.92446*
HOMEVAL	-.239615*	.0177060	1.862805*
OTHEASST	.0092220	.0141982	-.022162+
OTHEDEBT	-.133975+	-.256224	.2796075+

Details for calculations of these estimates see Appendix C.
* p<.05 + p<.1

Table 10

Marginal Effects of Independent Variables in the Stock Adjustment Model (Total sample, N=2419)

Variable	ACCT1	ACCT2	ACCT3
INTERCPT	-54723.2	-576685.*	-1047572*
ACCT183	.1390859*	.9836542*	.7928422*
ACCT283	-.079385*	.5495171*	.0183584
ACCT383	.0316030*	-.099796*	.6877949*
AGE<35	-54992.5+	-774.897	-112308.+
AGE35-54	-56729.1*	52101.06	-93733.9+
AGE55-64	-55161.6*	82324.07	-25626.0
NOWORK	3164.516	-198537.*	-70323.2
ONEWORK	51892.69*	-40269.7	50516.59
RETIRE	-8667.81	-52386.0	-1830.15
TYPE1	-48377.9	-77729.5	-214912.*
TYPE2	-62099.9+	-199686*	-167346.*
TYPE3	2575.484	-32123.9	-35232.4
HHSIZE	-9956.17	-22220.7	-18068.9
EDYR	7216.190*	35507.86*	61271.41*
INCOME	.3408146*	.8618694*	.3886245*
HOUSMTG	1.361202	-1.30491*	-2.06856*
HOMEVAL	-.188081*	.1950070*	1.087532*
OTHEASST	.0078233*	.0053826	-.011067*
OTHEDEBT	-.094370*	-.206787*	.0861542+

Details for calculations of these estimates see Appendix C.
* p<.05 + p<.1

pattern. The own-adjustment coefficients in ACCT1, ACCT2 and ACCT3 are 8, 20, and 40 percent, respectively.

Cross-adjustment coefficients

The second hypothesis implies that the absolute values of cross-adjustment of ACCTi to ACCTj are larger than those of ACCTj to ACCTi (i,j=1,2,3; i<j). This assumption is completely supported by the results from the middle-income sample (Table 8). In this subsample, ACCT1 and ACCT3, ACCT2 and ACCT3 are seen to be competitive, since the corresponding coefficients are negative. The effect of ACCT1 on ACCT3 is eighteen percent, while the effect of ACCT3 on ACCT1 is only ten percent. Similarly, ACCT2's influence on ACCT3 is 20 percent, while ACCT3's effect on ACCT2 is only seven percent. Interactions between ACCT1 and ACCT2 are not statistically significant.

In the low-income group (Table 7), only the result from one of three pairs of mental accounts are consistent with the second hypothesis. ACCT1 and ACCT3 act in a manner consistent with the hypothesis. However, the pairs of ACCT1 and ACCT2, and ACCT2 and ACCT3 show a pattern opposite to the one predicted by the hypothesis. It implies that the poor treat these mental accounts in different ways than do the middle class.

Situations in the high-income group (Table 9) are different from either the middle class or the poor. First of

all, ACCT1 and ACCT3 are complementary. ACCT1 has a much larger positive impact on ACCT3 than that of ACCT3 on ACCT1, which is consistent with the second hypothesis. Secondly, ACCT1 has a positive effect on ACCT2, while ACCT2's effect on ACCT1 is negative. Finally, ACCT3 affects ACCT2 negatively, while ACCT2 hardly influences ACCT3. The latter two situations are not consistent with the hypothesis and hard to explain. At minimum it suggests a different saving pattern of the rich compared to the poor and middle classes. It may also suggest that ACCT2 and ACCT3 are not as mutually exclusive for the rich as for the middle class, and that more information is needed about the financial needs met by various financial instruments, especially for the high-income group. Situations in the total sample (Table 10) show the same patterns as that of the high income group which is probably caused by the fact that the rich hold the largest portion of assets in terms of both ownerships and dollar values.

In summary, the estimates of cross-adjustment coefficients in the middle-income group are very supportive of the second hypothesis, while those of the poor and the rich offer weaker support to the hypothesis. This situation strongly suggests that preferences of families at different income levels for characteristics of the mental accounts defined for this study are very diverse.

Short-term Effects of Family Characteristics

Estimates of short-term effects of family characteristics are presented in Table 7 through Table 10. Findings in low-, middle-, and high-income groups will be discussed in turn.

In the low-income group (Table 7), educational level of the household head has a significant positive effect on savings in all three mental accounts. It suggests that education will decrease the psychological cost of all saving behavior. Income shows positive effects on ACCT3 and ACCT1, which is consistent with the hypothesis. It is conceivable that families with no one in the labor force are less likely than families with two workers to save in ACCT2, a behavior which is consistent with Maslow's human needs hierarchy. Family life cycle stages do not influence the savings in ACCT1 and ACCT3, but have some effects on ACCT2. The single without children or the married without children are more likely to save in ACCT2, which is consistent with the hypothesis. Home values have a positive effect, while other assets have a negative effect on ACCT1, which suggest home value decreases, while other assets increase the psychological cost for saving in ACCT1.

Compared to the poor, the middle class shows a different picture (Table 8). Education shows positive effects only on ACCT2 and ACCT3, a pattern consistent with the hypothesis. This implies that ACCT1, the lowest level of financial need, is fully met. Income shows positive effects on all three

mental accounts, which is consistent with the hypothesis. Consumers under 65 are less likely than their older counterparts to save in ACCT1, which implies that people at retirement age possibly do not meet basic financial needs. Consumers of age 55-64 are significantly more likely than consumers at retirement age to save for ACCT2, which is conceivable. Consumers under 35 are more likely than consumers over 64 to save in ACCT3, which implies that they may save for their children's equilibrium financial needs. Only families having no worker save more in ACCT1 than families having two workers, which suggests that in the middle-income families, one worker or two workers is not the critical factor to meeting basic financial needs. Single-headed families with/without children and husband-wife families without children save significantly less in ACCT2 than those married with children. This is against intuition. The possible explanation may be that single heads or married heads without children are either relatively younger than the married with children so that they are not currently considering retirement, or much older and then do not save but dissave in retirement accounts. The singles without children are less likely to save in ACCT3 (although the effect is weak), which is understandable, but no difference is found between those married without children and those married with children. Perhaps these two types of families put similar amounts of additional money in ACCT3 but for different

reasons. Household size decreases the savings in ACCT2, and other assets positively influence the savings in ACCT2, findings consistent with the hypothesis. However, other assets negatively affect the savings in ACCT1. It may be true that the consumption propensity is the largest in this account, and the increase of other assets is the direct cause of decreases of this account. Other debts have a positive effect on ACCT1 but a negative effect on ACCT2. This situation suggests that the increase of other debts will cause people to save more in ACCT1 and decrease savings in ACCT2. Other debts resulting in more savings in ACCT1 is not consistent with the hypothesis, because it is expected that debts decrease savings in all accounts. House mortgages have a negative effect, and home values have a positive effect on ACCT3, consistent with the hypothesis.

In the high income group (Table 9), income influences all three mental accounts positively, which is consistent with the hypothesis. House mortgages have negative effects on ACCT2 and ACCT3, which is reasonable because house mortgages are competitive with these two accounts. Home values have a positive effect on ACCT3, which implies that families having higher home values will have a higher level of financial needs. On the other hand, home values show a negative influence on ACCT1, which violates the hypothesis. Other assets have a weak negative effect on ACCT3, which again violates the hypothesis. Other debts have a weak negative on

ACCT1 and a weak positive on ACCT3. The former is consistent with the hypothesis, and the later violates the hypothesis. Compared to families with two workers, families with one worker are more likely to save in ACCT1 and ACCT3.

In the total sample (Table 10), education and income positively affect all three mental accounts. House mortgages negatively influence ACCT2 and ACCT3, while home values have positive effects on these two accounts. However, home values have a negative effect on ACCT1. Other assets have a positive effect on ACCT2, but a weak negative effect on ACCT1. Compared to the married with children, the single with children are less likely to save in three accounts, while the single without children are less likely to save in ACCT3. Families having two workers are less likely than families with one worker to save in ACCT1, while more likely than families without any worker to save in ACCT2. Families with the household head under 54 are less likely than their counterparts with the head over 64 to save in ACCT3, and families with the head over 65 are more likely to save in ACCT1.

In summary, education and income show strong effects on all three accounts. Age, employment status, life cycle stage, household size, house mortgages, home values, other assets, and other debts have some effect on various accounts in the total sample and subsamples. Retirement status does not show any effect in the total sample as well as in any of the

subsamples.

Comparison with previous studies

Comparison of empirical results with previous studies is difficult. The first difficulty is the diverse definitions of assets. In this study, intangible household assets are categorized into three groups, ACCT1, ACCT2, and ACCT3. Previous studies use definitions like liquid assets, financial assets, time deposit, money, etc. These definitions are frequently dissimilar. Compared to the definitions used in this study, previous studies sometimes overlapped in definitions, and sometimes certain assets are not covered by those studies. The second difficulty is in dividing the subsample by income level. This study divides the total sample into low-, middle-, and high-income groups. No previous study takes this same approach. However, some studies (Zick, 1982; Bryant, 1986) do research similar subgroups, such as husband-wife households, female-head households, etc. Usually the differences between husband-wife households and female-head households revealed in previous studies can be compared with the differences of middle-income families and low-income families. The third difficulty is that some studies (Motley, 1970; Wachtel, 1972) employ macro data, which makes a direct comparison impossible due to incompatible data sets. In addition, the greatest limitation is the lack of comprehensive findings in terms of own-

adjustment, cross-adjustment, or short-term effect estimates that can be compared with findings in this study. Of those that include such estimates, most findings are not statistically significant. Thus comparisons are only roughly made and should be considered incomplete.

Almost all own-adjustment estimates in this study are positive, which is consistent with previous studies. Motley (1970) uses macro data to estimate own-adjustment coefficients of money and saving deposits, and finds that they are positive. Wachtel (1972) also utilizes macro data to gain positive own-adjustment estimates of liquid assets. Zick and Gerner (1987) provide positive own-adjustment estimates of financial assets in two types of households: husband-wife and female-headed. In addition, they find that the estimate for husband-wife households is larger than that of female-headed households. Also female-headed households have much lower average permanent and transitory income. Financial assets are defined by them as all intangible household assets. Contrary to their study, here the own-adjustment coefficients of lower-income families are not always lower than those of higher-income families. One possible explanation is that direct comparison of estimates between subsamples at different income levels is problematic since the account variances of subsamples in this study are different.

Only Motley's (1970) study provides cross-adjustment estimates of money and saving deposits, and he finds these

estimates are negative, which suggests these two asset groups are competitive. In this study, cross-adjustment estimates are mixed, with some positive and some negative. It is hard to compare these estimates with Motley's because it is unclear how money and saving deposits in Motley's study are defined.

In this study, income always shows a positive effect on savings in various accounts. The same results have been found in previous studies. In Motley's (1970) study, transitory income has a positive effect on saving deposits. Wachtel's (1972) research shows that both permanent income and transitory income have positive effects on liquid assets.

House mortgages, and other debts often show negative effects, and home values and other assets in this study show positive effects on mental accounts. Watts and Tobin (1960) find that correlations are positive between assets, and negative between assets and debts. Bryant's (1987) findings show that other liquid assets have positive effects on car stocks in the total sample, and on home mortgage in the married couple sample. Wachtel's (1972) results indicate that durable stocks and credit liabilities have negative effects on liquid assets. Some of these results are not consistent with the results of this study, mostly due to the inclusion of the tangible goods in the definition of assets.

Comparison of Results between Subsamples

In order to investigate the substantial influence of

income, a comparison of results between subsamples is made. Table 11 summarizes the coefficient estimates of the stock adjustment model that are significantly different from zero.

All own-adjustment coefficient estimates are positive. According to the fourth hypothesis, the own-adjustment estimates of all accounts will be larger in higher-income subsamples. However, results presented in Table 7 through Table 9 do not show this pattern. Perhaps comparisons can not be made in this way because of the different variances among these subsamples. It is possible that relative size of gaps between desired stocks and real stocks of various accounts are different for families at different income levels. The coefficients represent adjustments in relative rather than absolute terms. Thus adjustment speed may be viewed in different ways. For example, one assumes the rich can adjust a gap faster than the poor, but if the gaps experienced by the rich are much larger than the poor, the final result may be that the rich have smaller own-adjustment coefficients.

In terms of cross-adjustment coefficient estimates, the three subsamples show different patterns, which implies different preferences of families at different income levels relative to the various mental accounts. The total sample has almost the same pattern as the high-income subsample, which suggests that ownership and absolute dollar values of household assets in the high-income subsample dominate the total sample.

Household heads under 64 in middle-income families are less likely than their older counterparts to save in ACCT1. However, those in age group 55-64 and the group under 35 are more likely to save in ACCT2 and ACCT3 respectively. Low-income and high-income families do not show any patterns in terms of age of household head. The total sample shows a pattern very similar to the middle-income families.

Compared to families with two workers, middle-income families without any worker tend to save more in ACCT1, and their low-income counterparts are likely to save less in ACCT2. High-income families with one worker are more likely than families with two workers to save in ACCT1.

Middle-income couples with children are more likely than families in other life cycle stages to save in ACCT2, while their low-income counterparts are less likely to do so. Middle-income singles without children are less likely than couples with children to save in ACCT3.

Increasing household size will decrease savings in ACCT2 of middle-income families. Education exerts positive effects on savings in all accounts for low-income families, and in ACCT2 and ACCT3 for middle-income families. Annual income positively influences savings in all accounts in all subsamples.

House mortgages influence savings negatively in ACCT2 and ACCT3, and positively in ACCT1 for high-income families, and they also have a negative effect on ACCT3 for middle-income

Table 11

Summary of Marginal Effects of Independent Variables in the Stock Adjustment Model

Variable	ACCT1	ACCT2	ACCT3
INTERCEPT		t,l,m	t,l,m
ACCT1	T,L,M,H	t, M,h	t,L,M,h
ACCT2	T,L, H	T,L,M,H	m
ACCT3	t, M,h	T,L,M,H	T,L,M,H
AGE<35	t, m		t, M
AGE35-54	t, m		t
AGE55-64	t, m	T, M	
NOWORK	m	t,l	
ONEWORK	T, H		
RETIRE			
TYPE1		L,m	t, m
TYPE2	t	t, m	t
TYPE3		L,m	
HHSIZE		m	
EDYR	T,L	T,L,M	T,L,M
INCOME	T,L,M,H	T,L,M,H	T,L,M,H
HOUSMTG	T, H	t, h	t, m,h
HOMEVAL	t,L	T	T,L,M,H
OTHEASST	T,l,m	M	t, h
OTHEDEBT	t, m	t, m,h	t, h

Note:

(1) Notation:
T--total families.
L--low-income families.
M--mid-income families.
H--high-income families.

(2) Lowercase letters mean the negative effects, all others are positive effects.

(3) Underlined letters indicate the significance level is 10%, others indicate the significant level is 5%.

families. Home values positively influence savings in ACCT3 for all subsamples, and in ACCT1 for low-income families. Other assets negatively affect savings in ACCT1 and positively in ACCT2 for middle-income families, negatively affect savings in ACCT3 for high-income families, and negatively affect savings in ACCT1 for low-income families. Other debts have a positive effect on savings in ACCT1 and a negative effect on savings in ACCT2 for middle-income families, and a positive effect on ACCT3 and a negative effect on ACCT2 for high-income families.

The above findings can be summarized as follows. (1) In middle-income families, savings in the various accounts increase savings in these accounts in the future. Household head age, employment status, life cycle stage, household size, household education, current income, house mortgages, other assets, and other debts have different effects on savings in various accounts. (2) High-income family saving in mental accounts have different patterns, and only a few family characteristics such as employment status, current income, house mortgage, house value, and other assets influence savings in some accounts. (3) Low-income families display a third pattern in terms of interactions of mental accounts. Comparatively, fewer effects from wealth variables such as house mortgage, home value, other assets, and other debts, are found on the various accounts.

Comparisons of empirical results among subsamples

indicate that there are definitely distinct patterns of portfolio behavior among families at the three distinct income levels defined for this study. Diverse portfolio behavior patterns suggest different preferences for asset characteristics, and dissimilar financial needs among these families. However, the notion that the corresponding own-adjustment coefficient of a certain mental account will be larger if the family has a higher income level, part of the forth hypothesis, fails to be confirmed by the findings. Another difference shown among subsamples relates to the determinants of mental accounts. Compared to each other, the determinants in the high-income group are more likely to be wealth variables, such as current income, house mortgages, home values, and other debts, while in the low-income group the determinants are more likely to be demographic variables, such as age of the household size, employment status, life cycle stage, household size, and education of the household. These diverse behavior patterns have many implications for practitioners in family/consumer finance education and financial service businesses as they work with different family types.

Equilibrium Effects of Family Characteristics

Based on equation (10), equilibrium effects of family characteristics on mental accounts are estimated and presented in Table 12 (low-income families), Table 13 (middle-income

families), Table 14 (high-income families), and Table 15 (the total sample). Because these figures are calculated based on many coefficients which are not statistically significant, whether or not, or to what extent these figures represent "true" equilibrium effects is hard to determine. Another factor that causes difficulty in interpreting the results is the dynamic nature of family characteristics. In the three-year period, many of these family characteristics may not change, an assumption in this study. However, in the long run many characteristics will definitely change, such as household size, life cycle stage, and so forth. Therefore, no attempt is made to discuss these deduced equilibrium effects in detail. Only cursory examinations are conducted to explore potential characteristics of equilibrium effects. Changes from short-term effects to equilibrium effects, which are observed by contrasting Table 7 through Table 10 with Table 12 through Table 15 accordingly, can be categorized as one of sign change and magnitude change. Magnitude change can be further divided as increasing, decreasing, or remaining the same. If a cell sign is changed, that situation indicates a fundamental change.

Contrasting Table 7 with Table 12 (low-income families), 20 percent (10/51) of cells (based on Table 12) have changed signs, 37 percent (19/51) increased in magnitude. There are even fewer changes in middle-income families. Contrasting Table 8 with Table 13, only four percent (2/51) have changed

Table 12

Equilibrium effects of Family Characteristics on Mental Accounts (Low-income families, N=786)

Variable	ACCT1	ACCT2	ACCT3
INTERCEPT	-113880	-17567	-15135+
AGE<35	-27236+	45	-283*
AGE35-54	-37365+	-338*	-2817*
AGE55-64	-32538+	1137+	-1739*
NOWORK	-42561+	-3048	-1639*
ONEWORK	-11750+	-1322	419
RETIRE	6253+	-563	-418
TYPE1	35479	3970	-602+
TYPE2	-6355+	1902	-872
TYPE3	46545+	3806	223*
HHSIZE	-5569+	302	-950
EDYR	5638+	434	619
INCOME	3.723+	.389	.463
HOUSMTG	.352+	-.014+	.007*
HOMEVAL	.652+	.021	.053
OTHEASST	-.417+	-.003	-.022*
OTHEDEBT	.334+	.0008*	.012*

+ contrasting Table 7, influence has increased in magnitude.
- contrasting Table 7, influence has decreased in magnitude.
* contrasting Table 7, sign has changed.

Table 13

Equilibrium effects of Family Characteristics on Mental Accounts (Middle-income families, N=966)

Variable	ACCT1	ACCT2	ACCT3
INTERCEPT	9736+	-33985	-63718
AGE<35	-29109	-2323+	6852-
AGE35-54	-27733	816	2615+
AGE55-64	-18135+	8962	2797
NOWORK	32133	6253	16664+
ONEWORK	5841	367*	5299
RETIRE	-2328+	7436	-6138
TYPE1	-4320+	-11149+	-13497+
TYPE2	-9489	-17048	-13553+
TYPE3	301	-14291	-3537+
HHSIZE	-2668+	-5216	-3241
EDYR	848	1076+	1973
INCOME	.682	.737	.988
HOUSMTG	-.046+	-.088	.169*
HOMEVAL	-.010+	.013+	.046
OTHEASST	-.064	.070	.011+
OTHEDEBT	.115+	-.170	-.097

+ contrasting Table 8, influence has increased in magnitude.
- contrasting Table 8, influence has decreased in magnitude.
* contrasting Table 8, sign has changed.

Table 14

Equilibrium effects of Family Characteristics on Mental Accounts (High-income families, N=667)

Variable	ACCT1	ACCT2	ACCT3
INTERCEPT	6590*	56260+	-2068000+
AGE<35	-138290+	529870*	-515980
AGE35-54	-39251	741090	-665270
AGE55-64	-69338	1036200+	-61062-
NOWORK	-17479*	-749980	902210
ONEWORK	125800	-129100+	203930
RETIRE	-210620+	593000*	1568400+
TYPE1	22306*	690430	-373620+
TYPE2	-438160	1822900*	1979200+
TYPE3	32877	-945320	-177980+
HHSIZE	-12652*	-136160+	43762*
EDYR	4700+	11424+	42562
INCOME	1.270+	-4.458*	3.448+
HOUSMTG	.820-	-23.323+	-11.536+
HOMEVAL	-.178	4.651+	5.088
OTHEASST	.017+	-.138*	-.120+
OTHEDEBT	-.285+	1.985*	1.764+

+ contrasting Table 9, influence has increased in magnitude.
- contrasting Table 9, influence has decreased in magnitude.
* contrasting Table 9, sign has changed.

Table 15

Equilibrium effects of Family Characteristics on Mental Accounts (Total families, N=2419)

Variable	ACCT1	ACCT2	ACCT3
INTERCEPT	-428770+	-466500+	-1016400
AGE<35	-199450+	365930*	56852*
AGE35-54	-178540+	424960+	58180*
AGE55-64	-162280+	465240+	13738*
NOWORK	-91247*	-196470	8182*
ONEWORK	170750+	-399400+	-112720*
RETIRE	-61892+	27797*	67942*
TYPE1	-207130+	214890*	-79439-
TYPE2	-331510+	254010*	132050*
TYPE3	-4635*	-58211	-44328
HHSIZE	-48555+	51621*	28322*
EDYR	41373+	-1915*	41443
INCOME	1.740+	-1.799*	-1.392*
HOUSMTG	4.663	-12.185	-8.057
HOMEVAL	-.712	2.055+	2.347
OTHEASST	.003	-.060*	-.053
OTHEDEBT	.482*	.608*	.665

+ contrasting Table 10, influence has increased in magnitude.
- contrasting Table 10, influence has decreased in magnitude.
* contrasting Table 10, sign has changed.

signs, two percent (1/51) decreased in magnitude, and 35 percent (18/51) increased in magnitude. High-income families display many changes. Contrasting Table 9 with Table 14, 22 percent (11/51) of cells have changed signs, 43 percent (22/51) increased in magnitude, and only four percent (2/51) decreased. Changes in the total sample are shown in contrasting Table 10 with Table 15. Thus, 38 percent (21/51) of cells have changed signs, 31 percent (16/51) have increased magnitude by at least 10, and two percent (1/51) have decreased.

The above findings suggest the following points. (1) Equilibrium effects of family characteristics are generally much larger than short-term influences. (2) Various family characteristics may play opposite roles in their influence on saving behavior. When comparing equilibrium effects to short-term effects, these situations are shown as sign changes. (3) Equilibrium effects of family characteristics on savings in mental accounts vary with income levels. In the long run, low-income and high-income families are more likely to change saving behavior, while middle-income families seem to be the least likely to do so. (4) Given income levels, family characteristics as determinants in the long run vary according to the different mental accounts. For example, family characteristics of low-income families (Table 12) will increase long run savings greatly in ACCT1, but not in other accounts. Most characteristics of high-income families will

cause fundamental changes in ACCT2 in the long-run, but not in other accounts.

Elasticities and Decompositions

In order to calculate elasticities, average values should be assigned to each independent variable in the tobit models (for details see Appendix C). For a continuously measured variable, the group mean is used, while for a categorical variable, the largest subgroup is chosen. For example, in the total sample, the mean value of ACCT1 in 1983 is $36,646, the largest subgroup of the household head age is AGE35-54. In this way, average values are assigned to the independent variables in the total sample and subsamples, and presented in Table 16.

Elasticities associated with ACCTi (i=1,2,3) are presented in Table 17 (low-income families), Table 18 (middle-income families), Table 19 (high-income families), and Table 20 (the total sample). The elasticity is decomposed into conditional elasticity, which refers to the elasticities for ACCTi (i=1,2,3) among those who are observed currently having dollar values in ACCTi, and the entry/exit elasticity, which means the elasticity of probability of possessing ACCTi (i=1,2,3) with changes in the independent variable.

Own-elasticity[9] shows that one percent change of last-

[9] Here, own-elasticity, cross-elasticity, and influence-elasticity are coined by the author of this study following the conventional definition of elasticity.

period ACCTi (i=1,2,3) results in present-period ACCTi's percentage change. In the low-income sample (Table 16), the own-elasticities of ACCT1, ACCT2, and ACCT3 are .489, .091, and .046, respectively. It suggests the relative volatile nature of ACCT1 for low-income families. The same pattern is shown in middle-income families. The own-elasticity of ACCT1 is the largest one. However, in high-income families, the elasticities of ACCT1, ACCT2, and ACCT3 are roughly equal, and neither as high in ACCT1, nor as low in ACCT2 and ACCT3 as those in the other two income groups. Another difference in behavior patterns between the rich and their lower-income counterparts is the distribution of conditional elasticity and entry/exit elasticity within the total elasticity. In high-income families, all three own-elasticities are dominated by the conditional elasticities, while in low- and middle-income families, the elasticities are largely from entry/exit elasticities in some accounts. For instance, in ACCT3 of low-income families, 70 percent (.0324/.0464) of elasticity is contributed by entry/exit elasticity. It suggests that only 30 percent of the total percentage change in present period ACCT3 savings results from a one percent change in previous period ACCT3 savings, whereas 70 percent would be generated by changes in the probability of saving to this account at all.

Cross-elasticity refers to the percentage change of present period ACCTi (i=1,2,3) resulting from a one percent change in the previous period ACCTj (j=1,2,3; $i \neq j$). Different

Table 16

Average Respondents in the Total Sample and Subsamples

	Total	Income I	Income II	Income III
ACCT1	36646	7080	11006	108620
ACCT2	192900	1548	5689	689523
ACCT3	84414	1783	6547	294559
AGE<35				
AGE35-54	1		1	1
AGE55-64				
AGE>64		1		
NOWORK		1		
ONEWORK	1			1
TWOWORK			1	
RETIRE				
NORETIRE	1	1	1	1
TYPE1		1		
TYPE2				
TYPE3				
TYPE4	1		1	1
HHSIZE	2.8	2.3	3.1	3.0
EDYR	12.9	10.8	13.0	15.4
INCOME	75951	9546	28917	221925
HOUSMTG	17329	3506	13276	39488
HOMEVAL	93334	29165	51416	229661
OTHEASST	334991	19781	52267	1115889
OTHEDEBT	35829	2651	6824	116933

Table 17

Total Elasticities and Decompositions (Low-income families, N=786)

Variable	Elas.	ACCT1	ACCT2	ACCT3
ACCT1	a	.4580	.0059	.1847
	b	.3651	.0014	.0558
	c	.0929	.0044	.1289
ACCT2	a	.0168	.0908	-.002
	b	.0134	.0222	-.001
	c	.0034	.0686	-.002
ACCT3	a	-.0002	.0692	.0464
	b	-.0002	.0169	.0140
	c	-.0000	.0523	.0324
HHSIZE	a	-.106	.3738	-.919
	b	-.084	.0915	-.277
	c	-.021	.2824	-.641
EDYR	a	.4161	1.567	2.259
	b	.3317	.3834	.6821
	c	.0844	1.183	1.577
INCOME	a	.2584	1.431	1.795
	b	.2059	.3501	.5421
	c	.0524	1.081	1.253
HOUSMTG	a	.0100	-.022	-.017
	b	.0080	-.005	-.005
	c	.0020	-.016	-.012
HOMEVAL	a	.1391	.1715	.4009
	b	.1109	.0420	.1211
	c	.0282	.1296	.2799
OTHEASST	a	-.063	-.001	-.041
	b	-.050	-.000	-.012
	c	-.013	-.001	-.028
OTHEDEBT	a	.0068	-.001	-.005
	b	.0054	-.000	-.001
	c	.0014	-.001	-.003

Details for calculations of these elasticities see Appendix C.
a=total elasticity
b=conditional elasticity
c=entry/exit elasticity

Table 18

Total Elasticities and Decompositions (Middle-income families, N=966)

Variable	Elas.	ACCT1	ACCT2	ACCT3
ACCT1	a	.6272	.0383	.1166
	b	.6133	.0202	.0405
	c	.0139	.0182	.0761
ACCT2	a	-.008	.0778	.0699
	b	-.008	.0410	.0243
	c	-.000	.0369	.0456
ACCT3	a	.0653	.0321	.0483
	b	.0638	.0169	.0168
	c	.0014	.0152	.0315
HHSIZE	a	-.309	-.861	-.242
	b	-.302	-.453	-.084
	c	-.007	-.408	-.158
EDYR	a	.2787	.6483	1.061
	b	.2725	.3412	.3687
	c	.0062	.3071	.6920
INCOME	a	.6494	1.004	1.007
	b	.6350	.5286	.3500
	c	.0144	.4758	.6569
HOUSMTG	a	-.008	-.055	-.098
	b	-.008	-.029	-.034
	c	-.000	-.026	-.064
HOMEVAL	a	-.049	.0312	.1217
	b	-.047	.0164	.0423
	c	-.001	.0148	.0794
OTHEASST	a	-.159	.2222	.0235
	b	-.155	.1169	.0082
	c	-.004	.1052	.0153
OTHEDEBT	a	.0419	-.067	-.029
	b	.0410	-.035	-.010
	c	.0009	-.032	-.019

Details for calculations of these elasticities see Appendix C.
a=total elasticity
b=conditional elasticity
c=entry/exit elasticity

Table 19

Total Elasticities and Decompositions (High-income families, N=667)

Variable	Elas.	ACCT1	ACCT2	ACCT3
ACCT1	a	.4145	-.125	-.368
	b	.4145	-.088	-.328
	c	0	-.038	-.040
ACCT2	a	.2439	.4261	-.044
	b	.2439	.2986	-.039
	c	0	.1276	-.005
ACCT3	a	-.041	.0281	.3566
	b	-.041	.0197	.3175
	c	0	.0084	.0391
HHSIZE	a	.1491	-.118	-.050
	b	.1491	-.083	-.045
	c	0	-.035	-.006
EDYR	a	.0552	.0477	.7776
	b	.0552	.0334	.6924
	c	0	.0143	.0852
INCOME	a	.3008	.2168	.2484
	b	.3008	.1519	.2212
	c	0	.0649	.0272
HOUSMTG	a	.2740	-.059	-.311
	b	.2740	-.041	-.277
	c	0	-.018	-.034
HOMEVAL	a	-.230	.0031	.8580
	b	-.230	.0022	.7639
	c	0	.0009	.0940
OTHEASST	a	.0430	.0122	-.050
	b	.0430	.0085	-.044
	c	0	.0037	-.005
OTHEDEBT	a	-.065	-.023	.0656
	b	-.065	-.016	.0584
	c	0	-.007	.0072

Details for calculations of these elasticities see Appendix C.
a=total elasticity
b=conditional elasticity
c=entry/exit elasticity

Table 20

Total Elasticities and Decompositions (Total sample, N=2419)

Variable	Elas.	ACCT1	ACCT2	ACCT3
ACCT1	a	.2158	-.106	-.049
	b	.2050	-.042	-.001
	c	.0109	-.064	-.048
ACCT2	a	.1048	.2555	-.006
	b	.0995	.1011	-.000
	c	.0053	.1544	-.006
ACCT3	a	-.018	.0248	.0442
	b	-.017	.0098	.0009
	c	-.001	.0150	.0433
HHSIZE	a	-.191	-.183	-.085
	b	-.181	-.072	-.002
	c	-.010	-.111	-.083
EDYR	a	.6368	1.347	1.326
	b	.6048	.5331	.0280
	c	.0320	.8137	1.298
INCOME	a	.1588	.1727	.0444
	b	.1509	.0683	.0009
	c	.0080	.1043	.0435
HOUSMTG	a	.1614	-.066	-.060
	b	.1532	-.026	-.001
	c	.0081	-.040	-.059
HOMEVAL	a	-.120	.0535	.1703
	b	-.114	.0212	.0036
	c	-.006	.0323	.1667
OTHEASST	a	.0179	.0053	-.006
	b	.0170	.0021	-.000
	c	.0009	.0032	-.006
OTHEDEBT	a	-.023	-.022	.0052
	b	-.022	-.009	.0001
	c	-.001	-.013	.0051

Details for calculations of these elasticities see Appendix C.
a=total elasticity
b=conditional elasticity
c=entry/exit elasticity

patterns are shown among families at different income levels. In low-income families, cross-elasticities of ACCT1 and ACCT2 are both positive, which implies that these accounts are complementary. However, the pairs of elasticities of ACCT1 and ACCT3, and ACCT2 and ACCT3 are totally different. In middle-income families, pairs of elasticities of ACCT1 and ACCT3, and ACCT2 and ACCT3 are positive, but the pair of elasticities for ACCT1 and ACCT2 is negative and unexpected. High-income families show another picture. ACCT1 and ACCT3 are competitive, but the relationships of ACCT1 and ACCT2, and ACCT2 and ACCT3 are hard to explain. Another difference is the same pattern discussed above, i.e. in low- and middle-income families, some cross-elasticities are contributed largely by entry/exit elasticities instead of conditional elasticities.

Influence-elasticity indicates the percentage change of ACCTi (i=1,2,3) resulting from a one percent change of in a family characteristic variable. Income elasticities for ACCTi (i=1,2,3) are positive in the total sample and all subsamples, which suggests these accounts are normal goods. Education of the household head plays the same role as income, and all education-elasticities are positive. Household-size-elasticities are all negative in middle-income families, while corresponding elasticities are mixed positive and negative in low- and high-income families. In terms of house mortgages, home values, other assets, and other debts, elasticities show

different patterns among families at different income levels.

The above findings can be summarized with two major points. The first is that elasticities associated with mental accounts show different patterns among families at different income levels. The second is that for low- and middle-income families, the total elasticities of some accounts, especially ACCT2 and ACCT3, are mainly contributed from entry/exit elasticities.

Summary of Results

This chapter presents and discusses empirical results estimated from tobit models. The first hypothesis is strongly supported by the results from the total sample and all subsamples. The second hypothesis is substantially supported by the results from the middle-income group, and partly supported by other subsamples and the total sample. Current income and education of the household head have strong positive effects on savings in various accounts. Age of household head, employment status, life cycle stage, household size, home values, house mortgages, other assets, and other debts have some different effects on accounts in the total sample and three subsamples generally in predicted direction. Calculated equilibrium effects of family characteristics on household asset portfolios show that their effects are usually much larger than short-term influences, and that they may possibly change the influence direction from that observed in

the short-term analysis. Elasticities associated with mental accounts and their decompositions indicate that own-elasticities are always positive, and that cross-elasticities may be either positive or negative on different occasions. Income elasticities and education elasticities are always positive in all accounts of all subsamples. Substantial income influences on family portfolio behavior are revealed by contrasting empirical results between subsamples. These substantial income effects are also reflected in and among subsamples, equilibrium effects of family characteristics on mental accounts, and elasticities associated with mental accounts.

CONCLUSIONS

This chapter gives conclusions based on empirical findings. Implications are drawn and recommendations for further research are then made.

Conclusions

Before conclusions from the empirical findings of this study may be made, several points must to be noted. This study has used an imputed data set, and the extent to which it truly represents the original data set is unknown. In addition, the data used are unweighted, so that no generalization to the national population can be made. Mental accounts used in this study are formulated based on Maslow's (1955) human needs hierarchy and secondary survey data. There is no empirical study to compare, and no direct consumer survey to confirm the validity of the definitions of mental accounts used in this study. Equilibrium effects of family characteristics are calculated on the basis of many coefficients that are not statistically significant. Keeping these limitations in mind, the following may be concluded.

(1) Different propensities to consume from different mental accounts are confirmed by own-adjustment coefficient estimates of the total sample and all subsamples. This indicates that consumers divided their paper assets into three hierarchical accounts. They saved the most in the account at

the highest level, and saved the least in the account at the lowest level over a three-year period.

(2) Different propensities to consume from different mental accounts are also confirmed by cross-adjustment coefficient estimates. Especially, the behavior of middle-income families is consistent with the hypothesis. However, behaviors of the poor and the rich only partly support the hypothesis. The supported assumption implies that if a consumer can save a certain amount in an account at a lower level, one will save more in any account at a higher level, because saving in a lower level account requires one to exert a larger amount of willpower. The different behavior patterns shown in the low-income group and the high-income group implies that their mental account hierarchies, or the specific definitions of these mental accounts may differ from those of middle income group.

(3) Education of household head and current family income have consistent, positive effects on savings in various mental accounts. Other family characteristics, such as age of household head, employment status, life cycle stage, and household size show effects, to various degrees, on savings in various mental accounts in the total sample and subsamples. House mortgages and other debts negatively influence savings for some mental accounts in some subsamples. House values affect savings for ACCT2 and ACCT3 in middle- and high-income subsamples. Other assets have positive effect on savings in

ACCT2 and negative effects in ACCT1 in some subsamples.

(4) Equilibrium effects of family characteristics on savings in mental accounts seem much larger in magnitude and may change the direction in contrast to short-term influences. However, this analysis assumes that family characteristics do not change in the long run. This assumption weakens confidence in these findings.

(5) Income's substantial impact on portfolio behaviors of families is revealed in the findings of marginal effects estimates, equilibrium effects of family characteristics, and elasticities associated with savings in mental accounts and their decompositions. Unique portfolio behavior patterns of families at different income levels suggest diverse preferences of families for various assets characteristics, and the existence of varying financial needs.

Implications

Findings of this study may be meaningful for family finance educators, financial service and counseling marketers, and public policy makers. Implications are drawn as follows.

Empirical results of this study support some newly developed terms, such as mental accounts, and the related factors of self-control and will power. These terms could be incorporated into existing family/personal finance curricula, and used as factors to reshape the system of family/personal financial planning. The effects of family characteristics on

savings in the various mental accounts may influence the body on knowledge of career planning, tax planning, wealth building, retirement planning, estate planning, etc. Conceptions and empirical results can also contribute to the development of newly arising family financial planning expert systems. This new system is based on a traditional life-cycle analysis (Hanna et al, 1991). Mental accounts and self-control features may possibly be integrated into this kind of system, resulting in more realistic simulations.

Mental account concepts and marginal propensities to consume from different accounts will help financial businesses understand consumer's portfolio behavior and help them better serve their clients. These new concepts and other empirical results may contribute to their strategic plans for new product positioning, and the marketing and development of effective and efficient promotion and sale tactics.

Personal savings constitutes the largest portion of national wealth. Public policy makers who encourage people to save can take full advantage of these new concepts and new empirical results. For example, if the aim is to encourage saving, special policies can be designed to attract and educate people to save more in lower level accounts, the final result being that people would also save more in higher level accounts. Utilizing empirical results, policy makers could design different programs for families at different income levels according to their behavior patterns. For example,

family characteristics that influence saving behavior are different among families at different income levels. Wealth variables such as house mortgage, home value, other debts, and other assets are more influential in saving behavior of high-income families than in the other two income groups. These empirical results could be used as references to develop special programs targeting different income segments to achieve policy goals.

Recommendations for Further Research

Many studies could be done to achieve more fruitful and more appealing results. Based on this study, the following are suggested for further research.

(1) Mental accounting is a very critical concept in the behavioral life-cycle hypothesis. In this study, the formulation is based only on Maslow's human need hierarchy and informal investigation from a secondary data set. Formal investigation is worth doing to systematically explore the existence and the extent of mental accounts, their connections with assets characteristics, and with family financial needs. Repeated studies are also worth conducting to test the robustness of mental account definitions used in this study. Winter (1986) argues that management is a mental process, and some scholars of family resource management have shifted their interest to the socio-psychological aspects of financial management (Prochaska-Cue, 1990; Rettig and Schultz, 1991).

All these studies are complementary to this study, toward a common goal: to better understand the dynamic and adaptive nature of family financial behavior.

(2) In this study, family characteristics are assumed to remain unchanged over a three-year period. It may be practical if only short-term influences of family characteristics are considered. However, if influences of changing family characteristics are assessed, that assumption will have to be released. Once that assumption is released, panel data over a longer period can be used, and influences of changing family characteristics on saving behavior will be assessed on a more sound basis. In that case, the methodology used in this study is no longer appropriate, and more sophisticated research approaches, such as event history analysis (Allison, 1984), would have to be utilized.

(3) Data from the Surveys of Consumer Finances are very useful for scholars studying family finance because they contain comprehensive family financial information. Another advantage of this data set is that it is a longitudinal panel, and allows researchers to study the dynamic nature of family financial behavior. The third advantage is that this continuous consumer survey has lasted for several decades and previous published research papers and books provide a sound basis for coming researchers to generate new research agendas and do comparisons. However, the disadvantage of this data set is that the proportion of missing values for certain

financial variables is sometimes rather large, and missing values are imputed by different statistical routines (for details see Avery at el, 1988). Further studies that explore differences between raw data files and imputed data files and offer remedies will be very helpful for explaining results of previous studies and for conducting new research.

REFERENCES

Allison, P. D. (1984). Event history analysis: Regression for longitudinal event data. Beverly Hills, CA: Sage Publications.

Ando, A., & Modigliani, F. (1963). The life-cycle hypothesis of saving: Aggregate implications and tests. American Economic Review. 53(1): 55-84.

Asher, H. B. (1983). Causal modeling. (2nd ed.). Beverly Hills: Sage Publications.

Avery, R. B., & Elliehausen, G. E. (1988). Survey of consumer finances technical manual and codebook, 1983 (Revised 1988). Washington, DC: Board of Governors of the Federal Reserve System.

------, Elliehausen, G. E., & Canner, G. B. (1984a, September). Surveys of consumer finances, 1983. Federal Reserve Bulletin. pp679-692.

------. Elliehausen, G. E., & Canner, G. B. (1984b, December). Surveys of consumer finances, 1983: A second report. Federal Reserve Bulletin. pp857-868.

------., Elliehausen, G. E., & Kennickell, A. B. (1987, October). Change in consumer installment debt: Evidence from the 1983 and 1986 surveys of consumer finances. Federal Reserve Bulletin. pp261-278.

------., Elliehausen, G. E., & Kennickell, A. B. (1988). Measuring wealth with survey data: An evaluation of the 1983 survey of consumer finances. Review of Income and Wealth. Series 34, No.4: 339-369.

------., & Kennikell, A. B. (1988) 1986 Survey of consumer finances: Technical manual and codebook. Washington, DC: Board of Governors of the Federal Reserve System.

Becker, G. (1965). A theory of the allocation of time. Economic Journal. 75(299). 493-517.

------. (1976). The economic approach to human behavior. Chicago, IL: University of Chicago Press.

------. (1981). A treatise on the family. Cambridge, MA: Harvard University Press.

Boone, L. E., & Kurtz, D. L. (1989). Personal financial management. Boston, MA: BPI and IRWIN.

Bryant, W. K. (1986). Assets and debts in a consumer portfolio. The Journal of Consumer Affairs. 20(1): 19-35.

------, & Hager, C. J. (1976). Consumer durables, cars, liquid assets, and debts of rural wage-working families. In D. L. Bawden and W. S. Harrar (eds.). Rural income maintenance experiment: Final report, vol V, Expenditures, health, and nutrition. Madison, WI: Institute for Research on Poverty, University of Wisconsin.

Bureau of the Census. (1989, February). Money income of households, families, and persons in the United State: 1987. Series P-60, No. 162. Washington, DC: U. S. Department of Commerce.

Courant, P., Gramlich, E., & Laitner, J. (1986). A dynamic micro estimate of the Life-Cycle Model. In H. G. Aaron and G. Burtless (eds.). Retirement and economic behavior. Washington, DC: Brookins Institution.

Diamond, P. A. and Hausman, J. A. (1984). Individual retirement and savings behavior. Journal of Public Economics. 23: 81-114.

Droms, W. G. (1987, April). Investment asset allocation for PFP clients. Journal of Accountancy. pp114-118.

Dunkleberg, W. C., & Stafford, F. P. (1971). Debt in the consumer portfolio: Evidence from a panel study. American Economic Review. 61(4):598-613.

Fisher, I. (1930). The theory of interest. New York, NY: Macmillan.

Friedman, M. (1957). A theory of the consumption function. Princeton, NJ: Princeton University Press.

Gitman, L. J., & Joehnk, M. D. (1987). Personal financial planning. (4th ed.). Chicago, IL: The Dryden Press.

Griliches, Z. (1967). Distributed lags: A survey. Econometrica. 35(1): 16-49.

Hanna, S., Chang, Y. R., & Fan, X. J. (1991). Prescribing life cycle savings patterns for households. In V. A. Haldeman (ed.). Proceedings of the 37th Annual Conference of American Council on Consumer Interests.

Hefferan, C. (1982). Determinants and patterns of family saving. Home Economics Research Journal. 11(1): 47-55.

Hendershott, P. H. (1985). An overview. In P. H. Hendershott (ed.). The level and composition of household saving. pp3-13. Cambridge, MA: Ballinger Publishing Company.

Hirshleifer, J. (1961). Risk, the discount rate, and investment decisions. American Economic Review. 51: 112-120.

------. (1965). Investment decision under uncertainty: Choice-theoretic approaches. Quarterly Journal of Economics. 79(4): 509-536.

------. (1966). Investment decision under uncertainty: Applications of the state-preference approach. Quarterly Journal of Economics. 80(1): 252-277.

Horrigan, M. W., & Haugen S. E. (1988, May). The declining middle-class thesis: a sensitivity analysis. Monthly Labor Review. pp3-12.

Ironmonger, D. S. (1972). New commodities and consumer behavior. Cambridge, MA: harvard University Press.

Judge, G. G., Griffiths, W. E., Hill, R. C., & Lee, T. C. (1980). The theory and practice of econometrics. New York: John Wiley and Sons.

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. American Psychologist. 39(4): 341-350.

Katona, G. (1960). The powerful consumer. New York: McGraw-Hill.

Kinsey, J. (1984). Probit and tobit analysis in consumer research. in K. P. Goebel (ed.). The proceedings of American Council on Consumer Interests 30th annual conference. pp155-161.

Kmenta, J. (1971). Elements of econometrics. New York: Macmillan Publishing Con, Inc.

Lancaster, K. J. (1966). A new approach to consumer theory. Journal of Political Economy. 74:132-157.

------. (1971). Consumer demand: A new approach. New York, NY: Columbia University Press.

Levin, L. (1991). Testing the behavioral life-cycle hypothesis. Unpublished manuscript.

Maddala, G. S. (1983). Limited-dependent and qualitative variables in econometrics. Cambridge: Cambridge University Press.

Markowitz, H. M. (1952). Portfolio selection. Journal of Finance. 7: 77-91.

Maslow, A. H. (1954). Motivation and personality. NY: Harper & Row.

Mayer, T. (1972). Permanent income, wealth and consumption. Berkeley, CA: University of California Press.

McDonald, J. F., & Moffitt, R. A. (1980). The uses of tobit analysis. The Review of Economics and Statistics. 62: 318-321.

Modigliani, F. (1986). Life cycle, individual thrift, and the wealth of the wealth of nations. Science. 234: 704-712.

------, & Brumberg, R. (1954). Utility analysis and the consumption function: An interpretation of cross-section data. In K. Kurihara (ed.). Post Keynesian economics. New Brunswick: Rutgers University Press.

------. (1979). In A. Abel (ed.). Collected papers of Franco Modigliani. Vol 2. pp 129-197. Cambridge, MA: MIT Press.

Motley, Brian. (1970). Household demand for assets: A model of short run adjustments. Review of Economics and Statistics. 52(3): 236-241.

Nerlove, M. (1956). Estimates of the elasticities of supply of selected agricultural commodities. Journal of Farm Economics. 38(2).

Pare, T. P. (1988). The pros tell how to balance assets at different stages of your life. Fortune (1989 investor's guide). pp103-114.

------. (1989). Allocating your assets by life's seasons. Fortune (1990 investor's guide). pp125-142.

Pratt, J. W., Wise, D., & Zeckhauser, R. (1979). Price differences in almost competitive markets. Quarterly Journal of Economics. New York: McGraw-Hill.

Prochaska-Cue, K. (1990). Towards one component of a model of psychological financial management style. Paper presented in NCR-116. Chicago, IL.

Pye, G. B. (1963). Investment rules for corporations. Unpublished doctoral dissertation. Massachusetts Institute of Technology, Boston, MA.

Rettig, K. D., & Schultz, C. V. (1991). Cognitive style preferences and financial management decision styles. Financial Counseling and Planing. 2: 25-54.

Robert, G. S. (1975). Lancaster's new demand theory: Its application in portfolio analysis. Journal of Economic Literature. 13(1): 45.

Schiano, A. (1987). A Lancasterian approach to examine the composition of household portfolios. Unpublished doctoral dissertation. Cornell University, Ithaca, NY.

Sharpe, W. F. (1985). Investments. (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Shefrin, H. M., & Thaler, R. H. (1988). The behavioral life-cycle hypothesis. Economic Inquiry. 26: 609-643.

Simon, A. E. (1985). Selecting an IRA: An application of a characteristics and new commodities approach to explain consumer behavior. Unpublished doctoral dissertation. Ohio State University, Columbus, OH.

Tai, P. (1984, January). Dividing it up. Money.

Talor, L. D. (1974). Price expectations and households' demand for financial assets. Explorations in Economic Research. 1(2): 236-241.

Thaler, R. H. (1990). Anomalies: Saving, fungibility, and mental accounts. Journal of Economic Perspectives. 4(1): 193-205.

------, & Shefrin, H. M. (1981). An economic theory of self-control. Journal of Political Economy. 89: 392-405.

Tobin, J. (1958a). Liquidity preference as behavior toward risk. Review of Economic Studies. 25: 65-86.

------. (1958b). Estimation of relationships for limited dependent variables. Econometrica. 26:24-36.

------. (1966). The theory of portfolio selection. in F. H. Hahn and F. P. R. Breching (eds.). The theory of interest rates. pp3-51. New York, NY: MacMillan.

------. (1967). Life cycle saving and balanced growth. In W. Fellner (ed.). Ten economic studies in the tradition of Irving Fisher. New York, NY: John Wiley.

------. (no date). Properties of assets. Unpublished manuscript.

Watts H., & Tobin, J. (1960). Consumer expenditures and the capital account. in I. Friend and R. Jones (eds.) Proceedings of the conference on consumption and saving, vol II. Philadelphia, PA: Wharton School of Finance and Commerce, University of Pennsylvania.

Wachtel, P. (1972, May). A model of interrelated demand for assets by households. Annals of Economic and Social Measurement. pp129-140.

Winger, B. J., & Frasca, R. R. (1986). Personal finance: An integrated planning approach. Columbus: Charles E. Merrill.

Winter, M. (1986). Management as a mental process: Implications for theory and research. Paper prepared for NCR-116.

Wolff, E. N. (1981). Accumulation of household wealth over the life cycle: A microdata analysis. Review of Income and Wealth. 27(1):75-96.

Zick, C. D. (1982). Human capital investments in a family portfolio context. Unpublished doctoral dissertation, Cornell University, Ithaca, NY.

------, & Gerner, J. L. (1987). Family composition and investment in household capital: Contrasts in the behavior of the husband-wife and female-headed households. The Journal of Consumer Affairs. 21(1): 21-39.

APPENDICES

Appendix A

Asset Glossary

ASSET GLOSSARY

All-saver Certificate: has a one year maturity and an annual yield of seventy percent of the prevailing rate on one year Treasury Bills.

Call money account: cash accounts at brokerage firms used for the purchase and/or sale of securities.

Certificates of Deposit (CD): a federally insured deposit that offers higher interest rates than passbook accounts but requires that the money remain on deposit for a specified period of time.

Corporate bond: issued by a corporation; categories include industrials, public utilities, railroad and transportation bounds, and financial issuers.

Individual Retirement Account (IRA): open to any working American, to which a person may contribute a specified amount each year (up to $2,000 in the case of an individual taxpayer); while annual contributions to IRAs may or may not be tax deductible, the earnings for all IRAs do accrue on a tax deferred basis.

Keogh Accounts: to which self-employed persons may make payments, up to the lesser 0f $30,000 or 20 percent of earned income per year, that may be taken as deductions from taxable income; the earnings on such accounts also accrue on a tax deferred basis.

Land contract: an arrangement that seller retains original mortgage. No transfer of title until loan is fully paid. Equal monthly payments based on below-market interest rate with unpaid principal due at loan end.

Money market deposit account (MMDA): a saving account that is meant to be competitive with a MMMF, offered by banks and thrift institutions.

Money market mutual fund (MMMF): a mutual fund that pools the deposits of investors for investment in short-term, high-denomination securities offered by the U. S. Treasury, major corporations, and commercial banks.

Municipal bond: issued by state and local government for the purpose of financing certain projects; interest income earned is exempt from federal taxes.

Mutual fund: a corporation that invests its funds in securities issued by other corporations or governments.

Negotiable order of withdrawal (NOW) account: an interest-bearing checking account against which checks can be written; pays the passbook rate of interest.

Note (Promissory note): a written agreement between a cash lender and borrower stating the terms of the loan, including its date of repayment and interest rate and the rights of the lender in case of default.

Passbook account: a savings account in which transactions are recorded in a passbook, and that pays the going passbook rate of interest.

Profit-sharing plans: in which the employees of a firm participate in the company's earnings.

Publicly traded stock: the shares that are readily available to the general public and that are bought and sold in the open market.

Regular checking account: pays no interest and any service charges that exist can be waived if you maintain a minimum balance (usually about $500).

Share draft account: an account offered by credit unions that is similar to the NOW accounts offered by other financial institutions.

Super NOW account: a NOW account that has no interest rate restrictions but which offers limited check-writing privileges.

Thrift and savings plans: established by an employer to supplement pension and other insurance fringe benefits, in which the firm makes contributions in an amount equal to a set proportion of the employee's contribution.

Trust: an arrangement whereby the right to property is held by one party, the trustee, for the benefit of another, the beneficiary.

U. S. savings bond (Series EE bond): issued in various denominations by the U. S. Treasury.

U. S. Treasury bill (T-bill): a short-term debt instrument issued by the federal government in the ongoing process of funding the national debt.

Source: Boone and Kurtz, 1989; Gitman and Joehnk, 1987; Schiano, 1988; Winger and Frasca, 1986

Appendix B

Results of Tobit Models

Table 21 through Table 24 consist of estimated parameters of equation (11).

Table 21

Estimates of Tobit Coefficients (Low-income families, N=786)

(1) Dependent Variable=ACCT186

Noncensored Values= 663
Left Censored Values= 123
Log Likelihood for NORMAL -7669.829337

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-11190.78	7357.662	2.313348	0.1283
ACCT183	1	1.05999438	0.061954	292.7316	0.0001
ACCT283	1	0.17810782	0.102099	3.043156	0.0811
ACCT383	1	-0.0015973	0.096454	0.000274	0.9868
AGE<35	1	-3431.4967	3651.572	0.883095	0.3474
AGE35-54	1	-4634.3786	3173.032	2.133213	0.1441
AGE55-64	1	-4289.7162	2713.263	2.499616	0.1139
NOWORK	1	-4802.1398	4409.094	1.186235	0.2761
ONEWORK	1	-1238.7166	3357.989	0.136077	0.7122
RETIRE	1	884.682352	2990.216	0.087533	0.7673
TYPE1	1	3745.29943	4441.1	0.7112	0.3990
TYPE2	1	-1138.1271	3535.214	0.103645	0.7475
TYPE3	1	5165.06058	3701.767	1.946851	0.1629
HHSIZE	1	-754.54225	1130.402	0.445555	0.5045
EDYR	1	631.379514	336.3672	3.523333	0.0605
INCOME	1	0.39878081	0.23988	2.763638	0.0964
HOUSMTG	1	0.04672872	0.093377	0.25043	0.6168
HOMEVAL	1	0.07817001	0.029125	7.203681	0.0073
OTHEASST	1	-0.0519209	0.022974	5.107531	0.0238
OTHEDEBT	1	0.04179347	0.028519	2.147617	0.1428
SCALE	1	23083.7811	633.6124		

Table 21 Con't

(2) Dependent Variable=ACCT286

Noncensored Values= 127
Left Censored Values= 659
Log Likelihood for NORMAL -1633.850146

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-85631.019	15183.65	31.80606	0.0001
ACCT183	1	0.01117101	0.096964	0.013273	0.9083
ACCT283	1	0.79085767	0.133643	35.01879	0.0001
ACCT383	1	0.52375737	0.122378	18.31702	0.0001
AGE<35	1	2036.05613	6402.018	0.101145	0.7505
AGE35-54	1	63.4972806	5688.954	0.000125	0.9911
AGE55-64	1	7415.03864	4882.127	2.306794	0.1288
NOWORK	1	-15124.015	8333.985	3.293281	0.0696
ONEWORK	1	-7226.2467	5726.926	1.592144	0.2070
RETIRE	1	-2894.0208	6096.607	0.225334	0.6350
TYPE1	1	21353.8324	8107.387	6.93729	0.0084
TYPE2	1	10799.7071	6659.65	2.629791	0.1049
TYPE3	1	19909.4104	6782.955	8.615469	0.0033
HHSIZE	1	2192.44683	1901.181	1.329877	0.2488
EDYR	1	1956.71195	684.9999	8.159674	0.0043
INCOME	1	1.81793746	0.459638	15.64322	0.0001
HOUSMTG	1	-0.0834162	0.153286	0.29614	0.5863
HOMEVAL	1	0.07932894	0.048495	2.675857	0.1019
OTHEASST	1	-0.0008274	0.036778	0.000506	0.9821
OTHEDEBT	1	-0.0052649	0.048894	0.011595	0.9143
SCALE	1	27099.5383	1836.617		

Table 21 Con't

(3) Dependent Variable=ACCT386

Noncensored Values= 104
Left Censored Values= 682
Log Likelihood for NORMAL -1353.397888

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-72308.029	19345.78	13.97013	0.0002
ACCT183	1	0.32867745	0.099419	10.92949	0.0009
ACCT283	1	-0.0180914	0.165221	0.01199	0.9128
ACCT383	1	0.32789219	0.13706	5.723207	0.0167
AGE<35	1	-11525.37	8017.523	2.066471	0.1506
AGE35-54	1	-8095.6149	6940.593	1.360525	0.2434
AGE55-64	1	-1862.4029	5766.644	0.104304	0.7467
NOWORK	1	2083.94686	10307.35	0.040877	0.8398
ONEWORK	1	6870.2166	7586.447	0.820095	0.3652
RETIRE	1	-5090.6009	6895.103	0.545075	0.4603
TYPE1	1	-15946.099	10738.74	2.20497	0.1376
TYPE2	1	-4183.1735	7920.438	0.278942	0.5974
TYPE3	1	-13611.061	8416.678	2.615186	0.1058
HHSIZE	1	-5033.2819	3242.757	2.409204	0.1206
EDYR	1	2635.37694	808.0332	10.63719	0.0011
INCOME	1	2.13063836	0.550581	14.97536	0.0001
HOUSMTG	1	-0.0626313	0.175449	0.127432	0.7211
HOMEVAL	1	0.17321666	0.04929	12.34963	0.0004
OTHEASST	1	-0.0257984	0.043201	0.356611	0.5504
OTHEDEBT	1	-0.0229096	0.303001	0.005717	0.9397
SCALE	1	29168.5986	2181.654		

Table 22

Estimates of Tobit Coefficients (Middle-income families, N=966)

(1) Dependent Variable=ACCT186

Noncensored Values= 950
Left Censored Values= 16
Log Likelihood for NORMAL -10701.22457

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	10207.7921	6226.144	2.687975	0.1011
ACCT183	1	0.55918045	0.021817	656.9167	0.0001
ACCT283	1	-0.0141737	0.016204	0.765145	0.3817
ACCT383	1	0.097829	0.019086	26.27235	0.0001
AGE<35	1	-14025.403	3085.358	20.66425	0.0001
AGE35-54	1	-12959.614	2882.474	20.21405	0.0001
AGE55-64	1	-8446.1158	2758.626	9.374078	0.0022
NOWORK	1	13164.5312	3537.726	13.84722	0.0002
ONEWORK	1	2160.32523	1457.201	2.197856	0.1382
RETIRE	1	-359.73299	3375.798	0.011356	0.9151
TYPE1	1	-815.18601	2894.483	0.079318	0.7782
TYPE2	1	-3258.8599	3052.654	1.139662	0.2857
TYPE3	1	282.112705	2152.658	0.017175	0.8957
HHSIZE	1	-977.86741	733.4128	1.777718	0.1824
EDYR	1	210.337224	263.508	0.637154	0.4247
INCOME	1	0.22592545	0.08943	6.382142	0.0115
HOUSMTG	1	-0.0058074	0.034692	0.028023	0.8671
HOMEVAL	1	-0.0092684	0.010877	0.72614	0.3941
OTHEASST	1	-0.029791	0.004361	46.67035	0.0001
OTHEDEBT	1	0.06022076	0.029189	4.256542	0.0391
SCALE	1	18630.2002	427.7776		

Table 22 Con't

(2) Dependent Variable=ACCT286

Noncensored Values= 493
Left Censored Values= 473
Log Likelihood for NORMAL -6253.178881

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-46281.754	17385.02	7.087108	0.0078
ACCT183	1	0.09517498	0.055081	2.985651	0.0840
ACCT283	1	0.37367807	0.014863	632.0619	0.0001
ACCT383	1	0.13397908	0.049795	7.239499	0.0071
AGE<35	1	-1832.5889	8499.721	0.046486	0.8293
AGE35-54	1	994.212553	7873.884	0.015943	0.8995
AGE55-64	1	15563.3741	7458.578	4.35407	0.0369
NOWORK	1	4625.20417	9721.887	0.22634	0.6343
ONEWORK	1	-683.67312	4021.327	0.028904	0.8650
RETIRE	1	12835.7484	9317.703	1.897687	0.1683
TYPE1	1	-15459.739	8282.537	3.483995	0.0620
TYPE2	1	-24315.443	8998.217	7.302161	0.0069
TYPE3	1	-22168.536	6001.568	13.64409	0.0002
HHSIZE	1	-7584.4101	2183.324	12.06722	0.0005
EDYR	1	1362.07448	744.6334	3.345928	0.0674
INCOME	1	0.97272866	0.244547	15.82188	0.0001
HOUSMTG	1	-0.1129741	0.095465	1.400457	0.2366
HOMEVAL	1	0.01656521	0.027943	0.351449	0.5533
OTHEASST	1	0.11610169	0.010825	115.0271	0.0001
OTHEDEBT	1	-0.2687512	0.082375	10.64405	0.0011
SCALE	1	45061.1614	1409.074		

Table 22 Con't

(3) Dependent Variable=ACCT386

Noncensored Values= 388
Left Censored Values= 578
Log Likelihood for NORMAL -5095.062907

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-126086.7	25363.85	24.71203	0.0001
ACCT183	1	0.43981891	0.075642	33.8079	0.0001
ACCT283	1	0.51012922	0.021814	546.8673	0.0001
ACCT383	1	0.30599782	0.064806	22.29486	0.0001
AGE<35	1	28951.8872	12459.46	5.399526	0.0201
AGE35-54	1	18325.8361	11602.92	2.494552	0.1142
AGE55-64	1	9511.86073	10859.51	0.767204	0.3811
NOWORK	1	19066.1468	13616.61	1.960594	0.1614
ONEWORK	1	8815.14511	5838.8	2.279354	0.1311
RETIRE	1	-16173.863	13243.38	1.491522	0.2220
TYPE1	1	-21884.559	11957.3	3.349727	0.0672
TYPE2	1	-16724.943	12578.74	1.76789	0.1836
TYPE3	1	-583.31455	8724.783	0.00447	0.9467
HHSIZE	1	-3243.3438	3134.812	1.070442	0.3008
EDYR	1	3386.62725	1080.774	9.81895	0.0017
INCOME	1	1.48196305	0.354044	17.52101	0.0001
HOUSMTG	1	-0.304981	0.139398	4.786625	0.0287
HOMEVAL	1	0.09826428	0.040491	5.889491	0.0152
OTHEASST	1	0.01866049	0.015497	1.449984	0.2285
OTHEDEBT	1	-0.1777951	0.119227	2.223774	0.1359
SCALE	1	61250.5369	2151.401		

Table 23

Estimates of Tobit Coefficients (High-income families, N=667)

(1) Dependent Variable=ACCT186

Noncensored Values= 667
Left Censored Values= 0
Log Likelihood for NORMAL -9916.740702

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-73162.505	319104.8	0.052567	0.8187
ACCT183	1	0.91363349	0.117094	60.88048	0.0001
ACCT283	1	0.08468189	0.017591	23.1741	0.0001
ACCT383	1	-0.0333496	0.010978	9.229336	0.0024
AGE<35	1	-74022.07	137435.6	0.290084	0.5902
AGE35-54	1	-88333.716	91876.34	0.92437	0.3363
AGE55-64	1	-95775.479	83530.42	1.314678	0.2515
NOWORK	1	92088.7777	167239.2	0.303206	0.5819
ONEWORK	1	126987.502	63001.11	4.062801	0.0438
RETIRE	1	-16100.69	150343.7	0.011469	0.9147
TYPE1	1	-69000.361	150183.5	0.211086	0.6459
TYPE2	1	-126202.77	197569.2	0.408037	0.5230
TYPE3	1	76955.7943	92679.05	0.689477	0.4063
HHSIZE	1	11897.1961	34534.04	0.118685	0.7305
EDYR	1	857.971255	14590.38	0.003458	0.9531
INCOME	1	0.37226533	0.082048	20.5861	0.0001
HOUSMTG	1	1.66117867	0.347975	22.7896	0.0001
HOMEVAL	1	-0.2396145	0.119894	3.99422	0.0457
OTHEASST	1	0.00922196	0.005715	2.603394	0.1066
OTHEDEBT	1	-0.1339749	0.078923	2.881631	0.0896
SCALE	1	692967.084	18972.92		

Table 23 Con't

(2) Dependent Variable=ACCT286

Noncensored Values= 570
Left Censored Values= 97
Log Likelihood for NORMAL -8926.571592

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	324628.501	650352.8	0.249158	0.6177
ACCT183	1	-1.7564844	0.233481	56.59573	0.0001
ACCT283	1	0.93968236	0.034595	737.8003	0.0001
ACCT383	1	0.14510801	0.021766	44.44608	0.0001
AGE<35	1	-45896.94	285555.2	0.025834	0.8723
AGE35-54	1	198408.229	186239.4	1.134949	0.2867
AGE55-64	1	125914.744	169332.2	0.552935	0.4571
NOWORK	1	-334484.19	340217.5	0.96658	0.3255
ONEWORK	1	-106193.18	126334.1	0.706565	0.4006
RETIRE	1	-460847.36	306967.6	2.253872	0.1333
TYPE1	1	252534.041	312850.4	0.651578	0.4195
TYPE2	1	-636648.55	398620.1	2.550828	0.1102
TYPE3	1	-134316.68	190562.7	0.496803	0.4809
HHSIZE	1	-59957.988	73215.6	0.670636	0.4128
EDYR	1	4713.03336	29593.51	0.025363	0.8735
INCOME	1	1.70436718	0.161966	110.7336	0.0001
HOUSMTG	1	-2.2604925	0.69121	10.69513	0.0011
HOMEVAL	1	0.02071912	0.23891	0.007521	0.9309
OTHEASST	1	0.01661434	0.011269	2.17361	0.1404
OTHEDEBT	1	-0.2998269	0.155412	3.721944	0.0537
SCALE	1	1359497.69	40530.01		

Table 23 Con't

(3) Dependent Variable=ACCT386

Noncensored Values= 547
Left Censored Values= 120
Log Likelihood for NORMAL -8718.415519

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-983588.85	867665.2	1.285058	0.2570
ACCT186	1	-2.0619345	0.325933	40.02137	0.0001
ACCT286	1	-0.0387097	0.044874	0.744135	0.3883
ACCT386	1	0.73613462	0.028609	662.0831	0.0001
AGE<35	1	-513977.22	375548.6	1.873076	0.1711
AGE35-54	1	-373735.61	241777.5	2.389446	0.1222
AGE55-64	1	-132366.09	218235.3	0.367878	0.5442
NOWORK	1	370915.879	449890.8	0.67973	0.4097
ONEWORK	1	307957.202	166296.4	3.429374	0.0640
RETIRE	1	346605.113	407003.4	0.725227	0.3944
TYPE1	1	-107830.08	407629.9	0.069976	0.7914
TYPE2	1	123521.152	520310.2	0.056358	0.8123
TYPE3	1	-54810.242	251680.2	0.047427	0.8276
HHSIZE	1	-10211.369	95300.37	0.011481	0.9147
EDYR	1	30701.6451	39457.19	0.60544	0.4365
INCOME	1	0.78084523	0.213123	13.42366	0.0002
HOUSMTG	1	-4.785404	0.903402	28.05917	0.0001
HOMEVAL	1	2.27146399	0.311294	53.24386	0.0001
OTHEASST	1	-0.0270236	0.015698	2.963496	0.0852
OTHEDEBT	1	0.34094736	0.204124	2.789893	0.0949
SCALE	1	1764945.05	53489.05		

Table 24

Estimates of Tobit Coefficients (Total sample, N=2419)

(1) Dependent Variable=ACCT186

Noncensored Values= 2280
Left Censored Values= 139
Log Likelihood for NORMAL -32598.25609

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-58059.411	67223.92	0.745929	0.3878
ACCT183	1	0.91339968	0.062254	215.2741	0.0001
ACCT283	1	0.08422423	0.009502	78.57159	0.0001
ACCT383	1	-0.0335297	0.005913	32.15831	0.0001
AGE<35	1	-58345.16	32663.08	3.190769	0.0741
AGE35-54	1	-60187.566	28708.76	4.395262	0.0360
AGE55-64	1	-58524.528	26698.53	4.805085	0.0284
NOWORK	1	3357.44007	39300.18	0.007298	0.9319
ONEWORK	1	55056.3224	19941.5	7.622527	0.0058
RETIRE	1	-9196.2405	34939.01	0.069279	0.7924
TYPE1	1	-51327.291	37726.75	1.850963	0.1737
TYPE2	1	-65885.818	35423.24	3.459452	0.0629
TYPE3	1	2732.49784	28439.72	0.009231	0.9235
HHSIZE	1	-10563.146	9819.407	1.15722	0.2820
EDYR	1	7656.12407	2825.031	7.344657	0.0067
INCOME	1	0.36159228	0.043556	68.92109	0.0001
HOUSMTG	1	1.44418756	0.174872	68.20354	0.0001
HOMEVAL	1	-0.1995475	0.059168	11.37432	0.0007
OTHEASST	1	0.00830026	0.003078	7.269939	0.0070
OTHEDEBT	1	-0.100123	0.033444	8.962393	0.0028
SCALE	1	377591.007	5590.281		

Table 24 Con't

(2) Dependent Variable=ACCT286

Noncensored Values= 1190
Left Censored Values=1229
Log Likelihood for NORMAL -18580.66781

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-1172270.4	208185.8	31.70687	0.0001
ACCT183	1	-1.9995459	0.137539	211.3541	0.0001
ACCT283	1	0.9157295	0.023223	1554.914	0.0001
ACCT383	1	0.202863	0.00936	469.7444	0.0001
AGE<35	1	-1575.1891	95828.06	0.00027	0.9869
AGE35-54	1	105909.637	82864.85	1.633542	0.2012
AGE55-64	1	167346.164	77336.44	4.682343	0.0305
NOWORK	1	-403580.79	121411.8	11.04942	0.0009
ONEWORK	1	-81859.122	55196.04	2.199471	0.1381
RETIRE	1	-106488.89	110251.1	0.932917	0.3341
TYPE1	1	-158006.53	111599	2.004607	0.1568
TYPE2	1	-405916.89	112244	13.0782	0.0003
TYPE3	1	-65300.6	80900.36	0.651528	0.4196
HHSIZE	1	-45169.556	29347.94	2.368844	0.1238
EDYR	1	72179.4152	8824.334	66.90566	0.0001
INCOME	1	1.75198502	0.108439	261.0289	0.0001
HOUSMTG	1	-2.6525885	0.43435	37.29588	0.0001
HOMEVAL	1	0.39640489	0.143401	7.641414	0.0057
OTHEASST	1	0.01094157	0.007628	2.057722	0.1514
OTHEDEBT	1	-0.4203508	0.103776	16.40717	0.0001
SCALE	1	927438.035	18281.68		

Table 24 Con't

(3) Dependent Variable=ACCT386

Noncensored Values= 1039
Left Censored Values=1380
Log Likelihood for NORMAL -16600.11883

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi
INTERCPT	1	-2438957.4	306187.4	63.45033	0.0001
ACCT183	1	-1.8458953	0.234975	61.71197	0.0001
ACCT283	1	-0.0427421	0.032642	1.714632	0.1904
ACCT383	1	0.72687604	0.020757	1226.259	0.0001
AGE<35	1	-261476.08	138451	3.566742	0.0589
AGE35-54	1	-218231.27	119198.7	3.3519	0.0671
AGE55-64	1	-59662.51	110032	0.294012	0.5877
NOWORK	1	-163726.4	172101.7	0.905039	0.3414
ONEWORK	1	117612.742	80187.17	2.15129	0.1425
RETIRE	1	-4260.9586	156842	0.000738	0.9783
TYPE1	1	-500358.26	164357.8	9.267899	0.0023
TYPE2	1	-389614.21	159115.6	5.995755	0.0143
TYPE3	1	-82028.13	118299.1	0.480798	0.4881
HHSIZE	1	-42067.984	43049.7	0.954912	0.3285
EDYR	1	142652.105	13311.01	114.8508	0.0001
INCOME	1	0.90479562	0.153094	34.92895	0.0001
HOUSMTG	1	-4.8160112	0.624207	59.52758	0.0001
HOMEVAL	1	2.53199296	0.211557	143.2424	0.0001
OTHEASST	1	-0.0257654	0.011178	5.313053	0.0212
OTHEDEBT	1	0.20058415	0.121895	2.707817	0.0999
SCALE	1	1293108.96	28451.42		

Appendix C

Calculations of Marginal Effects and Elasticity Decompositions

Calculations of Marginal Effects and Elasticity Decompositions

This appendix details calculations of marginal effects of the stock adjustment model, and elasticities associated with mental accounts and related decompositions, which are adapted from McDonald and Moffitt (1980), and Kinsey (1984).

(1) Marginal effects of independent variables.

A tobit model is written as:

$$(C.1) \qquad y_t = X_t\beta' + u_t \quad \text{if } y_t > 0$$
$$= 0 \quad \text{if } y_t \leq 0$$
$$t = 1, 2, \ldots N$$

where N is the number of observations, y_t is the dependent variable, X_t is a vector of independent variables, β' is a vector of unknown coefficients, and u_t is an independently distributed error term assumed to be normal with zero mean and constant variance σ^2.

As Tobin shows, the expected value of y in the model is

$$(C.2) \qquad Ey = X\beta' F(z) + \sigma f(z),$$

where $z = X\beta'/\sigma$, $f(z) = \exp(-z^2/2)/(2\pi)^{1/2}$ which is the unit normal density, and F(z) is the cumulative normal distribution function. Because $F'(z) = f(z)$, $f'(z) = -zf(z)$, and $z = X\beta'/\sigma$, the following relationship can be deducted,

$$(C.3) \qquad \partial Ey/\partial Xi = \beta' F(z) + X\beta' f(z)\beta'/\sigma - \sigma z f(z)\beta'/\sigma$$
$$= \beta' F(z).$$

(2) Elasticity Decompositions.

The expected value of y for observations above the limit, Ey*, can be expressed as:

(C.4) $$Ey^*=X\beta'+\sigma f(z)/F(z).$$

From (C.2) and (C.4), a relationship can be deducted:

(C.5) $$Ey=F(z)Ey^*.$$

Considering the effect of a change in the i^{th} variable of X on y:

(C.6) $$\partial Ey/\partial X_i=F(z)(\partial Ey^*/\partial X_i)+Ey^*(\partial F(z)/\partial X_i).$$

Multiplying X_i/Ey to the both sides of equation (C.6), and considering (C.5), the decompositions of elasticities are gained:

(C.7) $$(\partial Ey/Ey)/(\partial X_i/X_i)=(\partial Ey^*/Ey^*)/(\partial X_i/X_i) + (\partial F(z)/F(z))/(\partial X_i/X_i).$$

For example, if the dependent variable is ACCT1, and the independent variable is income, the left-hand side of (C.7) measures the total income elasticity for ACCT1. The first term on the right-hand side will give the income elasticity for ACCT1 among those who are observed currently having dollar values in ACCT1, which is named here as conditional elasticity. The second term on the right-hand side will give the elasticity of probability of possessing ACCT1 with changes in income, which is often refereed to as the entry/exit elasticity. (C.7) can be rearranged as:

(C.8) $$(\partial Ey/Ey)/(\partial X_i/X_i)=(\partial Ey^*/\partial X_i)Ey^*/X_i + (\partial F(z)/\partial X_i)F(z)/X_i.$$

McDonald and Moffitt show that:

(C.9) $\partial Ey^*/\partial X_i=\beta'_i[1-zf(z)/F(z)-f(z)^2/F(z)^2]$,

(C.10) $\partial F(z)/\partial X_i=f(z)\beta'_i/\sigma$.

After β' and σ are estimated, these elasticities can be calculated. Usually, $F(z)$ can be approximately substituted by the fraction of sample above the limit and X_i's are means of independent variables. Given β', σ, $F(z)$, and X, z and $f(z)$ can be calculated.