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Abstract

With increasing income uncertainty during the Great Recession, many households might have had difficulty in projecting future income changes. Ideally, a household should consider lifetime wealth and the distinction between transitory and permanent income changes in making saving decisions, but during the Great Recession it was probably very difficult for households to identify which income changes were transitory. Gain-loss utility based on prospect theory assumes that household inter-temporal decisions are determined not only by current or permanent income but also by their own expectations or assessment about income and income uncertainty in the first period.

In this study, how households’ perception of their past and future income compared to reference points in the first period and how households’ perception of their income uncertainty change affect saving decisions in the second period and between the periods were examined with estimates of future income change. Saving decisions were tested based on relative gain and loss utility using loss aversion theory of consumption and a two period model. Possible asymmetric saving responses between positive and negative changes in reference dependent income and uncertainty were also analyzed.

The 2007 and 2009 Survey of Consumer Finances (SCF) panel dataset was used. Both total and subsamples were analyzed based on the expected income change measure
to identify possible asymmetry of saving in response to a set of reference dependent income and uncertainty variables, such as deviation from normal income, expected income change, and income uncertainty change, as well as the effect on saving measured in two ways, savings between 2007 and 2009 and whether or not saved in 2009.

This study found a set of reference dependent income and uncertainty variables had significant effects on saving decisions of households and asymmetric saving responses between negative and positive changes in those variables. Households with a negative deviation from normal income or expected income change had smaller savings between 2007 and 2009 and less likelihood of saving in 2009 than households with a positive deviation from normal income or expected income change. For income uncertainty, those differences were identified in stayed negative income uncertainty and stayed positive income uncertainty compared to decreased income uncertainty as well as between stayed positive and stayed negative income uncertainty.

The results provide weak empirical evidence consistent with loss aversion theory. The findings were not explained by classical theories such as the life cycle hypothesis (LCH) and the permanent income hypothesis (PIH), which do not include asymmetric saving responses or the influence of reference dependent income and uncertainty variables on saving decision.

This study contributes to an extension of the discussion of saving by diversifying measures and estimating asymmetric saving responses to assessments of past income and income uncertainty change as well as expectations about future income change. The findings provide insights for financial planners, educators, and policy makers to improve saving decisions.
Dedicated to

My Loving Family
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Chapter 1. Introduction

1.1. Backgrounds

What affects saving decisions of households? Saving is an inter-temporal decision of households based on given current and expected future income. In a two period microeconomic model, they rationally make their consumption and saving decisions in each period by anticipating their next period’s future resources and current market condition, such as interest rate and consumption prices (Fisher, 1930). Each household is under different conditions often captured empirically by socio-demographic characteristics and the decisions reflect different views on their future income change and preference over the time periods (Bryant & Zlick, 2006). Socio-demographic characteristics of households have been found to be related to saving (Attansio & Banks, 2001; Browning & Lusardi, 1996; Cordes, 1990; Lunt & Livingstone, 1991).

Although determinants of saving have been identified with different theories (Attansio & Banks, 2001; Lunt & Livingstone, 1991), the mainstream saving theories are based on the life cycle of households focusing on income (Wärneryd, 1989). These classic economic models of household saving, such as the life cycle hypothesis and permanent income hypothesis, view income as the proxy to determine consumption and saving decisions of households. The theories assume utility is a function of the value of
lifetime income and households save to smooth consumption and dissave when income decreases (Ando & Modigliani, 1963; Friedman, 1957). In the extended life cycle model, increased uncertainty and decreases in expected future income declines should increase levels of saving (Feigenbaum & Li, 2011; Lusardi, 1996; Zeldes, 1989).

However, it is unclear whether households have a clear distinction between transitory and permanent income change. Each household has different degrees of income uncertainty and different expectations about future income. If the household is not sure about future income or facing increased income uncertainty, it the life cycle model may not be reasonable in terms of households distinguishing between transitory income changes and permanent income changes (Chang, 1993; Fisher, 2006).

Psychological evidence reviewed in many empirical and theoretical studies indicates both expectations about future income change and income uncertainty affect inter-temporal saving decisions assuming information about current income compared to past income reflects the possibility of actual income change and personal confidence about uncertain future income (Alessie & Lusardi, 1997; Campbell & Mankiw, 1991; Curtin, 2008; Flavin, 1981; Lindiquist, 1981; Shea, 1995a, 1995b). This is about a relative change of income and consumption. How much current income deviates from previous income or how far their current consumption is from past consumption creates expectations about future income change and influences saving and consumption in the current period (Plous, 1993).

Prospect theory proposed by Kahneman and Tversky (1979) focuses on the relative gains and losses that lead to utility of a choice. According to this theory, a consumer’s well-being depends not only on the amount of current consumption, but also
on how current consumption deviates from past consumption. This relative value function suggests asymmetry in the evaluation of increases and decreases in consumption evaluation is reference dependent and people care much more about losses relative to their reference point than about gains. Moreover, people are risk averse in gains, and risk taking in losses. Other empirical studies have found relative value compared to the previous period’s income or consumption as a reference point to be significant and have noted the asymmetry of response to expected income changes (Bowman, Minehart, & Rabin, 1999; Shea, 1995a, 1995b). Empirical findings and theoretical assumptions based on this theory are inconsistent with the classical model of consumption and saving and suggest saving is determined not only by income but also by psychological factors regarding accumulated goods (Cordes, 1990; Wärneryd, 1989). Perception of relative income change compared to reference points affects consumption and saving decisions and the consequent outcomes.

In particular, Bowman et al. (1999) noted loss aversion and asymmetry of consumption response to expectations about the change in future income. People resist reducing current consumption in response to negative expectations about uncertain future income change and the relative influence of expected income changes on saving and consumption are different between the positive and negative; responses to negative expected future income changes are greater than responses to positive expected future income changes. They also suggested saving in response to uncertain income expectations can be positive or negative depending on the degree of uncertainty.

Between 2007 and 2009, households had been through the Great Recession and experienced increased economic insecurity (Butterfield, 2009). Hacker, Rehm, and
Schlesinger (2013) found that the proportion of households worried about their family’s economic security doubled during the period, from 12.0% to 24.0%. Even for those with jobs over the period the proportion who answered “fairly worried” also more than doubled, from 12.2% to 28.7%. It is clear that the recent recession increased the level of income uncertainty for households, thereby potentially affecting saving and consumption decisions between periods.

The relative effect on saving decisions over the recession period between negative and positive change in income would be still in question. Although loss aversion theory opens the possibility of either decreases in saving or increases in saving depending on the uncertainty level change as Bowman et al described, probing the role of expectations is beyond dealing with mere pessimism or skepticism, and optimism or trust. Using related determinants of expectations about future income change and identifying the influence of each variable can influence expectations about the future income change (Acemoglu & Scott, 1994; Fan & Wong, 1998). This study is able to examine the relative increase and decrease in income using past income evaluations and future income expectations which provide direction and size of influences under increased uncertainty on saving.

1.2. Research Objectives

This study mainly explores the relative increases and decreases in income using past income evaluations and future income expectations had predictive power for future saving decisions under increased income uncertainty during the Great Recession between 2007 and 2009. This study has following research purposes: First, this study will assess how the deviation from normal income, the expected income growth, and subjective
income uncertainty change affected saving decisions and ascertain whether the measures result in qualitative differences. Second, this study will measure expected income change in two ways. Third, this study will assess the relative influence on saving between positive and negative deviation from normal income, between positive and negative expected income growth, and between positive and negative income uncertainty change, respectively. Fourth, this study will ascertain qualitative difference in results using saving measured as a decision made after the Great Recession and as a change during the Great Recession.
Chapter 2. Literature Review

The central question in this study is how, based on loss aversion theory, lagged change in income and expected income change influence saving decisions of households during economic fluctuations. Classic economic models of household savings decisions, such as the lifecycle hypothesis, and permanent income hypothesis (LCH/PIH), assume utility is a function of the value of lifetime income without income uncertainty. Households save to smooth consumption and save less when income decrease (Ando & Modigliani, 1963; Friedman, 1957). According to LCH/PIH, consumption does not respond to changes in current income, lagged change in income, or expected income growth (Feigenbaum & Li, 2011; Lusardi, 1996; Zeldes, 1989). In the extended life cycle hypothesis where income uncertainty, expected income and relative change were also included, increased income uncertainty and negative income expectations should increase saving (Yuh & Hanna, 2010). Differences between responses to positive and negative changes in expectations or evaluations were not included. However, many empirical studies have verified the predictive power of expectations about future income change and relative change in lagged income on both saving and consumption decisions in the next period and asymmetric responses between negative and positive changes in expectations and evaluations of income and uncertainty (Alessie & Lusardi, 1997; Campbell & Deaton, 1989; Campbell & Mankiw, 1991; Flavin, 1981; Hall & Mishkin, 1982; Shea, 1995a, 1995b).
2.1. Great Recession and Household Wealth

The Great Recession, which lasted officially from December 2007 until June 2009 (Business Cycle Dating Committee, National Bureau of Economic Research, 2010), has been evaluated as the most severe financial crisis in the global economy since the Second World War (Keeley & Love, 2010; Jenkins, Brandolini, Micklewright, & Nolan, 2013). Unlike the previous recession, the effects of this recession were felt concurrently in the stock, housing, and labor markets. For example, the unemployment rate rose, but the stock market increased and the housing market was constant in the recession of 1981-1982 (Hurd & Rohwedder, 2010). In this sense, the effects of the recession may not be predictable in a straightforward manner (Jenkins et al., 2013).

Statistics and indices showed the simultaneous effect of the recession on the financial, housing, and labor markets. The stock market downturn began in October 2007, with the S&P 500 stock index falling more than 50% by March 2009 (S&P 500, 2014). The drop in housing prices also reflected the effects of the recession. The Case-Shiller national home price index (S&P Case-Shiller national home price index, 2014) fell rapidly from September, 2007 (180.01) and hit its bottom in March of 2009 (129.17). The labor market was also affected. In November, 2007, the unemployment rate was 4.7%, but the rate continued to increase when the economy entered the recession, and even after the official end of the recession, reaching 10% in October 2009 (Bureau of Labor Statistics, 2014).

The recession also affected changes in household wealth, as a result of shifts in the composition of assets and debts in household portfolios during the period. There were declines in wealth in each percentile of the overall wealth distribution and substantial
absolute increases in the level of negative wealth in the tail of the distribution. According to the Survey of Consumer Finances, the median value of households’ holdings of both financial and nonfinancial assets decreased by 5% and 14%, respectively, over the period between 2007-2009, and the median amounts of most of the asset categories also fell; further, the median value of total debt increased from $70,300 to $75,600 (Bricker, Bucks, Kennickell, Mach, & Moore, 2011; Hurd & Rohwedder, 2010).

Decisions with respect to the types of assets to hold led to different aspects of asset shifts between the two periods. According to Bricker et al. (2011), among the financial assets, investment in risky assets, such as stocks and mutual funds, were found to contribute to negative wealth changes, with stocks showing the largest declines. The median value of directly-held stock decreased from $18,500 to $12,000, and the median percentage change was -31 %. When considering stocks in investment funds, a sharp drop in the median values was found as well.

By contrast, there were fairly different choices with respect to non-risky assets. Ownership of non-risky financial assets, such as cash-value life insurance and bonds, increased, and both the median dollar and percentage change for these types of assets increased, even though the median number of households holding these types of assets dropped. The difference in the proportion of holdings out of the total financial assets between risky and non-risky assets was also found. Stocks and pooled investment funds accounted for a smaller portion of the total financial assets in 2009 compared to 2007, while that of bonds rose.

According to loss aversion theory, households are risk averse with respect to sure gains, but risk prone with regard to unsure losses (Bowman et al., 1999; Kahneman &
Tversky, 1979). As long as there is uncertainty about future income, households are willing to take risks, hoping that the next period’s income might not be so low, and thus, their current decision about risky assets that may lead to possible losses might not have a significant effect on their wealth. Income uncertainty may lead them to think that they can recover potential losses from risky choices without anticipation of huge future financial difficulties.

2.2. Saving

There are two prominent aggregate measures of saving in the US. One is the National Income and Products Account (NIPA) measure developed by the U.S. Commerce Department’s Bureau of Economic Analysis (BEA), and the other is the Flow of Funds Account (FFA) measure based on the Federal Reserve’s Flow of Funds Account (FFA). Although NIPA’s measure of saving receives more frequent publicity, both measures have demonstrated a rapid decline in U.S. household savings (Guidolin & Jeunesse, 2007).

The NIPA personal saving is defined as the difference between income and consumption. More specifically, personal saving is calculated by subtracting consumption expenditures from disposable personal income that consists of rent from unincorporated business, interest income, and dividend income on assets, and non-asset income, such as labor income or government benefits, less personal contributions to social insurance and personal taxes paid. In other words, the calculation of the NIPA concept of household saving is the net acquisition of financial and tangible assets, which are less than the net increase in liabilities and the net capital transfer.
The NIPA measure distinguishes between capital gains and active saving for the purpose of measuring the funds from current income with the exclusion of capital gains that reflect revaluations of existing assets and that are not considered current production (Perozek & Reinsdorf, 2002). The NIPA measure focuses on resources available for investment; thus, it does not count capital gains (Penner, 2008). Although unrealized capital gains are not included in personal income, taxes paid on realized capital gains are deducted from before-tax income to get disposable personal income (Verma & Lichtenstein, 2000).

On the other hand, the flow of funds accounts (FFA) provides another measure of saving, as the total change in household wealth. This measure defines saving as net changes in wealth from one period to another; thus, saving in the FFA is calculated as the sum of the net acquisition of financial assets, such as cash, bank deposits, stocks, bonds, life insurance, and pensions, and tangible assets, such as homes, fixed assets, and consumer durables, minus the net increase in liabilities, such as mortgage debt and loans. Unlike the NIPA measure, estimates from the FFA can measure financial saving through assets and liabilities as the change in wealth.

Neither measure considers realized capital gains that can be accrued as an exchange of one asset for another, such as those from sales of stocks or a house, or unrealized capital gains that can be understood as the increase in the perceived purchasing power of the asset holder, such as those accrued on paper. Because these two types of capital gains cannot be considered returns from production or any activity that increases productivity, the two measures both exclude capital gains in the calculation of personal saving (Verma & Lichtenstein, 2000).
As saving is defined as an activity in which resources are not used in the current period and yield satisfaction in future periods or as the portion of income that is not spent on consumption (Bryant & Zick, 2006), in principle, these two approaches should yield the same results. However, there have been differences in these numerical measures and their influence in the US and in a number of other countries as well (Lipsey & Tice, 1989). In particular, depending on various studies, the treatment of durable purchases, such as cars and houses, is important. Differences seem to derive from the type of data analyzed and the limited variables in each data set in measuring saving.

There is a set of studies in macroeconomics that addresses the relationship between saving rates and economic growth (Carroll & Weil, 1994) or income inequality and aggregate saving (Schmidt-Hebbel & Serven, 2000). Carroll and Weil (1994) examined the relationship between income growth and saving using cross country macro-economic data and household level data. They suggested that higher saving has been related to higher economic growth rates in many countries, which often has been interpreted as higher saving leads to higher levels of income per capita. When using household level data, Carroll and Weil found that households with predictably higher income growth saved more than households with predictably lower income growth. This finding is not explained fully by the PIH. They used the Panel Study of Income Dynamics (PSID), the Consumer Expenditure Survey (CEX), and the Survey of Consumer Finances (SCF) for their analysis and measured saving rate as wealth/income ratios.

Unlike studies that have proposed a positive relationship between income inequality and personal saving on cross-sectional micro level data (Bunting 1991; Cook, 1995), Schmidt-Hebbel and Serven (2000) examined the links between income
distribution and aggregate saving empirically under the assumption that the links can be either positive or negative. They defined saving as gross national saving or its ratio to gross national product. They chose national saving and national product data as the relevant variables because they excluded net income from abroad, and found that income inequality had no systematic effect on aggregate saving.

In micro economic level studies of saving, analyses of the relationship between income distribution and saving behavior or net worth change and saving, use data in household-level surveys. Bosworth, Burtless and Sabelhaus (1991) evaluated the effect of changes in income growth on saving by individual households and by the distribution of income across different age cohorts. They considered demographic characteristics of households, such as age, income distribution, and capital gains, all of which are important in explaining declines in private saving rates in the U.S., and found the rate of saving rose and fell with the rate of growth of income and changes in the composition of the population.

For example, groups with traditionally high saving rates, such as married couples and the middle aged, were found to have higher saving rates than young and retired households. They measured saving by comparing a household’s wealth at two points in time in the SCF, while calculating saving as the difference between the flows of income and consumption spending in the CEX. In particular, when they measured saving as the difference in wealth holdings at two points in time using the SCF, they estimated capital gains from the SCF for owners of corporate stocks by assuming that capital gains on the original holdings of the equity holder in the first period would have been accrued in proportion to the percentage rise in the Standard and Poor’s index between the first and
the second period, in order to make it comparable with the saving measure in the NIPA. However, depending on the measurement of saving, they found different saving rates by income cohorts: the saving rate of the low-income cohort was lower, while the higher-income cohort had higher saving rates when saving was calculated using income less spending rather than the change in wealth.

Sabelhaus and Pence (1999) estimated how wealth accumulation and active saving varied across cohort by age and wealth distribution and measured wealth accumulation by adjusting the wealth change rates for predictable bequests based on mortality probabilities and active saving rates by adjusting capital gains based on the distribution of gain-producing assets across cohorts and subtracting the estimated gains from total wealth change. Thus, they differentiated active saving from capital gains when measuring saving rates in cross-sectional SCF datasets for estimating wealth accumulation and active saving rates. They found that the divergence between active saving and wealth change rates across cohorts was offset by differences in holdings of stocks and mutual funds, on which most of the capital gains are calculated. Their results indicated that assignment of capital gains in measuring active saving and wealth change affected the difference between demographic cohorts in the estimated rates of active saving in terms of their overall wealth change rates.

Dynan, Skinner, and Zedels (2004) examined whether higher lifetime income households saved a larger faction of their income and found a strong positive relationship between saving rates and lifetime income, with a weak positive relationship between the marginal propensity to save and lifetime income. They used various datasets, such as the PSID, the CEX, and the SCF, besides imputed saving from Social Security and pension
contribution, and measured active saving, which is defined as the difference between income exclusive of capital gains and consumption, under the assumption that if capital gains are not anticipated at the time of making the saving decision, excluding those capital gains from saving can better capture the true intentions of households. They used both active saving for the CEX and the PSID dataset, while saving included capital gains in the SCF and the PSID.

Many studies have measured aggregate saving and compared those results to micro level measurements, or have compared the saving rates between the measures (Garner, 2006; Huggett & Ventura, 2000; Kirsanova & Sefton, 2007). Bunting (2009) decomposed the macro saving rate into micro components and developed a procedure to calculate household saving rates using income and expenditure shares based on the survey. He defined the annual quintile saving rate as one minus the aggregate average propensity to consume times the share of the quintile expenditures, divided by the share of income. Next, he redefined saving as the sum of the unusual residual and credit or unused spending power, which is derived from net changes in liabilities that reflect additions to income and net changes in assets that indicate additions to spending when borrowing for spending. He used the March Current Population Survey (CPS) and the CEX to measure the micro level saving rates and found, after comparing the results from survey data to macro saving rates that the aggregate saving rate is a poor indicator of micro saving behavior. He concluded that the middle income group has lower saving rates and the low income group has higher non-saving, leading to declines in aggregate saving in the U.S.
Bosworth and Smart (2009) evaluated micro level survey estimates of wealth and saving by households and compared those to the macroeconomic estimates of wealth accumulation and saving based on the FFA using data from the PSID, the SCF, and the Health and Retirement Studies (HRS). Depending on the data, they used different measurements of saving and wealth accumulation. For wealth accumulation, they compared the FFA to the SCF. The FFA provides aggregate values for major categories of assets and liabilities and those of major sectors of the economy, while the estimate for the household sector is a residual after subtracting the holdings of other sectors from national totals.

The FFA estimates were measured as two year averages of the end of year data (beginning and end of year), which excluded consumer durables and the assets and liabilities of nonprofit institutions, while net wealth in the SCF was measured as the difference between total assets and liabilities, and then the results of the SCF were compared to those of the PSID and the HRS. Bosworth and Smart (2009) found that the FFA and the SCF valuations of net worth corresponded closely until 1998, but after that date, the SCF measures showed more rapid accelerations in wealth; the other two household-level surveys showed results similar to those of the SCF. In terms of estimates of saving, they computed rates of valuation change over the periods for real estate, non-corporate businesses, and corporate equities, and applied the index of valuation change to successive waves of the SCF. The estimates of saving in the SCF were obtained as residuals of the change in net worth minus the valuation change.

2.3. Lagged Income Deviation
Understanding how household consumption and saving respond to income change has been recognized as important in both economics and public policy. In particular, how households respond to macro policy, such as tax or welfare reforms, is relevant to this issue (Hall & Mishkin, 1982; Jappelli & Pistaferri, 2010). One traditional view is that changes in real incomes are converted quickly and thoroughly into changes in consumption and saving, and income changes resulting from tax changes can be used to create economic stability (Dolde, 1976; Okun, 1971). In contrast, studies based on the LCH and PIH maintain that households will change their consumption and saving decision by smaller amounts and only if they perceive current income changes as temporary rather than permanent. (Hall, 1978; Muth, 1960). The LCH and PIH assume that households can estimate their lifetime resources and adjust financial plans to smooth their consumption by spreading the resources over the remaining years of their lifetimes, that consumption is determined not by current transitory income but by permanent income, and that permanent income is relatively smooth compared to changes in current income. Thus, if policy-induced income changes occur, households may not perceive their income changes to be either permanent or transitory, and may not react to the changes as desired.

When income uncertainty is considered, households can still estimate the probability distribution of future resources with the information available to them, but should adjust their financial plans accordingly. Here, adjusting consumption and saving plans means accepting some degree of sensitivity to unexpected changes in transitory income. The PIH’s rational expectations (RE-PIH) model assumes that current consumption is the best proxy for future consumption, because current consumption
results from a rational choice based on any information currently available with respect to future income change.

Specifically, studies have tested LCH/PIH using the relationship between consumption and saving to income change to answer the following question (Jappelli & Pistaferri, 2010). Are changes in income, which lead to consumption responses, anticipated or not? Specifically: a) does household consumption respond to anticipated income changes? and b) do households respond to unexpected income changes? Under the LCH/PIH, households use saving to moderate the effects of income fluctuations and should react least to anticipated changes in income; otherwise, consumption is thought to be excessively sensitive to anticipated income changes. The influence of past income changes is also not expected to affect current or future consumption decisions.

In this sense, the predictive power of lagged change in income on future consumption growth has been interpreted as inconsistent with LCH/PIH (Deaton, 1986; Flavin, 1981; Köszegi & Rabin, 2009; West, 1998). There are studies that have analyzed the relationship between the marginal propensity to consume (MPC) and income changes, and their authors have concluded that consumption is excessively sensitive to income changes (Deaton, 1986; Flavin, 1981; Hall & Mishkin, 1982). Other studies have used lags in income changes on consumption change and have examined the effect of expected income change as the most recent lagged income change. Although the studies used lagged income change to measure the sensitivity of consumption changes, the values of those changes were absolute changes between t and t-1 or t-i and t-(i-1), rather than the relative change compared to a reference point.
Flavin (1981) used excess sensitivity of consumption in response to lagged consumption and lagged income changes to test whether or not coefficients of each lagged piece of information were zero. She found that the estimated coefficients of all lagged income changes were significantly different from zero, leading her to conclude that the observed sensitivity of consumption to past income change is greater than it would be in the PIH. These results led her to reject the PIH and conclude that the lagged change in income has predictive power for future consumption growth because consumption adjusts with a delay; thus, the relationship of consumption change to lagged income change was statistically significant.

Hall and Mishkin (1982) examined the relationship between consumption and income based on the rational expectation of consumption and used a regression model of the first difference in food consumption on the lagged change in income. They hypothesized that if household consumption has a transitory measurement error or other noise not explained by the theory, the simple regression test of the Euler equation, in which the coefficient of the changes in lagged income on changes in consumption should be zero, should be restricted. They also estimated a structural model of consumption that permits current consumption to react to future income change, using the timing of the data and advance information available to households. If consumption is based on information about next period’s change in income, a positive correlation between current consumption and income change should have been found, but they found a negative correlation instead.

The negative correlation indicated that either households were unable to distinguish changes in lifetime income from that of transitory income or were excessively
sensitive to transitory income. The following findings supported the latter interpretation. Their observed covariance of income and consumption showed that 80% of the households observed were found to make decisions about consumption in response to income change as the LCH described, while the remaining 20% of the households showed decision patterns that were inconsistent with the theories; this fraction of consumption moved proportionally with actual current income rather than permanent income. In other words, 20% of consumption was linked to current, rather than permanent, income and the negative relationship between the lagged change in income and the current change in consumption accounted for this 20% of consumption. When Hall and Mishkin (1982) distinguished the inability or unwillingness to borrow and lend due to higher interest rates, they found a difference in the relationship between consumption change and lagged income change. Although the authors hesitated to interpret large propensities to consume out of current income as evidence against the PIH without any discussion of the stochastic process of income, they concluded that consumption is more sensitive to current income fluctuations than it would be under the LCH/PIH assumption, as well as under assumptions of freedom from constraints on borrowing and lending freely at the treasury bill rate.

Deaton (1986) examined the relationship between consumption change and the lagged income change with an approach based on marginal utility or MPC between periods. He found that the MPC is less than one because consumption under-responds to permanent income shocks, and thus is excessively smooth.

Campbell (1987) estimated the predictive power of saving for labor income declines in an attempt to test the PIH, which posits that households that save expect
falling future incomes and those that do not save expect rising incomes, using 30 years of quarterly aggregate data in the U.S. Saving was the current expected value of future declines in labor income and was used as the dependent variable. Lagged income as a predictor was used to measure lagged saving and changes in labor income. If the PIH is true, saving signals a decline in the present value of future labor income. Saving was defined as a difference between disposable income and consumption, and was divided by interest rate, and derived from two types of consumption, assuming a linear combination of income and consumption. This can be viewed as saving under the PIH, i.e., total consumption and consumption of nondurables and services.

After regressing total income on each consumption variable, a second regression of income changes on lagged income change, its level, and consumption was conducted to estimate the predictive power of saving. The author found that both saving measures predicted future labor income declines, and thus rejected the PIH; however, he also found that lagged income change predicts consumption change when using 1 and 5 lags. Campbell (1987) argued that the excess sensitivity of consumption to income change should be interpreted as insufficient variability in saving rather than as a correlation between consumption changes and lagged income changes.

Campbell and Deaton (1989) proposed that excess smoothness indicates that consumption is too smooth in relation to permanent income, which is inconsistent with the PIH. In the PIH, consumption is not determined by current income, but by permanent income and current income change only results in a small change in permanent income and consumption. Permanent income is smoother than current income. However, their findings were inconsistent with the PIH. Consumption change did not react sufficiently to
changes in permanent income and no evidence for the proposition that permanent income is smoother than measured income was found. In fact, permanent income was less smooth than measured income and smooth consumption responded to a lagged income change: a positive correlation between consumption change and the lagged income changes indicating excess sensitivity of changes in consumption to unanticipated changes in income.

2.4. Expected Income Change

Expected income change has been found to determine consumption and saving decisions of households, because predicted income change is computed using the current information on income, which reflects the possibility of actual income change, and personal anticipation or confidence in future income (Curtin, 2008; Dominitz & Manski, 2003; Fan & Wong, 1998; Jappelli & Pistaferri, 2000; Shea, 1995b). Moreover, differences in the size and sign of consumption responses can be expected when distinguishing between positive and negative expected income change (Bowman et al., 1999; Shea 1995a, 1995b). The related question: “Does consumption respond differently to negative and positive income changes?” is answered differently by various models; credit constraints or myopia may be used to explain a correlation between consumption and expected income increases, but these cannot explain a correlation between consumption and income decreases.

Classical economic models, such as LCH and PIH, assume theoretically that if a household is sure about what its future income will be, the desire to smooth consumption indicates that changes in permanent income affect borrowing and saving immediately
(Chang, 1993) and predictable income changes should not affect consumption decisions (Ando & Modigliani, 1963; Friedman, 1957). However, if the household is unsure about its future income and a distinction between permanent and transitory income change, such financial decisions would be less predictable.

There are a number of studies that have supported the relationship between income expectation and saving decisions. Two ways of measuring the expectations of future income are found commonly in the related literature: a) using predicted income based on variables in the previous period, and b) using subjective expectations about future income. Katona (1949) proposed that saving behavior is affected by income changes and whether or not they are anticipated. He proposed that a decline in expected income would lead to an increase in saving or a change from saving to not saving, as long as the decline is considered temporary.

Flavin (1981) tested RE-PIH for consumption by decomposing income growth into anticipated and unanticipated components and estimated excess sensitivity of consumption in response to predictable changes in both current and past income change. The RE-PIH assumes that permanent income is the constant resource flow conditional on expectations in each period; if expectations of future income are rational, current consumption estimates future consumption, because any information affecting future consumption is already reflected in current consumption. Thus, the expectation of next period’s revision in expectation is zero and neither current nor past income has an effect on future consumption. In other words, a rationally-formed permanent income is orthogonal to information available at the time the expectations were formed, and if
consumption is proportionally related to permanent income, revisions to consumption are also orthogonal to the information set.

To test the RE-PIH, Flavin hypothesized the role of current income in signaling the effect on changes in permanent income when consumption responds to changes in permanent income and to changes in current income itself, by assuming the adjustment of consumption to a change in permanent income is completed within the quarter that new information on income becomes available. She tested excess sensitivity of consumption in response to lagged consumption and current income change measured as the most recent income change among the four lagged changes, and found that changes in permanent income were associated with an innovation in current income. Further, current income change or more recent income change with expectations of the current consumption was significant. In contrast to the RE-PIH, in which only lagged consumption would be a useful predictor of current consumption, her findings implied the significance of expected income change. Therefore, her study suggested that consumption responds to predictable changes in income, excess sensitivity of consumption to income changes, and large estimates of the MPC from current income. These results were confirmed in subsequent studies.

Campbell and Deaton (1989) found excess insensitivity of changes in consumption to expected income changes; this explains excessively insensitive consumption to unexpected income change, as well as the relationship between the aforementioned lagged income changes and consumption change. They ascertained that such insensitive change in consumption to unexpected income change is proof of a slow
adjustment to income change, which reveals that consumption is the average of previous income changes.

They also compared the relationship between consumption change and change in expectations about rates of income growth according to the significance of the effects of information. The ratio of the changes in consumption to current labor income was proportional to the change in the present value of future rates of income growth, and households construct their expectations using a variety of forms of financial information, such as monetary policy, prices, and economic growth. Thus, having sufficient information or early notice of sudden future income changes mediates the shock by affecting saving and consumption decisions in advance, even if expectations are conditional on current and lagged income. Variances in the rate of growth of labor income and the ratio of consumption changes were lower than those predicted by the PIH, indicating that the theoretical shock variance was larger than the actual shock variance, and consumption was smoother than is predicted by the PIH. Campbell and Deaton concluded, therefore, that smooth consumption is not due to PIH, but to consumption information.

Campbell and Mankiw (1991) examined aggregate consumption responses to income change with a weighted average of current income change and lagged income change represented as $ay_t + (1 - a)y_{t-1}$, assuming that current consumption is determined using current change and lagged income change as reference points. First, they forecast disposable income growth to a set of forecasting variables using lagged income change, lagged consumption growth rates and the lagged consumption-income ratio. Because they assumed that the error term in the consumption change model is
orthogonal to lagged variables, they used these instrumental variables, in which coefficients will be proportional to one another, to impose a simple set of cross-equation restrictions. The weak predictive power of lagged income changes on disposable income growth increased as lagged consumption change rates and the lagged consumption-income ratio were added to the model. Next, they regressed consumption change on relevant variables in the information set to estimate the effect of current disposable income change on consumption change.

A $\lambda$ model, in which aggregate change in consumption is equal to a weighted average change in current income and permanent income, $a$, with weight $\lambda$ and $(1-\lambda)$, was tested. They assumed two types of consumers in the population: current income consumers who receive a fraction $\lambda$ of aggregate income, and permanent income consumers who receive a fraction $(1-\lambda)$. In other words, a weight, $\lambda$, of the total population will consume in response to current income changes, which is inconsistent with the PIH, while the other fraction $(1-\lambda)$ of the population will consume from permanent income change, as the PIH describes. $\lambda$ was estimated empirically and $(1-\lambda)$ was calculated subsequently. The authors did not focus on why any consumers should set their consumption equal to their current income, but rather on the consequences of this assumption. They measured the direct effect of current income on consumption using $\lambda$: if all households consume only permanent income, then $\lambda = 0$; if all households consume their current income, then $\lambda = 1$. Aggregate consumption data across five countries—the U.K., Canada, France, Sweden, and Japan—were used to estimate $\lambda$ for comparison to that in the U.S.
They found that the predictive power of income growth on consumption growth was both economically and statistically significant, except for Japan, where \( \lambda \) was not identified due to the fact that disposable income growth could not be forecast. A significant \( \lambda \) implied that not all consumption was either equal to current income or purely consistent with LCH/PIH. The \( \lambda \) estimates ranged from 0.20 in Canada, through 0.35 in the U.S. and Sweden, to nearly 1.0 in France (0.97). The U.K showed a large variability in the estimates depending on a seasonal adjustment, 0.35 (adjusted) to 0.65 (unadjusted). In particular, \( \lambda = 0.35 \) indicated that 35% of U.S. consumption cannot be explained by the LCH/PIH. They did not find direct effects of real interest rates or nominal interest rate changes on consumption growth, even though they assumed that a positive estimate of \( \lambda \) reflected the possibility of liquidity constraints, which would indicate that higher values of \( \lambda \) are related to tighter liquidity constraints. PIH was rejected after finding that variables already in the consumers’ information set can predict consumption changes and excess sensitivity of consumption to income changes.

Rather than focusing on the reasons why consumption is related closely to income changes, such as inseparability of preference, myopia, liquidity constraints or other variables, Lusardi (1996) examined whether a relationship in micro level data can be found between predictable consumption and income growth. Consumer Expenditure Survey (CEX) data were used for consumption, which included nondurables other than food consumption. PSID data for income were used as well to evaluate the predictability of future income changes. She employed two sample instrumental variable estimators for expected income change and consumption change, using a set of household characteristics as instrumental variables, including gender, marital status, race, the
number of children, singles, the number of earners, education, and occupation dummy variables interacted with age. An Euler equation was used to estimate the excessive sensitivity of consumption to predictable income changes. She found that consumption was indeed excessively sensitive to predictable income growth. The estimates of the coefficient of sensitivity for consumption were between 0.20 and 0.50, which are close to Campbell’s and Mankiw’s (1990) estimates. These findings were inconsistent with the PIH, which proposes that a coefficient for predictable income growth should not be statistically significant if information already known to a household is used to predict income growth.

Also contrary to the LCH/PIH, Shea (1995a) found that predictable wage growth is correlated with changes in consumption and the asymmetric responses. He measured expected wage growth between the two periods using contract information from the household head. Expected nominal wage growth included guaranteed raises and expected cost of living adjustments, computed using labor contracts, as well as inflation forecasts. Expected real wage growth was equal to expected nominal wage growth minus forecast inflation over the periods. The growth rate in real food consumption between two periods was a function of: the growth rate in the household’s annual food needs constructed from the food consumption index using PSID information; expected real interest rate, and the expected growth rate of the household head’s real wage or salary over the two periods.

The coefficient of the expected real wage growth was large and statistically significant and no evidence of myopia, in which consumption should increase one-for-one with predictable income, was found. He also tested the possibility of liquidity constraints by splitting the sample by wealth and found that the results were mildly
supportive of liquidity constraints, as the sensitivity of consumption to the expected wage growth was larger for low-wealth than for high-wealth households. However, the asymmetric response of consumption, which was more sensitive to predictable real wage decreases than to predictable increases, was not explained by the liquidity constraints, in which symmetry was predicted, or by LCH/PIH.

Chang (1993) examined the relationship between expected income changes and savings based on the RE-PIH. Expected income change between two periods was measured as the difference between predicted income in the second period and actual income in the first period. Predicted income in the second period was computed from an income prediction equation, using actual income in the second period as the dependent variable and a set of demographic variables as the independent variables. Her assumption was that households make saving and borrowing decisions based on their first period income and expected second period income according to the RE-PIH. Expected income in the second period was estimated by assuming that the household projects its future income according to current income, current family composition, job status, and other socio-demographic factors, including age, education, ethnicity, marital status, occupation, and household size.

Carroll and Weil (1994) examined the relationship between income growth and savings growth using three different household level sets of data: PSID, CEX, and SCF. They used saving as the dependent variable, measured as savings rate or the wealth/income ratio, \( \log\left(\frac{\text{wealth}}{\text{income}} + 1\right) \), and predicted income growth as the independent variable; the saving ratio in the PSID was the first lag of wealth divided by averages of seven lags of income, while that of the SCF was from one period of data. As the SCF had
only a single year of income, the estimated predicted income growth that was computed based on demographic characteristics of households—including age, occupation, and education of head in the PSID—was used to predict income growth for the SCF. Next, saving was regressed on the estimated predicted income growth, separately. However, to cover the different periods and use a direct measure of the saving rate, CEX were also analyzed, in which income growth was not provided; thus, the estimates of predicted income growth with similar occupations and educations for each household in the PSID were used. The relationships between saving or wealth and predicted income growth were positive and significant in all data, and households that expected faster income growth tended to save more than their counterparts in young households. Liquidity constraints, precautionary saving, and habit formation could be used to explain the observed positive relation between expected income growth and saving across households.

Bowman et al. (1999) also examined the relationship between changes in consumption and income and demonstrated that the predictive power of expected income growth on consumption change other than lagged income changes. They estimated expected income growth by regressing actual income growth at time t against the second through fourth lags of consumption growth, income growth, real interest rates, and an error correction term measuring the difference between consumption and income from the second lag. They compared the regression coefficients of expected income growth with lagged consumption and income change across five countries and found that the variables were significantly related to consumption change.
Other studies have also used subjective expectations about income change to measure their ability to predict consumption decisions. Jappelli and Pistaferri (2000) tested the sensitivity of consumption to expected income change. They estimated the explanatory power of demographic variables on subjective income expectations, actual income change, and inflation change over 1990-1991 and 1992-1993. Their findings supported the hypothesis that predicted income change, as measured by both subjective income expectations and inflation expectations, are related closely to actual changes in income. Different estimations of expected and actual income change were found according to the demographic variables, including age, education, and occupation of the household head, region of residence, and household income.

Sensitivity of consumption was defined as the difference between realized and expected consumption change, while income expectations were measured as the expected change rate of nominal earnings or pension income, and the expected rate of inflation. Expected rate of real earnings was the difference between the expected change rate of nominal earning or pension income and the expected rate of inflation, and this was used to measure the actual change rate in earning of the household head. Jappelli and Pistaferri (2000) controlled for predictable changes in labor supply and found that consumption change was correlated positively with the expected variance of income and uncorrelated with predicted income change; these findings supported the precautionary saving model.

To predict consumption growth, consumer confidence is also often used as a measure of subjective expectations about future income change. Generally, consumer confidence refers to self-assessment of future, or current outcomes in family finances, business conditions, and economic conditions (Dominitz & Manski, 2003). Consumer
confidence is expected to reflect economic conditions, and is a measure of consumer mood with respect to aspects of the economy, such as income, wealth, and interest rates, which can serve as useful signals of consumers’ ability to pay for consumption expenditures (Adrangi & Macri, 2011; Wilcox, 2007). On the other hand, consumer confidence is also viewed as similar to “animal spirits,” defined as the psychology behind investor beliefs (Baker, Wurgler, & Yuan, 2012; Shiller, 2005), or to the degree of optimism or pessimism that consumers feel about the state of the economy, their job prospects, and financial situation, which causes them to increase or decrease their consumption (Grisse, 2009).

Katona (1968) used empirical measures of income expectations to explain spending and saving behavior. He challenged the idea that income is the best predictor of consumer purchasing decisions by arguing that consumer expectations or confidence in the economy are also important. According to him, consumer expenditures consist not only of the ability to buy, but also the willingness to buy—a psychological factor. The former is represented by current income, assets, and access to credit, while the latter relies on decision makers’ attitudes or assessments of their future income prospects or aggregate economic conditions. Katona addressed discretionary purchases as spending, and hypothesized that saving would increase when consumers are pessimistic and spending would rise when consumers are optimistic about their future income. He used consumer confidence as a measure of expected changes in income. Pessimism or skepticism, and optimism or trust as measurements of consumer confidence have been tied to the basic assumption that the influence of factors on decisions depends on
expectations about factors affecting household finances in the next period (Acemoglu & Scott, 1994; Fan & Wong, 1998).

Acemoglu and Scott (1994) used the consumer confidence index, which consists of subjective expectations, to examine the future excess sensitivity of consumption change to anticipated income growth. Their findings, which showed that the confidence index predicted the future variance in consumption growth and interest rates positively, and predicted the covariance between them negatively, did not support the RE-PIH, which assumes that the change in consumption is proportional to the current change in future income expectations. This indicates that a high level of consumer confidence is related to greater optimism about the level of future consumption, which leads to higher consumption growth, and a larger forecast variance for their forecast errors. Consumer confidence in the first period reflects uncertainty about future values of interest rates and consumption growth. In investigating a positive relationship between consumer confidence and precautionary saving, assuming that precautionary saving implies that consumption growth depends on the variance of consumption and interest rates, they confirmed a gradual upwards revision in consumption level in response to a positive income shock as a consequence of precautionary saving.

These results suggested that the ability to predict future income is based on the predictive content of other macroeconomic variables, and thus, confidence variables can reflect private information about economic circumstances. Acemoglu and Scott (1994) concluded that subjective expectations about the economy and income were able to predict consumption, while greater uncertainty about the value of future interest rates and consumption growth caused agents to lower their consumption level optimally more than
they would under certainty equivalence. Non-certainty equivalence is an important aspect in rejections of the RE-PIH when there is no evidence of liquidity constraints derived from imperfect capital markets.

Alessie and Lusardi (1997) analyzed the relationship between future income changes and saving based on the assumption of RE-PIH, in which households save for a precautionary purpose and current saving reflects what households expect about future conditions. They used a total of three measures of saving in the study. The first two were obtained from first-differencing wealth, both with and without housing assets, and the other was whether households reported that they had saved in the past twelve months. Expectations about future income changes were measured using five point categorical responses to the following question: whether households expected their income to increase strongly; increase; remain the same; decrease, or decrease strongly in the next twelve months. When regressing savings on expectations about future income, they found a positive and significant effect on the third saving measure, whether the household had saved or not, but not on either of the first two measures. This positive coefficient was inconsistent with precautionary saving motives as the LCH/PIH indicated, because saving predicts future income changes and a negative coefficient is expected, i.e., high saving will indicate expected income declines. To examine whether the expectations about income changes in the short run were correlated positively with the expectations about income changes in the long run, which supports the above positive relationship between saving and expectations, they regressed expectations about income in the next twelve months on lagged income expectations. A positive correlation coefficient for lagged income expectations was identified and the LCH/PIH was rejected.
However, the regression of realized income growth on subjective income expectations measured in the first period was also employed. Each of the answers to subjective expectation questions had predictive power with respect to future income changes, i.e., households were able to predict their income. Large expected decreases and increases in income, such as choices of “strongly decrease” and “strongly increase,” were associated with actual income changes and the results were not affected by the demographic variables.

To test the discrete expected income changes using the five categories as dependent variables, they estimated the income expectations variable as of April 1988 using regressors, including the income expectations variable as of April 1987, gender, and two dummy variables for education level and age, as well as some interaction terms. Even when using estimates of the discrete expected income changes from the ordered probit, they still could predict the probability of the expected income changes for every period in the future based on observed income expectations at a certain point of time. Although they did not conclude that excess sensitivity of consumption to income was sufficient to reject the PIH, their empirical test supported the predictability of saving and expectations about future income on realized income changes.

On the other hand, the index from surveying consumers’ outlook on the economy has also been used to prove the explanatory power of consumer confidence in predicting future consumption behavior. Carroll (1994) analyzed whether the University of Michigan’s index of consumer sentiment had predictive power for future changes in consumption spending by testing Campbell and Mankiw’s study (1991) empirically. They found that 14% of the variation in increased total real personal consumption
expenditures over 40 years, and concluded that lagged consumer sentiment has explanatory power for current changes in household spending. Household consumption in the U.S. accounted for approximately 65% of fluctuations in the national GDP; thus, small changes in household consumption have a significant influence on the macro economy.

Bram and Ludvigson (1998) used two representative consumer confidence indices in their regression analysis, the University of Michigan’s consumer sentiment index and the conference board’s consumer confidence index, and argued that the latter has a higher accuracy than the former in forecasting ability, because the root mean forecasting error decreased by comparison to the baseline equation in the latter.

Wilcox (2007) also confirmed the predictability of consumer confidence using 2000-2005 empirical data from the University of Michigan’s consumer sentiment index. He suggested that when the four-quarter-ahead horizon is used, measures of consumer sentiment can reduce consumption forecasting errors and improve the forecasting power of consumption expenditures, not only on durables, but also on nondurables and services.

Chauvet and Guo (2003) analyzed the effects of pessimism and optimism in consumer confidence on economic environmental changes such as recessions and slowdowns, in which agents’ perceptions of future economy were formed using Markov switching VAR. They used sales, employment, personal income, and interest rate as behavior variables reflecting waves of pessimism or optimism in consumer confidence in three recession periods including 1969-1970, 1973-1975, and 1981-1982, and found that with increasing uncertainty in the economy, consumer confidence played a useful role in providing information about future economic circumstances.
Howrey (2001) investigated the predictive power of this consumer sentiment index from 1961 to 1999 on future rate of growth of real GDP and future consumption spending despite a large standard error.

2.5. Determinants of Expected Income Growth

Studies (Carroll, 1994; Chang, 1993; Dominitz, 2001; Jappelli & Pistaferri, 2000; Limosani & Millemaci, 2011; Souleles, 2004) have used the following demographic variables in the expected income growth equation, which was the output of the process of analyzing other dependent variables, such as saving and consumption. Therefore, they used the variables in the equation, but in the final study, they did not include the specific details about the significance, such as coefficients and \( p \) values. In this sense, the following is a brief summary of each study regarding the related demographic variables used in estimating the expected income itself or expected income change.

Age

Souleles (2004) used age of household head and age squared/100 in estimating the forecasting error, defined as the difference between subjective income expectations and actual income growth, using CEX and the Michigan Survey of Consumer Attitude and Behavior (CAB). He found a negative relationship between age and the forecasting error, but a positive relationship between age squared/100 and the error. Jappelli and Pistaferri (2000) used age of household head in estimating both subjective expectations of income growth and average actual income growth and found different influences on expected income growth by age groups in households less than age 35, ages between 35 and 55,
and ages over 55. Both Chang (1993), Carroll (1994), and Limosani and Millemaci (2011) included age and age squared in the equation for expected income growth.

Education

Earnings are determined by an individual’s productivity, and by the supply of and demand for workers with similar levels and types of training and expertise. Higher educational attainment is believed to increase an individual’s productivity in the labor market, whereby employers recognize education attainment and pay higher wages to those with higher levels of education (Bryant & Zick, 2006). Perna (2003) found a positive relationship between earnings premiums and the level of education using longitudinal data from high school sophomores. She examined the proportion of income premium attributable to a bachelor’s degree after percentage variance due to idiosyncratic labor market characteristics, including ability, job experience, industry, and occupation, excluding demographic characteristics such as gender and race. Overall, earnings were higher for individuals with a bachelor’s degree, or advanced degree than for individuals with a high school diploma. Net increases in earning of college degree earners were also higher than among those with a high school diploma.

Snyder and Hoffman (2001) found that median annual earnings of male wage and salary workers aged 25 to 34 were $15,499 higher for those who completed at least a bachelor’s degree than for those who completed only a high school diploma. For women, the difference in median annual earnings between those with a high school and bachelor’s degree was $15,375 in the U.S. Dominitz (2001) found a different effect on actual income growth and subjective income growth expectations by education levels. For both dependent variables, an overall higher education level had a positive influence on income
growth. Souleles (2004) used education and found that households with a college degree had more prediction error in their expectations of future and actual income growth than did high school graduates. Chang (1993) and Limosani and Millemaci (2011) also used educational level in her equations of expected income growth.

Marital Status

Dominitz (2001) used marital status in the equation predicting subjective income growth from the Survey of Economic Expectations (SEE), and the actual income growth from the PSID. Dominitz (2001) found that married or cohabiting households had higher income growth than those that were not. Souleles (2004) used marital status in estimating the forecast error, but found no statistical difference between married or separate and single households. Chang (1993) also used marital status of the household head in estimating the expected real income for 1984-1985 using the SCF dataset.

Working Status and Occupation

Jappelli and Pistaferri (2000) found that there was a different estimation in expected income growth and actual average income growth between the employed and self-employed from 1990-1991 and 1992-1993. Dominitz (2001) also found that self-employed households had a negative effect on actual income growth compared to non-self-employed households, but showed a positive effect on subjective income growth. Limosani and Millemaci (2011) included occupation, such as employed, self-employed, retired or students in estimating income growth. Chang (1993) also included occupation of the household head in her estimation.

Children
Souleles (2004) found that households without a child had a larger discrepancy between subjective expected income growth and actual income growth than those with at least one child.

*Income*


### 2.6. Income Uncertainty Change

The function of both the ability and willingness to consume or save can be presented differently depending on the degree of income uncertainty (Carroll, 1994; Fisher & Montalto, 2011; Sandmo, 1970). An increase in the degree of risk or uncertainty drives people to avoid possible resource losses, and thus, the level of uncertainty can affect consumption and saving decisions. Unlike traditional models that predict consumption and saving decisions when income certainty is assumed, many studies have used the income uncertainty level itself and its change to predict changes in consumption and saving (Acemoglu & Scott, 1994; Carroll & Kimball, 1996; Feigenbaum & Li, 2011; Guariglia, 2001; Ochmann, 2011). Greater income uncertainty or income risk leads to lower current consumption and higher saving (Lusardi, 1998; Sandmo, 1970). Even if the financial position or condition of households remains unchanged, the perceived degree of future income uncertainty relative to the present can cause a change in consumption and saving decisions.
Sandmo (1970) examined theoretically whether increased uncertainty about future income causes a decrease in consumption and an increase in saving by using a risk aversion function, which is a decreasing function of future consumption. An increasing degree of uncertainty leads consumers to avoid the possible loss of their resources by decreasing consumption, as more savings could protect them from the possibility of very low levels of future consumption.

Zeldes (1989) examined whether consumption functions are different between the certainty equivalence model, in which consumption is proportional to the sum of the expected value of lifetime financial wealth, and the uncertainty model. He compared MPC between the certainty and uncertainty equivalence models and found differences between the models with respect to excess sensitivity; the MPC out of a transitory income change was greater than that predicted by certainty equivalence. Households with low current certain assets relative to expected uncertain future income had higher MPC out of transitory changes in income than for the rest of the population. This difference was derived from current assets relative to expected future uncertain labor income rather than from the absolute amount of current wealth.

When examining current certain assets relative to expected future labor income under the certainty equivalence model, Zeldes (1989) found that households tended to over-respond to changes in current income or wealth and under-responded to changes in expected future income. In particular, this was supported strongly when current assets are relatively low. These results suggested that current assets are more important in the consumption function relative to uncertain future income than they would be under certainty or certainty equivalence. The level of using precautionary also showed that
saving consumption growth was 20% higher in the low-risk, free interest rate than it was under uncertainty for households and the certainty equivalence model greatly overstated the optimal level of consumption for low levels of wealth.

Kimball (1990) introduced income uncertainty to analyses of MPC out of transitory shocks based on the theoretical assumption that precautionary saving in response to risk is related to convexity in the marginal utility function. To measure the sensitivity of choices to risk, they distinguished the concept of “prudence,” indicating the propensity to prepare for and protect from uncertainty, and risk aversion, measuring how much one dislikes uncertainty and avoids it if possible. His findings suggested that the MPC for a given level of risky choice is a function of the level of prudence, which affects the role of income uncertainty; decreased absolute prudence expects labor income uncertainty to increase MPC at any level of consumption, whereas increased absolute prudence expects labor income uncertainty to decrease MPC at any level of consumption.

Similarly, Carroll and Kimball (1996) examined income uncertainty and the MPC of a consumption function. They added a wealth effect on MPC and found that the MPC out of wealth was higher at lower than at higher levels of wealth. They also found a positive relationship between income uncertainty and MPC at any given level of consumption compared to the certainty model. Uncertainty increased MPC more dramatically for households with lower levels of wealth, inconsistent with the LCH/PIH, assuming that current consumption is expected to be constant over time.

On the basis of loss aversion theory, Bowman et al. (1999) examined theoretically the relationship between changes in household consumption level and income uncertainty level changes. Like Bowman et al. (1999), Guariglia (2001) also found that uncertainty
measured as earnings variability had a statistically significant effect on households’ saving decisions, such that households that expected a negative financial situation were more likely to save.

Ochmann (2011) found significant positive effects of transitory income uncertainty, or income risk, on savings, and negative effects on consumption when estimating the elasticity of consumption and savings with respect to transitory income uncertainty. An error components model, in which the variance of household income is decomposed into permanent and transitory income over time, was used to analyze income dynamics. When doubling transitory income uncertainty for households, measured by a doubling over the average level of the variation in transitory income shocks, its marginal effect on the level of savings was 4.4% and on consumption was 1.8%. Different effects of income uncertainty on consumption-saving decisions were observed for different household compositions. Apparently, the presence of children in a couple household influenced decisions by restricting the budget for precautionary savings, such as saving for the children’s education and saving for bequests. Saving by couples with children was less elastic to transitory income shocks than was that of couples without children or single households, while single households’ saving was more elastic to these income shocks than was that of couples without children.

Feigenbaum and Li (2011) also measured income uncertainties using variances in forecast errors over 30 years of cross-sectional datasets. Rather than imposing parametric restrictions on the underlying income shocks, such as examining how they are correlated across forecast horizons, and decomposing forecast errors into permanent and transitory components, they constructed forecast errors separately at different future horizons and
estimated the variances in the forecast errors and the correlations across forecast horizons. They found that increasing income uncertainty since the early 1970s is due to increases in variance of both persistent and transitory income shocks. Although differences in income uncertainty were also captured by different household characteristics, overall income uncertainty across all subpopulations increased, and single-earner and high-income households showed the largest percentage increase in income uncertainty.

2.7. Asymmetric Responses

The relationship between expectations about future income and consumption change has been examined in many studies and many of them have indicated a different response of consumption change between negative expectations and positive expectations about future income. An increase in expected income may result in a decrease in saving or a change from saving to dissaving since people anticipate further income increases while a decrease in expected income may either increase or decrease saving. A difference in absolute size of the effects of two opposite expectations on consumption change were also indicated. In general, such an asymmetric response of consumption is known to be more strongly correlated with predictable income declines than increases (Bowman et al., 1999; Shea, 1995a, 1995b).

That is, consumption responds significantly both to expected income rises and declines, but the response is more sensitive to predictable income declines than rises. This asymmetric response of consumption between an expected income rise and decline is inconsistent with the LCH/PIH (Bowman et al., 1999; Shea 1995a, 1995b). Neither the
LCH nor the PIH explains this asymmetric response of saving and consumption to predictable income change. Neither liquidity constraints nor myopia explains asymmetric responses (Shea, 1995). Liquidity constraints describe the situation in which a household cannot borrow money when needed. If so, consumption should be more strongly related to an increase in predictable income rather than a decline in income since liquidity constraints are associated with borrowing not saving. In the case of myopia, consumption follows current income and responds equally to both expected income increases and decreases. Elasticity of consumption with respect to predictable future income should be the same for both cases. Loss aversion can explain these asymmetric consumption changes (Kahneman & Tversky, 1979). When households receive good news about future income increases, they may immediately adjust current consumption upward, thereby reducing or even removing the possibility of a further increase in future consumption. In contrast, households may react differently to negative future income changes. No effect on current consumption can be captured in this case, which implies that future consumption will decline significantly when a negative income shock is realized (van Treeck, 2008).

Empirical studies have attempted to analyze asymmetries in economic models of aggregate consumption and many of them started from Campbell and Mankiw (1991)’s $\lambda$ model proposed to test whether the impact of expected income change on consumption change equals zero under the assumption that $\lambda$ can estimate some constant fraction of consumption out of current income. A time series form of Campbell and Mankiw’s $\lambda$ model can be written.

$$\Delta C_t = \mu + \lambda [\alpha \Delta Y_t + (1 - \alpha) \Delta Y_{t-1}] + \epsilon_t$$
where $\Delta C_t$ is consumption growth between $t-1$ and $t$, $\Delta \hat{Y}_t$ is expected income change between $t-1$ and $t$, $\alpha$ is the relative weight of current income change as opposed to a one-period lag of income change, and $\varepsilon_t$ is white noise.

Shea (1995a, 1995b) extended Campbell and Mankiw (1991)’s model in order to identify the difference between $\lambda$ depending on a positive or a negative income change. The $\lambda$ model Shea (1995b) used is presented as follows:

$$\Delta C_t = \mu + \lambda_1 (POS_t)\Delta \hat{Y}_t + \lambda_2 (NEG_t)\Delta \hat{Y}_t + \varepsilon_t$$

where $\Delta C_t$ is consumption growth between $t-1$ and $t$, $\Delta \hat{Y}_t$ is expected income change between $t-1$ and $t$, and $\varepsilon_t$ is white noise. $POS$ is a dummy variable for positive expected income change between $t$ and $t-1$ and $NEG$ is a dummy variable for negative expected income change between $t$ and $t-1$. Hypotheses about $\lambda_1$ and $\lambda_2$ differ by theory. For $\lambda$ of expected income change on consumption growth, PIH and classic LCH hypothesize the $\lambda \neq 0$ and extended LCH, in which income uncertainty and expectations about future income change are included, would hypothesize symmetry between $\lambda_1$ and $\lambda_2$. The myopic household approach hypothesizes symmetry of the $\lambda_1$ and $\lambda_2$ which are both positive and equal since households are assumed to track current income. On the other hand, liquidity constraints hypothesize asymmetry between $\lambda_1$ and $\lambda_2$ because liquidity constraints occur when households cannot borrow when income is low. In this case, $\lambda_1$ should be positive and greater than $\lambda_2$. Loss aversion hypothesizes asymmetric response of consumption and impact of negative income change is greater than positive income change, thus, $\lambda_1 < \lambda_2$. The expected sign and size of $\lambda$ depending on theoretical approach are summarized as follows (van Treeck, 2008)
• LCH/ RE-PIH: $\lambda_1 = \lambda_2 = 0; \lambda_1 = \lambda_2$

• Myopia: $\lambda_1 = \lambda_2 > 0$

• Loss aversion: $\lambda_1 < \lambda_2 ; \lambda_1, \lambda_2 > 0$

• Liquidity constraints: $\lambda_1 > \lambda_2 ; \lambda_1, \lambda_2 > 0$

Empirically, a higher value of $\lambda$ for previously predicted income declines, $NEG$, was found than to previously predicted income change (Bowman et al., 1999; Shea, 1995a, 1995b). Shea (1995b) found that both $\lambda_1$ and $\lambda_2$ were significant for consumption change and $\lambda_2$ was greater than $\lambda_1$ using National Income and Product Account (NIPA) data over 30 years. Consumption was more sensitive to predictable income declines than increases. His another study (1995a) using a subsample of the Panel Study of Income Dynamics (PSID), in which he tracked heads’ long term union wages to construct a measure of expected wage change, also had the same results. Expected wage was significantly correlated with consumption growth and consumption was more sensitive to predictable real wage declines than increases. The results of his two studies are inconsistent with both the LCH/PIH and myopic and liquidity constraint. Although he did not depend on loss aversion theory, his results were consistent with loss aversion.

Bowman et al. (1999) tested the above model using loss aversion theory by theoretically explaining how utility of households from consumption and change depends on relative changes or the difference between reference point and consumption level by level of uncertainty in terms of gains and losses. Asymmetric responses of consumption and saving between the predictable positive and negative income changes was supported by theoretical proof and empirical evidence from five countries. They focused on the
explanation of the asymmetric response of consumption and possibility of either increase or decrease in saving by changing uncertainty in addition to the expected future income change. Households resist decreasing their consumption or increasing their saving even if there is sufficient risk of decreasing their future income.

Basically, according to prospect theory, the marginal disutility of loss is greater than the marginal utility of gain, which is called loss aversion, but households are risk taking for uncertain losses and risk averse for certain gains. Households feel the cost of not smoothing losses is smaller than the potential benefit of never having to reduce consumption below reference levels because they are happier if their reference point matches their consumption level than if it is either lower or higher, called acclimation. This loss aversion tendency and the relative gains and loss compared to a reference point explains why consumption is insensitive to predictable income raises, but responds greatly to predictable income declines. This conforms with the relative income hypothesis that people resist decreasing their standard of living in response to bad news about income.

Other empirical studies (Johansson, 2002; van Treeck, 2008, 2010) also used the $\lambda$ model to explain asymmetric responses of consumption and saving in response to income change. Johansson (2002) found mixed evidence of the asymmetry response of consumption to positive and negative income expectations. He found asymmetric responses by examining Swedish quarterly data 1975-1997, but did not find support for the loss aversion theory when using annual panel data of 15 OECD countries during 1973-1997. In particular, he used the households’ perception of their future personal economic situation as the expectation variable rather than a continuous variable like Shea
(1995b) and Bowman et al. (1999). To construct an index that measures consumer sentiment Swedish data subtracts the proportion of pessimists (worst) from the proportion of optimists (better) and this difference (balance) measures the net proportion of optimists in the survey. The reason for this discrepancy of the results between quarterly data and annual data was not provided. The asymmetric response in consumption to income expectations reported in Bowman et al (1999) and Shea (1995a, 1995b) has been confined to studies using quarterly data and measuring income expectations by instrumenting income growth.

van Treeck (2008; 2010) found asymmetric responses of saving to income changes by distinguishing between long-term and short-term effects in order to examine the rapidly declining personal saving rate in the U.S. over the past three decades. He assumed that, depending on the time horizon, the cause of the asymmetry would differ, and found evidence of long-term loss aversion and short-term liquidity constraints. Long-term effects of positive changes in real per capita disposable income and personal wealth on real per capital personal consumption expenditure were larger in absolute value than were the effects of negative changes in income and wealth. Loss aversion was used to explain the long-term asymmetry effects: households have expanded their consumption as income and wealth have increased over the past years, but they have not decreased their consumption in a symmetric fashion following declines in income and wealth. This interpretation was based on Bowman’s et al.’s (1999) viewpoint on loss aversion; delaying the decrease in current consumption to negative income change, which may have no effect on current consumption, can bring about significant decreases in future consumption when the shock is realized.
van Treeck (2008; 2010) also found such an asymmetry in the short-term, negative changes in wealth, which led to a stronger consumption change than did positive changes; however, these results were interpreted as liquidity constraints or the time lags involved with learning about new consumption opportunities. In particular, negative changes in wealth have a very strong negative effect on consumption in the short-run, while positive changes have weaker effects. Whether or not households would like to, when expected income increases instant increases in consumption in the current period may not be realized if there are liquidity constraints, even when those constraints will be reduced after an increase in income is realized. In contrast, households can reduce their consumption relatively more quickly and easily in response to expected decreases in income. Thus, a decline in income and saving could have very substantial negative effects on consumption in the short-run, but in the long-run, households could manage relatively large increases in consumption in response to increases in income and wealth, while reducing spending as income and wealth decrease. Although these asymmetric responses were not consistent with some previous studies, such as those of Shea (1995a, 1995b) and Bowman et al. (1999), both long-term and short-term effects were inconsistent with the there-PIH and evidence of either loss aversion or liquidity constraints could be supported, depending on the time frame.

Some studies have identified the asymmetric consumption change in response to wealth changes, rather than income changes. Shirvani and Wilbratte (2002) found an asymmetric response of consumption to wealth changes derived from stock price changes that differed depending on the length of the data observed. They compared three countries: the U.S., Germany, and Japan, and found that the inequality of wealth effects
disappeared as the lag length extended beyond seven quarters. They found that consumption change was more sensitive to wealth change due to stock price decreases than to price increases, with a seven quarter lag, but could not find asymmetry for both eight and nine quarter lags.

Apergis and Miller (2006) studied the asymmetric influence of changes in real per capita U.S. stock market value on real per capita consumption changes. Agents responded more strongly to negative than to positive changes in the stock market. Their empirical findings were consistent with other studies that have found that stock market wealth influenced real per capita consumption asymmetrically during the short-run adjustment process (Shirvani & Wilbratte, 2002), where the effect of negative changes on stock market wealth was stronger than positive changes. Even for equal positive and negative shocks in stock market value wealth, negative changes had 50% more influence on consumption change than did positive changes.

On the other hand, Altonji and Siow (1987) found results opposite to those of Shea (1995a, 1995b) and Bowman et al. (1999). When they estimated the relationship between income and consumption change in varied ways, they emphasized the presence of measurement error in the income variable, as this can yield different results when the PSID data are used. Depending on how measurement error was handled, there were large differences in estimating coefficients of income change on consumption change, but introducing treatment error into the model did not change the results dramatically against the RE-PIH. Their findings demonstrated asymmetric consumption responses to positive and negative expectations of both current and lagged income changes, but positive income change was slightly higher than the response to negative income change, leading
them to reject the hypothesis that consumption responds to expected and unexpected income changes in the same way.

2.8. The Determinants of Saving

2.8.1. Demographic Characteristics

Age

As has been demonstrated in both theoretical and empirical studies, age is one of the most closely associated demographic determinants of saving. For example, the LCH emphasizes the importance of age in saving, because overall earned income is assumed to increase until retirement, after which it drops, and the working age group prepares for their retirement savings more than do other age groups, such as the young and elderly. Many studies have demonstrated this relationship empirically. Lusardi and Tufano (2011) found that household heads aged 35-65 were more likely to save than younger heads aged 18-34. Jappeli and Modigliani (2005) found a similar relationship between age and saving in Italian cross-sectional data from 1989 to 2000. The results of the humped total wealth distribution, in which savings becomes negative after retirement, supported the LCH. Huggett and Ventura (2000) also found household saving rates differed across age groups. This relationship has also been supported by cross-country macro data (Deaton & Paxson, 2000; Masson, Bayoumi, & Samiei, 1998). If working age people account for a high proportion of the population in a country, the aggregate household saving rate will be high. However, when this age cohort is close to retirement age or stops saving, the aggregate saving rate will decline. Masson and Tryon (1990) found that relatively higher proportions of the young and elderly by comparison to the working age cohort are related
to lower saving rates. Yuh and Hanna (2010) found that, when income and other variables were controlled, older households were less likely to save than were those with a household head under age 30.

*Education*

Education of the household head is also related to financial decisions, such as heavy debt burden, financial insecurity, and saving. Educational level is often assumed to represent financial literacy or cognitive ability to make financial decisions (Berry, Gruys, & Sackett, 2006). The level of financial insecurity is also related to the educational level of household head. Hanna, Yuh, and Chatterjee (2012) found that, compared to households with heads whose education level was less than a high school degree, those with heads who had some college or a college degree were more likely to have heavy financial burdens and a higher ratio of debt payment to income than the recommended cut-off level.

When financial security was defined as sufficient financial reserves needed to recover from household income declines, Hacker, Huber, Nichols, Rehm, and Craig (2011) found that 25.8% of U.S. households with heads lacking a high-school degree suffered a major economic loss each year between 2008 and 2010 compared to 15.8% of those in households with heads with a post-college education. Regarding saving decisions, Lusardi and Tufano (2011) found that households with heads having a college degree were more likely to use saving as a coping method for unexpected expenses than were households with heads having a high school degree or less. Other research also identified a positive relationship between education and saving (Fisher, 2013; Fisher & Montalto, 2010). Fisher and Montalto (2011) confirmed the positive relationship between
education and the likelihood of saving: each additional year of education increased the odds of saving by 4.3%. Yuh and Hanna (2010) also found that the likelihood of saving increased with education.

Marital status

Generally, married couples with no children have higher saving rates than households with children and single parents were found to have the lowest saving rates in the population (Browning & Lusardi, 1996; Fisher & Montalto, 2011). There were clear differences in saving among people coping with unexpected expenses during the recession. Divorced or widowed households had a lower predicted probability of depending on saving than did married households, whereas single households or never married households had a higher predicted probability of depending on saving than did married households (Lusardi & Tufano, 2011). Yuh and Hanna (2010) controlled for income, having a child, and other variables and found that single females were less likely to save than were married couples.

Children

Household composition also affects saving decisions. Yuh and Hanna (2010) found a negative relationship between the presence of a child under age 19 and the probability of saving. Lusardi and Tufano (2011) determined that households having children had a lower predicted probability of depending on saving for unexpected expenses, while households living with parents had more chances of depending on savings. However, Dynan et al. (2004) did not find any evidence of a relationship between saving rates and children, when income was held constant, which indicated that
inter-temporal decisions to smooth consumption through bequest saving motives alone may not be the primary reason why high-income households save more. On the other hand, they discussed the expectation for children to substitute for monetized savings to some extent. Children were viewed as an inter-temporal investment for transferring resources over the lifecycle of the parents from a period of relatively high adult productivity to a period of relatively low productivity in old age (Mason, Lee, Tung, Lai, & Miller, 2006).

*Foreseeable expenses in the next 5 to 10 years*

Having foreseeable expenses also affects saving decisions because saving is considered a reserve to cover both unforeseen and foreseen expenses. Rha, Hanna, and Montalto (2006) used foreseeable expenses as a behavioral lifecycle variable that measures a notion of self-control to examine the relationship between self-control and saving behavior and found a positive effect of self-control on saving.

Hu (2004) examined the role of foreseeable expenses and their type on saving and different household portfolio choices. He compared homeowners’ and renters’ asset allocation and found a negative influence of foreseeable future expenses on renters’ stock investment, and stock to liquidity assets. Renters were saving for a new home and having foreseeable future expenses made them risk averse and less likely to hold stocks.

Anong and Fisher (2013) examined the role of foreseeable expenses in saving decisions as a planned behavior and future orientation. The number of foreseeable major expenses in 5 to 10 years and the types of those expenses, including education, health, family, home purchases, and general expenses, affected the likelihood of both past saving decisions (already saved for it) and current saving decisions (saving for it now). A larger
number of saving expenses led to a higher likelihood of current saving and some major unforeseeable expenses, such as healthcare, were related negatively to the odds of both current and past saving.

Unemployment

The labor market is one of the areas in which huge changes occurred during the Great Recession and unemployment is well known to affect consumption and saving (Bricker et al., 2011; Hurd & Rohwedder, 2010). Hurd and Rohwedder (2010) found that unemployment had a negative effect on spending during the May 2009 to April 2010 waves. Both mean and median spending by unemployed households was lower when they were employed in the first period than was spending by households that were employed in both waves.

Health condition

Regardless of whether households have been through an economic recession or not, health condition is known to affect total wealth accumulation and asset composition. Households in poor health are less likely to hold risky assets (Rosen & Wu, 2003, Starr-McCluer, 1996). The relationship between saving and health condition is often identified as precautionary saving and is influenced by health insurance. If household heads are in poor health and do not have health insurance, they have higher out-of-pocket spending for health costs, and therefore, saving is lower. Starr-McCluer (1996) analyzed the relationships among precautionary saving, poor health, and health insurance, assuming that an uninsured household faces greater uncertainty in medical expenses than does an insured household that controls for health condition; thus, the uninsured household would
have more incentive to engage in precautionary saving. However, she found that U.S. households covered by private health insurance saved more than comparable uninsured households, which was inconsistent with her assumption.

According to self-reported spending changes, households cut spending on healthcare, such as doctors’ visits and prescription drugs during the recession (Hurd & Rohwedder, 2010). These reductions in healthcare spending were derived from reduced economic resources or pessimistic expectations about future economic resources, such as an increased likelihood of unemployment and the associated reduction in income.

_Understanding of the SCF survey questions_

Understanding of SCF survey questions is used as a proxy for financial sophistication, which measures the SCF interviewer’s assessment of the degree to which a householder understands personal finances (Smith, Finke, & Huston, 2012). Financial sophistication is defined as a household’s ability to avoid making mistakes (Calvet, Campbell, & Sodini, 2009). In general, households with a higher degree of financial sophistication are considered to have higher odds of understanding complex financial markets and therefore, of having better financial outcomes (Smith et al., 2012). Calvet et al (2009) found that more financially sophisticated households were more likely to have risky assets and invest more efficiently than individuals who were not.

Kimball and Shumway (2007) analyzed the relationship between financial sophistication and investments and diversification. They found that financial sophistication was correlated with behavior that financial economists recommend. More sophisticated investors were also more likely to participate in the stock market. Lusardi
and Mitchell (2007) found that, among baby boomer consumers, financially sophisticated households were related to the adequacy of saving for retirement.

_Credit constraints_

The study of the relationship between credit constraints and saving is associated with the role of capital market imperfections. If households cannot borrow the desired amount of money from financial institutions, saving will be higher than in perfect credit markets. Generally, a positive relationship between the two has been identified. Using the SCF 1983 data, Jappelli (1990) found that credit constraints increased both saving rate and the effect of growth on saving using the SCF 1983 data. He measured credit-constrained households as either those that were rejected for credit or discouraged from applying for it; these included 20% of the total number of households. This proportion was consistent with the proportion of households that exhibited excess sensitivity to current income fluctuations, supporting the assertion that the fraction was neither exogenous nor constant, but can vary depending on the lender’s and consumer’s behavior.

Deaton (1991) analyzed the relationship between liquidity constraints and precautionary saving motives, because the inability to borrow in time of need leads people to accumulate assets in good times. In fact, he found saving was positive when income was plunging, negative when income was increasing, and almost zero during normal good times.

Carroll and Kimball (2001) also analyzed the relationship between credit constraints and precautionary saving motives, focusing on the role of credit constraints, increasing risk, and income uncertainty. They explained the differential flexibility in
responding to income fluctuation or uncertainty according to whether households were constrained or not, and found a positive relationship. Constrained households, i.e., those with less flexibility, would not spread out the shocks over time, and thus would have a greater risk of a decrease in utility than would unconstrained households. Thus, the desire to reduce the risk induces precautionary saving.

On the other hand, Shea (1995b) indicated that liquidity constraints assume a positive relationship between consumption and expectations about future income increases, because liquidity constraints are associated primarily with the inability to borrow money when times are bad; that is, there is a greater response in positive than negative expectations on consumption expectations. Thus, liquidity constraints can lead to an asymmetric consumption response, although this response does not explain the empirical results that demonstrated a greater influence on consumption of an income decrease than increase.

2.8.2. Financial Attitude Variables

Preferences affect household financial decisions (Kahneman & Tversky, 1981), including inter-temporal decisions, such as saving and borrowing, and investment decisions, such as composition and allocation of an investment portfolio (Barsky, Juster, Kimball, & Shapiro, 1997; Hanna & Chen, 1997). Two variables that indicate household taste and preferences—risk tolerance and planning horizon—are included as financial attitude variables. Risk and time preferences and risk tolerance and planning horizon have been used widely in studies of financial decisions (Barsky et al., 1997).

*Risk tolerance*
Financial decisions may result in losses depending on the types of assets and the proportions allocated to each asset (Chavas, 2004). There are risky and non-risky assets and more risky and less risky assets. The choice has to do with which type of assets reflects one’s preference for risk or risk tolerance, which refers to a person’s attitude about accepting risk in their financial decisions. Household decisions are influenced not only by the degree of income uncertainty, but also by their degrees of tolerance to risk (Chang, 1993). In general, a greater aversion to risk will have a larger saving demand with respect to risky assets. Households divide savings between a diversified portfolio of risky and non-risky assets, with the weights determined by the household’s attitude toward risk (Heaton & Lucas, 1997).

Greater uncertainty increases households’ incentives to save as they seek to protect themselves against the higher likelihood of adverse outcomes and losses (Carroll, 1992; Deaton, 1991; Zeldes, 1989). With respect to risk and relative return, savings is one of the safest types of assets (Droms, 1987). So, when economic fluctuations increase, household demands for saving increase as well for precautionary purposes and to smooth consumption. Mody, Ohnsorge, and Sandri (2012) found that at least two-fifths of households had a sharp increase in saving rates between 2007 and 2009. Lusardi and Tufano (2011) also found that when U.S. households faced unexpected expenses, they listed savings as their first priority coping method among six methods, including savings, family or friends, mainstream credit, alternative credit, sale of possessions, and increased work.

Planning horizon
Inter-temporal decisions are related closely to the time period considered when making financial plans. Since inter-temporal decisions are based on relative tradeoffs between costs and benefits at different points in time (Frederick & Loewenstein, & O'Donoghue, 2002), the time horizon has been found to be an important determinant of saving decisions and is often captured as the marginal rate of substitution of current consumption for future consumption (Bryant & Zick, 2006).

Depending on the marginal rate of substitution—the willingness to exchange consumption in year one for consumption in year two—households can either be present oriented, with a high discount rate, and prefer current consumption to future consumption, or future oriented, with a lower discount rate, and more willing to delay current consumption. Households tend to value what they receive in the future differently than what they receive in the present, even though the total amount of consumption or type of consumption remains the same.

Planning horizon has a positive and significant effect on household financial well-being across credit card usage, saving, and retirement preparation decisions (Munnell, Sunden, & Taylor, 2001; Rutherford & DeVaney, 2009). Saving is one of the most direct and simple ways of analyzing inter-temporal consumption, where time preference is applied primarily to interpret households’ decision-making processes (Bhargava & Lown, 2006; Bryant & Zick, 2006; Fisher & Montalto, 2010; Rha et al., 2006). In general, households that prefer a long planning horizon have a higher likelihood of saving (Fisher & Montalto, 2010; Rha et al., 2006).
Chapter 3. Theory and Model

This chapter presents the theoretical models for household saving, describes the empirical specification for the estimating models, and states the research hypotheses.

3.1. Two Period Model

Fisher (1930) presented his theory of interest to illustrate how a household makes its consumption and saving decisions over time as inter-temporal decisions. He assumed a household lives only two periods and allocates income during the periods through saving and borrowing for current and future consumption. Three elements are used to present this allocation, total income (Y), total consumption (C), and total investment or savings (S). The two period model assumes that income in each period, \( Y_1, Y_2 \), income in the first period and income in the second period, respectively, are exogenous.

The budget constraint in the first period is,

\[
C_1 + S_1 = Y_1 \quad \text{Eq. (3-1)}
\]

\[
C_1 > 0, \quad S_1 < 0 \text{ or } S_1 > 0
\]

where the subscript denotes the time period. If \( S_1 > 0 \), the household is a lender; whereas, if \( S_1 < 0 \) the household is a borrower.

The household is assumed to have a preference ordering between present and
future consumption \((C_1, C_2)\) which consists of a continuous, cardinal utility function (Sandmo, 1970). Utility is a function of consumption today and consumption tomorrow and can be presented by,

\[
\max U = f(C_1, C_2) \quad Eq. (3-2)
\]

Future consumption or the budget constraint in the second period is represented by,

\[
C_2 = Y_2 + S_1(1 + r) \quad Eq. (3-3)
\]

Where \(r\) is the rate of interest, which is assumed to be known in this case of pure income risk, and \(Y_2\) is future income, which is not known in the first period. By rearranging terms in Eq. (3-3), \(S_1\) can be seen to be a function of consumption in period 2, income in period 2, and the interest rate.

\[
S_1 = \frac{C_2 - Y_2}{1+r} \quad Eq. (3-4)
\]

When substituting Eq. (3-4) into Eq. (3-1) and rearranging terms, we have equation Eq. (3-5)

\[
C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r} \quad Eq. (3-5)
\]

The right hand side of Eq. (3-5) represents the present value of lifetime disposable income or lifetime wealth and the left hand side of Eq. (3-5) represents the present value of lifetime consumption. Since \(r\) is the interest rate, thus \((1 + r)\) refers to the relative price of consumption in the second period in terms of consumption in the first period,
while the price of $C_2$ is normalized to one. This function expresses the degree of impatience for future consumption in terms of current consumption, and the relative time preference for the allocation of income to the first period and the second period which are all at the same level of utility, and can be represented as separate indifference curves.

From Eq. (3-3) and Eq. (3-4), we can write future consumption as,

$$C_2 = Y_2 + (Y_1 - C_1)(1 + r) \quad \text{Eq. (3-6)}$$

To maximize satisfaction over periods longer than a year, households need to allocate their income resources to consumption using saving and borrowing strategies. This theory can be used to derive optimal allocation of consumption to multiple periods. The optimal choice of the combination of current consumption and saving is assumed to maximize satisfaction under the given current and expected future financial resources, the price of consumption goods, and the interest rate (Bryant & Zick, 2006).

3.2. Loss Aversion Theory

According to prospect theory suggested by Kahneman and Tversky (1979), financial decision making under uncertainty is based on strong preferences for certainty and loss aversion. People are interested in value defined in terms of gains and losses compared to a reference point and interested in the different value functions between losses and gains (Plous, 1993). To explain the decisions, Kahneman and Tversky define a prospect $(x_1, p_1; \ldots; x_i, p_i)$ as a contract that yields outcome $x_i$, with probability $p_i$, where $p_1 + p_2 + \cdots + p_i = 1$ and $(x, p)$ as $(x, p; 0, 1-p)$ that yields $x$ with probability $p$ and 0 with probability $1-p$. Thus, the riskless prospect that yields $x$ with certainty is $(x)$. 

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They apply expected utility theory to choices between prospects by describing the utility function as (Kahneman & Tversky, 1979, p.263),

\[ U = \sum p_i u(x_i) \quad Eq. (3-7) \]

where \( u(x_i) \) is the utility of outcomes \( x_i \) with probabilities \( p_i \).

The utility function of prospect theory can be written as (Camerer, 2004, p.148),

\[ \sum \pi(p_i) v(x_i - R) \quad Eq. (3-8) \]

where \( \pi(p) \) is a function that weights probabilities nonlinearly, overweighting small probabilities, and underweighting larger probabilities. \( v(x_i - R) \) is the value function from a choice on the outcome, \( x_i \) compared to reference point, R. \( v(x) \) reflects the subjective value of that outcome, \( x \).

The value function of Kahneman and Tversky’s prospect theory can be rewritten in terms of consumption and a reference point.

\[ U = u(C, R) \quad Eq. (3-9) \]

where \( C \) is the individual’s consumption level and \( R \) is reference level of consumption.

Since prospect theory defines utility as value in terms of gains and losses, which are deviations from a reference point, the gain-loss utility function depends on the difference between consumption and the reference point, \( C-R \), rather than net wealth itself. Thus, the gain-loss function measures how people are affected by changes in consumption from a fixed reference point. This gain-loss utility function can be rewritten as (Bowman et al., p.156),
\[ U(C_i, R) = w(R) + v(C_i - R) \quad \text{Eq. (3-10)} \]

where \( v(C_i - R) \) is the gain-loss utility function, and \( w(R) \) is the reference utility.

The following assumptions about the gain-loss utility function, \( v(\cdot) \), are incorporated into Kahneman and Tversky’s Prospect theory (Bowman et al., 1999, p.157).

\( v(x) \) is strictly increasing in \( x \) \quad \text{Assumption (1)}

According to Kahneman and Tversky (1979), \( v(x) \) for losses is different from that of gains. The utility function is concave when consumption increases above a reference point, gains, while the utility function is convex when consumption declines below the reference point, losses. This function is characterized by diminishing marginal sensitivity to deviations from a reference point, in other words the marginal utility of a gain from consumption decreases as the gain increases; whereas the marginal disutility of a loss from consumption decreases as the loss increases (Kahneman & Tversky, 1979, p.278).

\( v(x) \) is strictly concave for \( x > 0 \) and strictly convex for \( x < 0 \)

\quad \text{Assumption (2)}

This theory also assumes that the convex function for losses is relatively steeper than that for gains, which implies loss aversion. Loss aversion is exhibited if the value of a loss \( -x \) is larger in magnitude than the value of an equal-sized gain, \( x \) (Kahneman & Tversky, 1979, p.279).

\( -v(-x) > v(x) \) for \( x > 0 \) \quad \text{Assumption (3)}
Here, the steeper utility function for losses means households care more about losses relative to the reference point than about gains. Losses are felt more strongly than equivalent gains (Plous, 1993). Loss aversion means that the marginal disutility of a loss is strictly greater than the marginal utility of an equivalent gain. It is equivalent to the condition (Kahneman & Tversky, 1979, p.279),

\[
v(y) + v(-y) > v(x) + v(-x) \text{ for } x > y > 0 \quad Assumption (4)
\]

In prospect theory, the value of choices or the utility function is defined in terms of consumption and a reference point that determines relative gains and losses. Households are interested in how different their consumption level is from the reference point. In this sense, loss aversion is a relative aversion to losses even when comparing very small losses to very small gains. If \( x > 0 \), households perceived marginal disutility from a loss is greater than marginal utility from a gain (Bowman et al., 1999, p.157).

\[
\lim_{x \to \infty} \frac{v'(-x)}{v'(x)} = L > 1 \text{ for } x > 0 \quad Assumption (5)
\]

When comparing the marginal disutility of losses to the marginal utility of gains, households perceive the disutility of losses 2 to 2.5 times more strongly than the utility of gains according to empirical research (Bowman et al., 1999, p.158).

\[
v'(y) > 2v'(x) \text{ for } x \geq 0, y < 0 \quad Assumption (6)
\]

To perceive gains and losses and to measure the utility from those relative deviations from a reference point, the reference point is important. In particular, for inter-temporal decisions future reference points can be affected by current choices: Today’s
reference point is determined by choices in the last period. When both a reference point and consumption level equally increase, marginal utility is non-increasing (Bowman et al., 1999, p.158).

\[ U_R(R, C) + U_C(R, C) \geq 0. \quad U_{RR}(R, C) + 2U_{RC}(R, C) + U_{CC}(R, C) \leq 0 \]

*Assumption (7)*

Bowman et al. (1999) normalize \( v(C_i - R) \) to be equal to zero if \( C=R \). So \( v(0)=0 \) and \( U(R, R) = w(R) \). When \( U(R, R) \), \( w(R) \) can be interpreted as reference-adjusted utility, in which a household’s consumption level is accustomed to the reference point in terms of habit formation. So, if a household is currently deprived of a given level of consumption to which the household has been accustomed, they are likely to feel a greater sense of loss (Bowman et al., 1999, p.159).

\[ U(R, C) \text{ is decreasing in } r \text{ when } R > C, \text{ and increasing in } r \text{ when } R < C \]

*Assumption (8)*

A household gets more satisfaction from a fixed consumption level than from variable consumption even when it is lower than their reference point. When fixing a consumption level, \( c \), the nearer \( r \) is to \( c \) the greater the utility from consumption, \( c \), is achieved (Bowman et al., 1999, p.159).

\[ w'(x) < v'(y) \text{ for all } x \geq 0 \text{ and all } y \geq 0, \]

\[ w'(x) < v'(y) \text{ for all } x \geq 0, \text{ all } y \leq 0 \]

*Assumption (9)*

3.3. Loss Aversion with a Two Period Model
This study revisits Bowman et al. (1999). For simplicity, this theoretical discussion assumes no discounting, no liquidity constraints, no interest earned from savings, and no negative consumption in each period, so the consumer cannot borrow against uncertain future income in the current period. The maximization of expected utility between two periods can be written by (p.159),

$$U(R_1, C_1; R_2, C_2) = w(R_1) + v(C_1 - R_1) + E\{w(R_2) + v(C_2 - R_2)\} \quad Eq.(3-11)$$

$$s.t. C_1 + C_2 = Y_1 + Y_2 \quad Eq.(3-12)$$

where $R_t$ is the reference level in time period, $t$, $C_t$ is the consumption in the time period $t$, and $Y_t$ is income in the time period, $t$.

The reference point formation is understood as habit formation in consumption. The reference of the first period $R_1$ is taken as exogenously determined and the second period reference point, $R_2$ is determined by $R_1$ and $C_1$ (Bowman et al., 1999, p.160).

$$R_2 = (1 - \alpha)R_1 + \alpha C_1 \quad Eq.(3-13)$$

Where $\alpha$ is the speed at which the reference point changes in response to recent consumption, $0 \leq \alpha \leq 1$. Utility is time-separable if $\alpha = 0$, where consumption of the first period $C_1$, has no effect on the reference point in the second period, $R_2$. Utility is time-inseparable if $\alpha = 1$, where the $R_2$ completely reflects $C_1$. This equation describes the utility of households from consumption in the second period as depending on how much households consumed in the first period through the effect of previous consumption on the current reference point. If $C_1$ is high, $R_2$ will also be high and they will be
disappointed if \( C_2 < R_2 \), since they would perceive their satisfaction or utility in the second period as cut (Camerer, 2004). Current or past value of income can be considered a reference point, to which the households compare fluctuations during certain periods of time in the economy. The difference between the current or past value of income and any changes that occur in those values would then be regarded as gains or losses (Golder & Tellis, 1998). These relative gains and losses may have an impact on their saving choices even though these fluctuations would not actually change the value of their income.

When income uncertainty is considered, an increase in uncertainty can either increase or decrease consumption and saving. Contrary to the prediction of consumption under income certainty, in which habit formation leads households to focus on losses in the first period, they can postpone these losses as long as there is some chance that future income will be high enough to avoid taking a possible loss. According to Bowman et al (1999)’s theorem (p.161),

\[
\text{If assumption (1), (2), (3), (4), (5), (7), and (8)}
\]

\[
\text{hold and } P[Y \geq R_1] \geq \frac{\alpha}{1 + \alpha}, \text{ or}
\]

\[
\text{if assumptions (1), (2), (3), (4), (5), (6), and (7)}
\]

\[
\text{hold and } P[Y \geq R_1] \geq \frac{2\alpha}{1 + \alpha},
\]

\[
\text{then } C_1 \geq R_1 \text{ whenever } P[Y \geq 0.5R_1] = 1 \quad \text{Eq.(3-14)}
\]

where \( \alpha = \) the speed at which the reference point changes in response to recent consumption, \( 0 \leq \alpha \leq 1 \). Households resist reducing consumption in response to sufficient probability or expectations that they may not be able to maintain their level of consumption. The above theorem suggests that as long as future income is greater than
the reference point with at least probability \( \frac{\alpha}{1+\alpha} \), consumption in the first period will be at or above the reference point no matter how low their expected lifetime income is. The result is derived from loss aversion characteristics, such as risk taking preferences in losses and reference point dependence. Under uncertainty, there is a strong tendency to delay potential losses hoping that future income will cover any loss (dissaving) from the current decision, implying an asymmetry in consumption and saving decisions under loss aversion. Although consumption in the first period is not below the reference level, \( C_1 \geq R_1 \), the probability of gain, \( P[Y \geq R_1] \), greater than the given bounds, \( \frac{\alpha}{1+\alpha} \) and \( \frac{2\alpha}{1+\alpha} \), does not mean consumption in the first period always will be above the reference level when the probability of a gain exceeds the bounds (Bowman et al., 1999, p.162).

\[
U(C, R) = (wr + \frac{1}{1-\gamma} b_g + C - R)^{1-\gamma} \text{ if } C > R \quad Eq.(3-15a)
\]

\[
(wr - \frac{1}{1-\gamma} b_g + C - R)^{1-\gamma} \text{ if } C \leq R \quad Eq.(3-15b)
\]

\[
Y_1 = R_1, \quad Prob(Y_2 = Y_h) = Prob(Y_2 = Y_l) = \frac{1}{2} \quad Eq.(3-15c)
\]

The above utility over gains and losses suggests households postpone consumption decreases whenever news is bad either for \( \alpha = 0 \) or \( \alpha = 1 \). This is only supported under the condition that first period consumption remains at the reference level where \( \alpha = 1 \) when there is a zero probability of a gain. So, a 1% decline in expected income change causes a 1% decline in expected consumption growth. However, a 1% increase in expected income change leads to less than a 1% increase in expected consumption growth by raising consumption in the first period. Thus, decisions under
loss aversion show an asymmetric response based on the expected growth rate of consumption as a function of the expected growth rate of income.

On the other hand, when loss aversion is not considered, when $\alpha = 0$, the life cycle hypothesis (LCH) and permanent income hypothesis (PIH), in which the expected growth rate of consumption is unrelated to the expected growth rate of income, can be applied to analyses of saving decisions. When $\alpha$ is this shows habit formation in which the expected consumption growth is related to the expected income change but shows a symmetric relationship between expected consumption growth and expected income change unlike where $\alpha = 1$ in loss aversion with an asymmetric relationship (Bowman et al., 1999).

When changes in uncertainty are considered, loss aversion theory can provide different predictions about saving in response to expected income change from a conventional, time-separable, concave-utility model, in which households are supposed to increase saving in response to increased income uncertainty. Bowman et al. (1999) found that an increase in uncertainty can either increase or decrease saving (p.164).

**Proposition:** Let $C_1(Y, k)$ be the consumer's first-period consumption when faced with probabilistic total income $((1 - k)Y, (1 + k)Y)$, where $k \in [0,1]$. (i) If $A.(1), A.(2), A.(3), A.(4), A.(5), A.(6)$, and $A.(8)$ holds and $\alpha > 0$, then there exists $Y^* < R_1$ such that for all $Y \in (Y^*, R_1)$ and $k$ satisfying $(1 - k) Y > 0.5R_1$, $C_1(Y, k) > C_1(Y, 0)$. (ii) If $A.(1), A.(2), A.(3), A.(4), A.(5), A.(6), A.(8)$, and $A.(9)$ hold, then there exists $k^* > 0$ and $Y^* > R_1$ such that for all $Y \in (R_1, Y^*)$ and all $k < k^*$, $C_1(Y, 0) > c_1(Y, k)$.

Where $Y^*$ is expected average per period income and $k$ is uncertainty of future income and probability of not being able to maintain the current consumption level or standard of living. Part (i) of the above proposition posits that when expected income, $Y^*$, is slightly below the reference point, $R_1$, an increase in the odds that a household will be
able to consume above their reference point, \((1 - k) Y > 0.5R_1\), will decrease saving, \(C_1 (Y,k) > C_1 (Y,0)\). On the other hand, part (ii) illustrates that if expected income is slightly above the reference point, \(Y^* > R_1\), increasing uncertainty, \(k < k^*\), will raise saving, \(C_1 (Y,0) > C_1 (Y,k)\). This is because an increase in uncertainty means raising the probabilities of not being able to maintain the current consumption level, and thus, households will increase saving even if expected income exceeds the reference point.

Thus, households may not cut their current consumption even after getting bad news about their future income. According to loss aversion theory of consumption, reducing current consumption means consuming below the reference point this period, which makes households feel awful. Households are willing to take a risk, hoping that the next period income might not be so low. This risk loving attitude toward losses causes the asymmetric response of consumption change in response to expected income increase and decrease and implies that negative income expectations could have bigger impact on saving decisions than positive income expectation.

### 3.4. Theory of Consumption and Saving

Studies of household saving decisions have been examined in terms of consumption theory (Browning & Lusardi, 1996; Sandmo, 1970; Tin, 2000). Theories of consumption are used because saving is believed to be the part of income not spent on current consumption or the residual between income and current consumption (Browning & Lusardi, 1996). Inherent in the concept of saving as a residual is the belief that saving does not provide utility directly, or phrased another way, saving does not provide utility in the current time period. This approach has led to a large body of empirical literature on
saving decisions based on consumption theory. On the other hand, many empirical studies of saving are viewed as more descriptive and lack any theoretical background (Browning & Lusardi, 1996). Thus, to connect consumption and saving decisions of households, interchangeably described in the above studies, this study combines microeconomic theory with a model of saving and consumption decisions based on aggregate consumption and saving. This study uses both saving models and consumption models from the aforementioned theories.

Application of macroeconomic theory to micro data or vice versa has been found in many studies of financial decisions (Bourguignon, Branson, & De Melo., 1992; Daly, Duncan, Kaplan, & Lynch, 1998). In particular, Bowman et al. (1999), Campbell & Mankiw (1991), and Shea (1995a, 1995b) applied microeconomic theories, such as loss aversion theory and the two period model, to macrolevel data. This study applies microeconomic theories to household level data, but also incorporates an empirical specification previously used with macroeconomic data.

Theoretically, we assume that income may be allocated to consumption and saving as presented in Eq. (1)

\[ Y = C + S \quad Eq. (3-16) \]

We can rewrite the above equation as the relationship between saving and income.

\[ S = f(Y) = Y-C \quad Eq. (3-17) \]

This saving function or propensity to save relates the level of saving to the level of income and can be rewritten using Keynesian marginal analysis in terms of the
relationship between changes in income and changes in saving or change in income and change in consumption. Empirically, this marginal approach fits well at both the aggregate level and the household level, in particular, explaining saving decisions (Gupta, 1970).

The marginal propensity to save (MPS) is change in saving divided by the change in income and the marginal propensity to consume (MPC) is change in consumption divided by the change in income. Because we assumed the sum of consumption and saving is equal to income, MPC+MPS=1 (Blanchard, 2006).

The saving function can be derived from the consumption function represented as a relationship between consumption and income.

\[ C = a + bY \quad Eq. \ (3-18) \]

where \( a \) is the intercept of the consumption function, minimum consumption regardless of how much you have income, and \( b \) is the slope of the function, change in consumption per one unit change in income (MPC). The consumption function has the conditions \( a > 0 \), and \( 0 < b < 1 \), where \( a > 0 \) means that even if income \( \leq 0 \), consumption will still be positive and \( 0 < b < 1 \) means that the MPC is positive and less than one (Bryant & Zick, 2006; Blanchard, 2006).

Then using eq. (2) and eq. (3), we can solve for saving:

\[ S = Y-C=-a + (1-b) Y \quad Eq. \ (3-19) \]

Where \(-a\) is the intercept or the level of autonomous saving and \((1 - b)\) is the slope of the saving function, MPS, change in saving per one unit change in income. As a negative intercept indicates, the saving function can be negative at zero or low level of
income when households dissave. The saving function has a positive slope because the MPS is positive. In this sense, the saving function is a corollary of the consumption function. Thus, this link between consumption and saving can be extended to a more general relationship between consumption and saving theory; the consumption function implies a saving function and the MPS is the inverse of the MPC (Blanchard, 2006; Dopfer, 2001).

3.5. Lamda Model

Empirical models estimating the relationship between consumption growth and current income change and deviation from normal income often enforce constraints on the coefficients to be consistent with life cycle hypothesis (LCH) or permanent income hypothesis (PIH) (Bowman et al., 1999; Campbell & Mankiw, 1991; Shea, 1995). The Lamda (λ) model proposed by Campbell and Mankiw (1991) was extended by Shea to estimate the influence of current income growth on consumption growth (1995a, 1995b). As indicated above, this study extends, the λ model of consumption to estimate the relationship between income change and saving growth. To estimate the specific effect of projected income change on saving growth, the basic λ model is presented using β as follows (Campbell & Mankiw, 1989, 1990, 1991; Shea, 1995),

$$\Delta S_t = \mu + \beta \Delta \bar{Y}_t + \epsilon_t \quad Eq. \ (3-20)$$

where $\Delta S_t$ is saving growth between time t and t-1, and $\Delta \bar{Y}_t$ is expected income change between t and t-1. Expected income change is estimated by regressing income change on a set of household socio-demographic characteristics at time t-1.
To estimate different $\beta$ for positive and for negative expected income change, the following regression equation is proposed (Bowman et al, 1999; Shea, 1995).

$$\Delta S_t = \mu + \beta_1 (POS_t)(\Delta \bar{Y}_t) + \beta_2 (NEG_t)(\Delta \bar{Y}_t) + \epsilon_t \text{ Eq. (3-21)}$$

Where $POS$ is a dummy variable for positive expected income change between $t$ and $t-1$ and $NEG$ is a dummy variable for negative expected income change between $t$ and $t-1$. Loss aversion theory of consumption hypothesizes saving responses to expected income change can either be positive or negative. In particular, under increased income uncertainty, households can either decrease or increase saving as indicated in the previous proposition. When expected income is slightly below the reference level and an increase in the probability of being able to consume above the reference level will lead to a decrease in saving compared to decision under certainty. On the other hand, increasing the probability of not being able to consume the reference level will lead to an increase in saving even if expected income is slightly above the reference point. Therefore, depending on the uncertainty degree, the relationship between expected income change and saving growth can be different and saving will also respond differently both to expected income rises and declines, showing an asymmetry.

3.6. Study Model

Following are two proposed empirical models: Model 1 is for saving decisions using a continuous variable, saving as measured by changes in non-housing net worth excluding capital gains between 2007 and 2009 whereas Model 2 is for saving decision using a dichotomous variable, whether households saved or not in 2009. Model 1 focuses
on how much actual savings occurred over the recession while Model 2 focuses on how the decision at a certain point has been made after the recession from a behavioral perspective rather than the value of savings. This study hypothesized that the dependent variables in each model are a function of deviation from normal income, expected income change, change in uncertainty about the future income, financial attitude, and demographic characteristics.

*Model 1.*  
\[
\]

*Model 2.*  
\[
\text{Whether or not saved in 2009} = f (\text{deviation from normal income 2007, expected income change between 2007 and 2009, uncertainty change between 2007 and 2009, financial attitude variables 2007, and socio-demographic variables 2007})
\]

These saving models are analogous to the Shea (1995a, 1995b) regression models that tested the LCH/PIH model using consumption growth between \(t-1\) and \(t\) as a dependent variable. Since the focus of this research is on an inter-temporal saving decision of households, this study uses savings between 2007 and 2009 as a dependent variable in the model besides whether or not saved in 2009. To simplify the model, this study assumes household total income may be allocated only to total consumption (C), and total investment or savings(S), based on the two period model of the inter-temporal decision on saving and consumption.
Unlike the classical LCH/PIH assumption in which both expected transitory income change and deviation from normal income should not affect consumption and thus, coefficients should be equal to 0, this study tested whether the coefficients of the explanatory variables on the right hand side are zero or not based on the loss aversion theory in which consumption and saving decisions can be affected by expected income change and deviation from normal income.

Studies have indicated that the sensitivity of consumption changes to the expected income change are different between the negative and positive expected income change and similar differences should be expected for saving (Bowman et al., 1999; Campbell & Mankiw, 1989; Shea, 1995). When households do not immediately respond to expected future income declines, they should respond more at the time income actually declines. Empirically, the coefficient of negative expected future income was higher than that of positive expected future income (Bowman et al., 1999). Therefore, this study tested whether or not the coefficient of the negative expected income change on saving decisions is statistically different from positive expected income change. Size and signs of the coefficients between negative and positive expectations were tested. To identify possible difference derived from measurement issue in analyzing the effects on saving decisions, this study used both objective expected income change and subjective expected income change and also employed two sample groups based on objective expected income change, positive and negative expected income change. The detailed information on subsamples is provided in methods section.

Income uncertainty and its degree change between the two periods is also considered. The level of future income uncertainty is known to affect consumption and
saving decisions (Carroll, 1994; Fisher & Montalto, 2011; Sandmo, 1970). Although objective financial position or condition of households stays the same, changes in the perceived future income uncertainty can lead to different consumption and saving decisions. Usually, greater income uncertainty or higher income risk leads to lower current consumption, or higher saving (Lusardi, 1998; Sandmo, 1970). However, under the loss aversion tendency, income uncertainty increases can either decrease or increase saving (Bowman et al, 1999). Thus, this study estimated the effect of future income uncertainty change over the two periods on saving decisions.

3.6.1. Model 1

In Model 1 saving is measured by changes in non-housing net worth excluding capital gains between 2007 and 2009. Model 1 is estimated using both objective and subjective measures of expected income change.

3.6.1.1 Objective Expected Income Change

\[
\Delta Saving_{2007,2009} = a_0 + a_{11k}Dev(\Delta Inc -)_{2007} + a_{21k}Dev(\Delta Inc 0)_{2007} + a_{31k}Exp(\Delta Inc)_{2007,2009} + a_{41k}(\Delta Uncy +)_{2007,2009} + a_{51k}(\Delta Uncy 0 +)_{2007,2009} + a_{61k}(\Delta Uncy 0 -)_{2007,2009} + a_{71k}Ft_{2007} + a_{81k}Demog_{2007} + \epsilon_{2007}
\]

where \(a_{ijk}, i = \text{explanatory variables, } j = \text{models (Model 1=1, Model 2=2)}, k = \text{sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)\}
Dev(ΔInc−) is negative deviation from normal income, measured in 2007, Dev(ΔInc 0) is about the same as normal income, measured in 2007, Exp(ΔInc) is expected income change between 2009 and 2007, (ΔUncty+) is increased income uncertainty change between 2007 and 2009, (ΔUncty 0+) is stayed positive income uncertainty change between 2007 and 2009, (ΔUncty 0−) is stayed negative income uncertainty change between 2007 and 2009, Ft is financial attitude variable in 2007, demog is socio-demographic variable in 2007, and ε is an error term in 2007.

Dev(ΔInc+) is positive deviation from normal income, the reference category, measured in 2007, and (ΔUncty−) is decreased income uncertainty change between 2007 and 2009, the reference category.

### 3.6.1.2 Subjective Expected Income Change

\[
\Delta Saving_{2007,2009} = b_0 + b_{11} \text{Dev}(\Delta Inc -)_{2007} + b_{21} \text{Dev}(\Delta Inc 0)_{2007} + b_{31} \text{Exp}(\Delta Inc -)_{2007,2009} + b_{41} \text{Exp}(\Delta Inc 0)_{2007,2009} + b_{51} (\Delta Uncty +)_{2007,2009} + b_{61} (\Delta Uncty 0 +)_{2007,2009} + b_{71} (\Delta Uncty 0 -)_{2007,2009} + b_{81} Ft_{2007} + b_{91} Demog_{2007} + \varepsilon_{2007}
\]

where \(b_{ij}\), \(i\) = explanatory variables, \(j\) = models (Model 1=1, Model 2=2)

Dev(ΔInc−) is negative deviation from normal income, measured in 2007, Dev(ΔInc 0) is about the same as normal income measured in 2007, Exp(ΔInc −) is negative expected income change between 2007 and 2009, Exp(ΔInc 0) is about the same expected income change between 2007 and 2009, (ΔUncty+) is increased income
uncertainty change between 2007 and 2009, \((\Delta \text{Unc}ty_0+)\) is stayed positive income uncertainty change between 2007 and 2009, \((\Delta \text{Unc}ty_0-)\) is stayed negative income uncertainty change between 2007 and 2009, \(Ft\) is financial attitude variable in 2007, \(demog\) is socio-demographic variable in 2007, and \(\varepsilon\) is an error term in 2007. 

\(Dev(\Delta\text{Inc}+)\) is positive deviation from normal income, the reference category, measured in 2007, \(Exp(\Delta\text{Inc}+)\) is positive expected income change between 2007 and 2009, the reference category, and \((\Delta \text{Unc}ty-)\) is decreased income uncertainty change between 2007 and 2009, the reference category.

### 3.6.2. Model 2

Model 2 is a qualitative dependent variable indicating whether households saved or not in 2009.

#### 3.6.2.1 Objective Expected Income Change

\[
\Delta \text{Saving}_{2007,2009} = a_0 + a_{12k} \cdot Dev(\Delta \text{Inc} -)_{2007} + a_{22k} \cdot Dev(\Delta \text{Inc} 0)_{2007} + a_{32k} \cdot Exp(\Delta \text{Inc})_{2007,2009} + a_{42k} \cdot (\Delta \text{Unc}ty +)_{2007,2009} + a_{52k} \cdot (\Delta \text{Unc}ty 0 +)_{2007,2009} + a_{62k} \cdot (\Delta \text{Unc}ty 0 -)_{2007,2009} + a_{72k} \cdot Ft_{2007} + a_{82k} \cdot demog_{2007} + \varepsilon_{2007}
\]

where \(a_{ijk}, i=\text{explanatory variables}, j=\text{models (Model 1=1, Model 2=2), k=sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)}\)
Dev(ΔInc−) is negative deviation from normal income, measured in 2007, Dev(ΔInc 0) is about the same as normal income, measured in 2007, Exp(ΔInc) is expected income change between 2009 and 2007, (ΔUncty+) is increased income uncertainty change between 2007 and 2009, (ΔUncty 0+) is stayed positive income uncertainty change between 2007 and 2009, (ΔUncty 0−) is stayed negative income uncertainty change between 2007 and 2009, Ft is financial attitude variable in 2007, demog is socio-demographic variable in 2007, and ε is an error term in 2007.

Dev(ΔInc+) is positive deviation from normal income, the reference category, measured in 2007, and (ΔUncty−) is decreased income uncertainty change between 2007 and 2009, the reference category.

3.6.2.2 Subjective Expected Income Change

\[ Saved_{2009} = b_0 + b_{12} \text{Dev}(\Delta Inc -)_{2007} + b_{22} \text{Dev}(\Delta Inc 0)_{2007} + b_{32} \text{Exp}(\Delta Inc -)_{2007,2009} + b_{42} \text{Exp}(\Delta Inc 0)_{2007,2009} + b_{52}(\Delta \text{Uncty} +)_{2007,2009} + b_{62}(\Delta \text{Uncty} 0 +)_{2007,2009} + b_{72}(\Delta \text{Uncty} 0 -)_{2007,2009} + b_{82} Ft_{2007} + b_{92} \text{Demog}_{2007} + \varepsilon_{2007} \]

where \( b_{ij}, i \) = explanatory variables, \( j \) = models (Model 1=1, Model 2=2)

Dev(ΔInc−) is negative deviation from normal income, measured in 2007, Dev(ΔInc 0) is about the same as normal income measured in 2007, Exp(ΔInc −) is negative expected income change between 2007 and 2009, Exp(ΔInc 0) is about the same expected income change between 2007 and 2009, (ΔUncty+) is increased income uncertainty change between 2007 and 2009, (ΔUncty 0+) is stayed positive income uncertainty change between 2007 and 2009, (ΔUncty 0−) is stayed negative income uncertainty change between 2007 and 2009.
uncertainty change between 2007 and 2009, \( F_t \) is financial attitude variable in 2007, \( demog \) is socio-demographic variable in 2007, and \( \epsilon \) is an error term in 2007.

\( Dev(\Delta Inc+) \) is positive deviation from normal income, the reference category, measured in 2007, \( Exp(\Delta Inc +) \) is positive expected income change between 2007 and 2009, the reference category, and \( (\Delta Uncty-) \) is decreased income uncertainty change between 2007 and 2009, the reference category.

3.7. Research Hypotheses

Based on loss aversion theory under uncertainty and on the empirical literature on saving decisions, the following hypotheses for each model are proposed.

3.7.1. Effect of Deviation from Normal Income

Hypothesis 1: Holding other things constant, deviation from normal income will affect both saving decisions, savings between 2007 and 2009 and whether saved or not in 2009.

\[
H_{01}: a_{1jk} = a_{2jk}; \quad b_{1j} = b_{2j} \\
H_{1-1}: a_{1jk} \neq a_{2jk}; \quad b_{1j} \neq b_{2j} \\
H_{02}: a_{2jk} = 0 \; or \; b_{2j} = 0 \\
H_{1-2}: a_{2jk} \neq 0 \; or \; b_{2j} \neq 0
\]

where \( a_{ijk}, i \) and \( b_{ij}, i = \) explanatory variables, \( j = \) models (Model 1=1, Model 2=2), \( k = \) sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)
3.7.2. Asymmetric Effects of Deviation from Normal Income

Hypothesis 2: Holding other things constant, there will be a difference in saving decisions, savings between 2007 and 2009 and a difference in whether or not saved in 2009, between positive deviation from normal income and negative deviation from normal income.

\[ H_0: a_{1jk} = 0 \text{ or } b_{1j} = 0, \text{ if positive deviation is omitted group} \]

\[ H_2: a_{1jk} \neq 0 \text{ or } b_{1j} \neq 0 \text{ if positive deviation is omitted group} \]

where \( a_{ijk}, i \) and \( b_{ij}, i \) = explanatory variables, \( j \) = models (Model 1=1, Model 2=2), \( k \) = sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)

3.7.3. Effects of Expected Income Change

Hypothesis 3a: Holding other things constant, objective expected income change will affect both saving decisions, savings between 2007 and 2009 and whether or not saved in 2009.

\[ H_{0a}: a_{3jk} = 0 \text{ for every } k, \]

\[ H_{3a}: a_{3jk} \neq 0 \text{ for every } k \]

where \( a_{ijk}, i \) = explanatory variables, \( j \) = models (Model 1=1, Model 2=2), \( k \) = sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)
Hypothesis 3b: Holding other things constant, subjective expected income change will affect both saving decisions, savings between 2007 and 2009 and whether or not saved in 2009.

\[ H_{01}: b_{3j} = b_{4j} \]
\[ H_{3b-1}: b_{3j} \neq b_{4j} \]
\[ H_{02}: b_{4j} = 0 \]
\[ H_{3b-2}: b_{4j} \neq 0 \]

where \( b_{ijk}, i = \text{explanatory variables}, j = \text{models (Model 1=1, Model 2=2)} \)

3.7.4. Asymmetric Effects of Expected Income Change

Hypothesis 4a: Holding other things constant, there will be a difference in saving decisions, savings between 2007 and 2009 and a difference in whether or not saved in 2009, between positive expected income change and negative expected income change when using objective expected income change measure.

\[ H_0: a_{3j1} = a_{3j2}, \]
\[ H_{4a}: a_{3j1} \neq a_{3j2} \]

where \( a_{ijk}, i = \text{explanatory variables}, j = \text{models (Model 1=1, Model 2=2)}, k = \text{sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)} \)

Hypothesis 4b: Holding other things constant, there will be a difference in saving decisions, savings between 2007 and 2009 and a difference in whether or not saved in
2009, between positive expected income change and negative expected income change when using subjective expected income change measure.

\[ H_0: b_{3j} = 0, \text{if positive expected income change is omitted group} \]

\[ H_{4b}: b_{3j} \neq 0, \text{if positive expected income change is omitted group} \]

where \( b_{ij}, i = \text{explanatory variables, } j = \text{models (Model 1=1, Model 2=2)} \)

### 3.7.5. Effect of Uncertainty Change

Hypothesis 5: Holding other things constant, uncertainty change will affect both saving decisions, savings between 2007 and 2009 and whether or not saved in 2009.

\[ H_{01}: a_{4jk} = a_{5jk}; b_{5j} = b_{6j}, \]

\[ H_{5-1}: a_{4jk} \neq a_{5jk}; b_{5j} \neq b_{6k}; \]

\[ H_{02}: a_{4jk} = a_{6jk}; b_{5j} = b_{7j}, \]

\[ H_{5-2}: a_{4jk} \neq a_{6jk}; b_{5j} \neq b_{6j}; \]

\[ H_{03}: a_{5jk} = 0, a_{6jk} = 0; b_{6j} = 0, b_{7j} = 0, \]

\[ H_{5-3}: a_{5jk} \neq 0, a_{6jk} \neq 0; b_{6j} \neq 0, b_{7j} \neq 0 \]

where \( a_{ijk}, i = \text{explanatory variables, } j = \text{models (Model 1=1, Model 2=2)}, k = \text{sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)} \)
3.7.6. Asymmetric Effects of Income Uncertainty Change

*Hypothesis 6a:* Holding other things constant, there will be a difference in saving decisions, savings between 2007 and 2009 and a difference in whether or not saved in 2009, between decreased income uncertainty over the two periods and increased income uncertainty over the two periods.

\[ H_{0a}: a_{4jk} = 0 \text{ or } b_{5j} = 0 \]

*if decreased income uncertainty is omitted group*

\[ H_{6a}: a_{4jk} \neq 0 \text{ or } b_{5j} \neq 0 \]

*if decreased income uncertainty is omitted group*

where \( a_{ijk}, i \text{ and } b_{ij}, i \) = explanatory variables, \( j \) = models (Model 1 = 1, Model 2 = 2), \( k \) = sample groups (Group 1 = Expected income change is positive, Group 2 = Expected income change is negative)

Hypothesis 6b: Holding other things constant, there will be a difference in saving decisions, savings between 2007 and 2009 and a difference in whether or not saved in 2009, between stayed positive income uncertainty over the two periods and stayed negative income uncertainty over the two periods.

\[ H_{0b}: a_{5jk} = a_{6jk}; b_{6j} = b_{7j}, \]

\[ H_{6b}: a_{5jk} \neq a_{6jk}; b_{6j} \neq b_{7j} \]
where $a_{ijk}, i$ and $b_{ijk}, i =$ explanatory variables, $j=$ models (Model 1=1, Model 2=2), $k=$ sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)

3.7.7. Equality test

Hypothesis 7: Holding other things constant, there will be a difference in estimated coefficients of above variables, deviation from normal income, expected income change, and uncertainty change, on saving decisions between positive income expectation group and negative income expectation group.

$$H_0: a_{1i\neq k} = a_{2i\neq k},$$

$$H_7: a_{1i\neq k} \neq a_{2i\neq k}$$

where $a_{ijk}, i$ and $b_{ijk}, i =$ explanatory variables, $j=$ models (Model 1=1, Model 2=2), $k=$ sample groups (Group 1=Expected income change is positive, Group 2=Expected income change is negative)
Chapter 4. Analytical Procedure

4.1 Data and Sample

4.1.1. Data

This study used the 2007-2009 Survey of Consumer Finances (SCF) panel dataset. The SCF is normally conducted as a triennial cross-sectional survey in order to provide reliable and detailed information on the financial circumstance of U.S. households to the Board of Governors of the Federal Reserve System since 1983. Over the 1983–1989 and 2007–2009 periods, panel data were also collected. Respondents to the 1983 survey were re-interviewed both in 1986 and in 1989. Participants in the 2007 SCF were re-interviewed in 2009. No further SCF panel interviews have been conducted.

Questionnaires are at the microeconomic level of the individual household. The survey data include information on a variety of aspects of household finances, including assets, debts, income, saving, investments, pensions, and credit card usage. The SCF also includes a wide range of information on individual attitudes in financial decision making, such as risk preference, planning horizon, saving rules and goals, and credit card behavior. The 2009 SCF follow-up interview focused on a smaller set of variables that were useful to understand the nature of the changes experienced by families during the financial crisis.
The respondents in 2007 were the economically dominant individual or the financially most knowledgeable member of the economically dominant couple in a household. The 2009 SCF follow up interview was designed to track every 2007 household with the original respondent or an eligible alternate. While panel data have some advantages over cross-sectional data, panel data are potentially subject to compounding measurement error. However, the SCF dataset has a relatively high level of comparability between the two years (Bricker et al., 2011). The re-interview took place between July of 2009 and January of 2010 and had approximately an 87% response rate with little variation in the response rate across demographics between 2007 and 2009.

4.1.2. Repeated Imputation Inference (RII)

Multiple imputation is a statistical technique designed to handle missing data. Each missing or deficient value is replaced by two or more plausible values using a distribution of possibilities (Rubin, 1988) rather than a constant. Multiple imputation provides benefits of an increased efficiency of point estimation and additional validity in inferences since multiple imputation assumes in large samples infinite-N repeated imputation inferences will be valid (Montalto & Yuh, 1998; Rubin, 1988). The Federal Reserve Board used a multiple imputation technique to handle missing or incomplete response in the SCF by generating five implicates, five complete data sets. For instance, data originally missing in the 2007 survey were re-imputed conditional on the 2009 data (Bricker et al., 2011). The information is stored in five separate imputation replicates, called implicates. The number of observations in the five times imputed data set equals five times the actual number of respondent households (Federal Reserve Board, 2012).
Thus, in the public dataset, for the 3,857 households interviewed, there are 19,285 records.

Parameter estimates from a single implicate are considered less efficient than those from five implicates and variance estimates are too small, thereby overestimating the statistical significance (Montalto & Yuh, 1998). On the other hand, in the RII procedure, point estimates of a parameter from the separate implicates are averaged to generate a single parameter estimate. The average implicate variance and the variance among the implicates are summed to generate an estimate of the total variance (Montalto & Yuh, 1998). Therefore, this study employs the repeated-imputation inference (RII) method and estimates from multiple imputations.

SCF used a dual frame design which includes one set of sample collected from a multi-stage area-probability and the other set of sample collected from a tax list of the Statistics of Income (SOI) Divisions of Internal Revenue Service. Although the area-probability sample was selected with equal probability, the strata of the high levels of the wealth index, the wealth rank of taxpayers, were over sampled in the second set of sample (Kennickell, 2010). The resulting sample overrepresents wealthy population, thus, to obtain estimates representative of the the U.S. population, the weights provided by the SCF were used (Lindamood, Hanna, & Bi, 2007).

For descriptive statistics, the results of weighted analyses were averaged across all implicates in order to have representative results. However, it is controversial to weight the multivariate analyses, in particular, for hypotheses testing (Lindamood, Hanna, & Bi, 2007). Controlling strata defining variables used to generate the weights in the multivariate analysis could be endogenous and coefficients from the multivariate analysis
may have simultaneity bias (Montalto, 1998). Lindamood et al. (2007) noted that multivariate analyses of datasets with endogenous weights may have biased estimates, so the standard recommendation for multivariate analyses of SCF datasets is to not use population weights. They also found that unweighted estimates of variances produced more conservative estimates of significance levels. Although this study did not directly use strata defining variables as controls, to make more conservative decisions weights were not used in multivariate analyses.

4.1.3. Sample

4.1.3.1. Subsample Analyses

A total of 3,857 households were analyzed in this study and different sample restrictions were used depending on expected income change measure. For the model using the objective expected income measure (Table 4.1), the sample was divided into two groups, households with positive expected income change (Group 1) and households with negative expected income change (Group 2). The reasons to choose objective expected income change as a criterion for sample selection are for consistency in the theory and for practical usage of continuous variable. Negative and positive classification in objective expected income change was consistent with the usage of expected income change in previous asymmetric studies (Bowman et al., 1999; Shea, 1995b). In this sense, subjective expected income change composed of three categories, such as positive, negative, and about the same, was not used as a criterion nor sample restricted. Second, using two groups for objective measurement of expected income change measured as a continuous variable can provide a clearer interpretation of saving also measured as a
continuous variable in Model 1. Otherwise, interpretation is complicated when the value of the continuous independent variable can be either positive or negative.

In this sense, using two samples is expected to facilitate examining asymmetric response of saving decision between negative and positive expected income changes by distinguishing the effects not only between groups but also within groups. The hypothesized asymmetric response of saving decisions between positive and negative deviation from normal year and income uncertainty change can also be identified between groups and within groups. These are distinctions of this study from the previous studies (Bowman et al., 1999; Shea, 1995b), in which only between group asymmetry was identified and expected income change was used. Group 1 (62.32%) is households with a positive expected income change and Group 2 (37.68%) is households with a negative expected income change. Distribution of actual and predicted income change between 2007 and 2009 is presented in Table 4.2. For models using the subjective income change measure, total of 3,857 households were used and no sample restriction was employed.

4.1.3.2 Sample Description

The descriptive statistics for the demographic characteristics of sample households are presented in Table 4.3.

Demographic characteristics in 2007

Differences and similarities in demographic characteristics were found between two groups (Table 4.3). Households in Group 1 were younger and more educated than those in Group 2. In both groups, a majority of households were white, have less than 1
child, and work for someone else. In terms of occupation, managerial/professional was the most frequently answered (34.14%) and other occupation group working as production/craft/repair workers, operators, laborers, farmers, foresters, and fishers was the least frequently answered (19.07%) in Group 1 while the former was the least common occupation (20.14%) and the not working group was the most commonly found (24.21%) in Group 2. The percentage of unemployment experience over the last 12 month was 18.37% and 9.71% in Group 1 and Group 2, respectively. The descriptive results showed the more households in Group 1 were participated in labor market, thus, they were more exposed to labor market change than Group 2.

Homeowners, stock equity holders, and stock holders were found slightly more in Group 2 than Group 1 but preference for risk tolerance and planning horizon and level of understanding of SCF survey questions were found similar between two groups. Pattern of answers to perceived health status were also similar but having foreseeable expense and credit constraints, such as experience of being rejected or giving up applying for credit, were higher in Group 2 than Group 1.

Expectation Characteristics

Table 4.4 describes the reference dependent income and uncertainty variables of the sample households. Overall, in both groups, households evaluated their 2006 income as normal income and expected about the same real income change in 2008. In evaluating subjective uncertainty, a noticeable difference was not found. Estimated income change using both demographic characteristics in 2007 and actual income change between 2007 and 2009 showed a difference between two groups. Before rescaling, $21,891 income increase was expected in Group 1 while $44,526 decrease in income was estimated in
Group 2. Approximately 50% of households in both groups saw their income uncertainty remain positive, the most frequent response, and almost 20% of the total responded their income uncertainty level increased during the periods.

*Financial Characteristics*

Overall, Group 2 had a higher value of income, net worth, primary residence equity, other residential real estate equity, stock equity than Group 1, thus, Group 2 had greater negative saving between 2007 and 2009 than Group 1. Detailed information of the values and comparisons are presented in Table 4.5.
Table 4.1. Regression Results of Expected Income Change (in thousands of dollars) between 2007 and 2009

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>P-value</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged Income 2006</td>
<td>-0.583</td>
<td>0.000</td>
<td>0.050</td>
</tr>
<tr>
<td>Age 2007</td>
<td>0.239</td>
<td>0.226</td>
<td>0.197</td>
</tr>
<tr>
<td>Education 2007</td>
<td>4.913</td>
<td>0.000</td>
<td>0.986</td>
</tr>
<tr>
<td>Marital Status (Married) 2007</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partner</td>
<td>-17.526</td>
<td>0.036</td>
<td>8.378</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>-25.759</td>
<td>0.000</td>
<td>6.536</td>
</tr>
<tr>
<td>Widow/widower</td>
<td>-19.380</td>
<td>0.034</td>
<td>9.137</td>
</tr>
<tr>
<td>Never married</td>
<td>-30.423</td>
<td>0.000</td>
<td>7.421</td>
</tr>
<tr>
<td>Work Status (No) 2007</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>27.496</td>
<td>0.002</td>
<td>8.936</td>
</tr>
<tr>
<td>Retired</td>
<td>-36.059</td>
<td>0.000</td>
<td>8.061</td>
</tr>
<tr>
<td>Occupation (No) 2007</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>-22.199</td>
<td>0.001</td>
<td>6.429</td>
</tr>
<tr>
<td>Other job</td>
<td>-22.870</td>
<td>0.001</td>
<td>6.804</td>
</tr>
<tr>
<td>Children 2007</td>
<td>1.609</td>
<td>0.439</td>
<td>2.080</td>
</tr>
<tr>
<td>Intercept</td>
<td>-5.672</td>
<td>0.742</td>
<td>17.261</td>
</tr>
</tbody>
</table>

R square (Adjusted-R square) = 0.612~0.753 (0.611~0.752)

Note: Population weighted data; RII technique is used. Detailed description is presented in 4.2.2 Explanatory Variables.
Table 4.2. Distribution of Actual and Expected Income Change between 2007 and 2009

<table>
<thead>
<tr>
<th></th>
<th>Actual Income Change</th>
<th>Expected Income Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1</td>
<td>Group 2</td>
</tr>
<tr>
<td>Mean</td>
<td>7.285</td>
<td>-20.397</td>
</tr>
<tr>
<td>10th Percentile</td>
<td>-17.216</td>
<td>-64.520</td>
</tr>
<tr>
<td>50th Percentile</td>
<td>1.944</td>
<td>-2.751</td>
</tr>
<tr>
<td>(Median) 75th Percentile</td>
<td>13.155</td>
<td>7.315</td>
</tr>
<tr>
<td>90th Percentile</td>
<td>33.348</td>
<td>29.986</td>
</tr>
</tbody>
</table>

Note: Population weighted data. Detailed description is presented in 4.2.2 Explanatory Variables. Just over half (51.47%) of households had a positive change in actual normal income, compared to 62.32% of households having a positive change in predicted normal income. A majority (58.55%) of households were categorized correctly.
<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Restricted Sample</th>
<th>Total Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Age of head</td>
<td>48.93 (48)</td>
<td>50.23 (49)</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>55.63%</td>
<td>45.50%</td>
</tr>
<tr>
<td>Partner</td>
<td>5.78%</td>
<td>11.24%</td>
</tr>
<tr>
<td>Separated or Divorced</td>
<td>16.04%</td>
<td>19.95%</td>
</tr>
<tr>
<td>Widow or widower</td>
<td>8.64%</td>
<td>8.60%</td>
</tr>
<tr>
<td>Never married</td>
<td>13.91%</td>
<td>14.72%</td>
</tr>
<tr>
<td><strong>Education of Household Head</strong></td>
<td>13.78 (14)</td>
<td>12.63 (12)</td>
</tr>
<tr>
<td><strong>Racial-ethnic category</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>73.20%</td>
<td>74.18%</td>
</tr>
<tr>
<td>Black</td>
<td>14.46%</td>
<td>11.12%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>7.81%</td>
<td>10.93%</td>
</tr>
<tr>
<td>Asian or others</td>
<td>4.53%</td>
<td>3.76%</td>
</tr>
<tr>
<td><strong>Children</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Children</td>
<td>0.908 (0)</td>
<td>0.770 (0)</td>
</tr>
<tr>
<td><strong>Working Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work for someone else</td>
<td>60.64%</td>
<td>62.05%</td>
</tr>
<tr>
<td>Self-employed/partnership</td>
<td>11.97%</td>
<td>8.23%</td>
</tr>
<tr>
<td>Retired/Disabled a</td>
<td>20.35%</td>
<td>29.10%</td>
</tr>
<tr>
<td>Other groups not working b</td>
<td>7.05%</td>
<td>0.62%</td>
</tr>
<tr>
<td>Unemployment</td>
<td>18.37%</td>
<td>9.71%</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managerial/Professional</td>
<td>34.14%</td>
<td>20.14%</td>
</tr>
<tr>
<td>Technical/Sales/Services</td>
<td>19.39%</td>
<td>25.93%</td>
</tr>
<tr>
<td>Other group c</td>
<td>19.07%</td>
<td>24.21%</td>
</tr>
<tr>
<td>Not working</td>
<td>27.40%</td>
<td>29.72%</td>
</tr>
<tr>
<td><strong>Homeowners</strong></td>
<td>67.33%</td>
<td>71.56%</td>
</tr>
<tr>
<td><strong>Stock related equity holders</strong></td>
<td>50.20%</td>
<td>59.37%</td>
</tr>
<tr>
<td><strong>Stock holders</strong></td>
<td>15.90%</td>
<td>22.55%</td>
</tr>
</tbody>
</table>

Continued
Table 4.3. Continued

<table>
<thead>
<tr>
<th>Variable</th>
<th>Restricted Sample</th>
<th>Total Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1 (Positive)</td>
<td>Group 2 (Negative)</td>
</tr>
<tr>
<td></td>
<td>Mean (Median), %</td>
<td>Mean (Median), %</td>
</tr>
<tr>
<td><strong>Perceived Health Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>26.17%</td>
<td>27.36%</td>
</tr>
<tr>
<td>Fair</td>
<td>50.03%</td>
<td>46.58%</td>
</tr>
<tr>
<td>Good</td>
<td>19.00%</td>
<td>19.74%</td>
</tr>
<tr>
<td>Excellent</td>
<td>4.80%</td>
<td>6.33%</td>
</tr>
<tr>
<td><strong>Understanding of the SCF survey Questions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>49.02%</td>
<td>50.35%</td>
</tr>
<tr>
<td>Good</td>
<td>42.72%</td>
<td>41.57%</td>
</tr>
<tr>
<td>Fair</td>
<td>7.65%</td>
<td>7.72%</td>
</tr>
<tr>
<td>Poor</td>
<td>0.62%</td>
<td>0.35%</td>
</tr>
<tr>
<td><strong>Foreseeable Expense in 5 to 10 years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>44.98%</td>
<td>51.40%</td>
</tr>
<tr>
<td><strong>Credit Constraints</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>19.63%</td>
<td>14.53%</td>
</tr>
<tr>
<td><strong>Financial Attitude</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk tolerance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substantial risk</td>
<td>3.69%</td>
<td>3.12%</td>
</tr>
<tr>
<td>Above Average risk</td>
<td>15.54%</td>
<td>20.64%</td>
</tr>
<tr>
<td>average risk</td>
<td>37.51%</td>
<td>39.70%</td>
</tr>
<tr>
<td>No risk</td>
<td>43.26%</td>
<td>36.54%</td>
</tr>
<tr>
<td><strong>Planning Horizon</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>few months</td>
<td>22.66%</td>
<td>18.64%</td>
</tr>
<tr>
<td>next year</td>
<td>12.29%</td>
<td>11.73%</td>
</tr>
<tr>
<td>next few years</td>
<td>27.98%</td>
<td>26.95%</td>
</tr>
<tr>
<td>next 5 to 10 years</td>
<td>24.42%</td>
<td>25.42%</td>
</tr>
<tr>
<td>longer than 10 years</td>
<td>12.65%</td>
<td>17.26%</td>
</tr>
<tr>
<td><strong>Total Sample Size</strong></td>
<td>1840.4 (62.32%)</td>
<td>2016.6(37.68%)</td>
</tr>
</tbody>
</table>

Note: 2007-2009 Survey of Consumer Finances. Percentages are based on the weighted numbers; whereas, actual numbers are not weighted. Restrictions are described in the Methods Section. Non-restricted total sample 3,857 households. Group 1 is households with positive expected income change and Group 2 is households with negative expected income change.

- **a** Include student/homemaker/those not working and age 65 or older.
- **b** Mainly those under 65 and out of the labor force
- **c** Production/craft/repair workers, operators, laborers, farmers, foresters, and fishers.
### Table 4.4: Descriptive Results of Reference Dependent Income and Uncertainty Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Restricted Sample</th>
<th>Total Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1 (Positive)</td>
<td>Group 2 (Negative)</td>
</tr>
<tr>
<td></td>
<td>Mean(Median), %</td>
<td>Mean(Median), %</td>
</tr>
<tr>
<td>Deviation from Normal Income in 2007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>9.69%</td>
<td>9.19%</td>
</tr>
<tr>
<td>Negative</td>
<td>13.66%</td>
<td>17.12%</td>
</tr>
<tr>
<td>About the Same</td>
<td>76.66%</td>
<td>73.69%</td>
</tr>
<tr>
<td>Expected Income Growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Objective Expected Income Change between 2007 and 2009</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>21.8907 (18.5833)</td>
<td>-44.5263 (-13.6601)</td>
</tr>
<tr>
<td>Subjective Expected Income Change in 2007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>20.43%</td>
<td>21.70%</td>
</tr>
<tr>
<td>Negative</td>
<td>37.87%</td>
<td>35.09%</td>
</tr>
<tr>
<td>About the Same</td>
<td>41.70%</td>
<td>43.21%</td>
</tr>
<tr>
<td>Income Uncertainty Change between 2007 and 2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease</td>
<td>15.02%</td>
<td>14.16%</td>
</tr>
<tr>
<td>Increase</td>
<td>18.57%</td>
<td>20.29%</td>
</tr>
<tr>
<td>Stays positive</td>
<td>48.14%</td>
<td>51.51%</td>
</tr>
<tr>
<td>Stays negative</td>
<td>18.27%</td>
<td>14.04%</td>
</tr>
</tbody>
</table>

Note: 2007-2009 Survey of Consumer Finances. Percentages are based on the weighted numbers.
Table 4.5. Descriptive Results of Major Financial Value Change (Unit=$1,000)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Restricted Sample</th>
<th>Total Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1 (Positive)</td>
<td>Group 2 (Negative)</td>
</tr>
<tr>
<td></td>
<td>Mean (Median)</td>
<td>Mean (Median)</td>
</tr>
<tr>
<td>Year</td>
<td>2007</td>
<td>2009</td>
</tr>
<tr>
<td>Lagged Income</td>
<td>50.634</td>
<td>57.919</td>
</tr>
<tr>
<td>(72.599)</td>
<td>(45.825)</td>
<td>(1.944)</td>
</tr>
<tr>
<td>Net worth</td>
<td>282.211</td>
<td>232.666</td>
</tr>
<tr>
<td>(100.463)</td>
<td>(79.500)</td>
<td>(-9.649)</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Residence Equity</td>
<td>97.376</td>
<td>78.564</td>
</tr>
<tr>
<td>(40.388)</td>
<td>(29.000)</td>
<td>(0)</td>
</tr>
<tr>
<td>Other Residential Real Estate Equity</td>
<td>21.212</td>
<td>23.168</td>
</tr>
<tr>
<td>(0)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>Housing Equity(^d)</td>
<td>114.528</td>
<td>96.238</td>
</tr>
<tr>
<td>(44.531)</td>
<td>(33.000)</td>
<td>(0)</td>
</tr>
<tr>
<td>Stock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.425)</td>
<td>(0)</td>
</tr>
<tr>
<td>Wilshire Index</td>
<td>15163.58</td>
<td>10574.54</td>
</tr>
<tr>
<td>(15300)</td>
<td>(10400)</td>
<td>(-4700)</td>
</tr>
<tr>
<td>Equity Gains(^e)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(-1.416)</td>
</tr>
<tr>
<td>Saving(^f)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>(1.745)</td>
<td>(1.745)</td>
<td>(-1.280)</td>
</tr>
</tbody>
</table>

NOTE: 2007-2009 Survey of Consumer Finances Percentages are based on the weighted numbers.
\(^a\) Difference = Value (\(\cdot\)) 09 - Value (\(\cdot\)) 07
\(^b\) Housing equity = Primary residence equity + Other residential real estate equity
\(^c\) Equity gains = Stock related equity in 2007 * Wilshire index change between 2007 and 2009
\(^d\) Saving = Net worth difference - Housing equity difference - equity gains
\(^e\) Stock related equity in 2007 * Wilshire index change between 2007 and 2009
4.2. Measurement of Variables

The SAS code used to define variables is also provided in the Appendix A.

4.2.1. Dependent Variables

Since SCF provides no direct evidence of annual saving, this study estimated saving in two ways based on previous studies.

4.2.1.1. Whether Saved or Not

The first saving variable was whether households are savers or not. This dichotomous measure reflects whether or not households saved after the recession. This saving measure is constructed from the answer to the question (Rha et al., 2006), “Over the past year, would you say that: your spending exceeded your income, that it was about the same as your income, or that you spent less than your income?” This variable is considered the difference between income and spending in which the spending for vehicles, houses, or any investment, possibly viewed as assets, was not included (Fisher & Montalto, 2010; Yuh & Hanna, 2010). Three SCF variables (P7508, P7509, and P7510) are used to create this saving measure using SAS code provided by the Federal Reserve Board (2012). A household is designated as a saver if the respondent answered that spending was less than income during the previous year. If the respondent replied spending about the same as income, but the spending included purchases for houses, vehicles, or any investments, the household is also considered a saver (Yuh & Hanna, 2010). The percentage of the total households (n=3,857) who saved in 2007 was 56.42% while the percentage of the households who saved in 2009 was 52.41%.
4.1.1.2 Saving between 2007 and 2009

The second saving variable is measured as a change in non-housing net worth between 2007 and 2009 minus net capital gains using a balance sheet approach (Alessie & Lusardi, 1997; Avery & Kennickell, 1991; Dynan et al., 2004; Chang, 1993).

The SCF defines net worth as the total value of a household’s assets, including all financial and non-financial assets, minus the total value of its liabilities (Bricker et al., 2011). Financial assets include liquid assets or all types of transaction accounts (checking accounts, saving accounts, money market accounts, and call accounts at brokerages), certificates of deposit, savings bonds, mutual funds, bonds, stocks, pooled investment funds (non-money market mutual funds), retirement accounts (IRA/Keogh accounts), cash value life insurance, other managed assets, and other financial assets. Specifically, financial assets include trusts with an equity interest, annuities with a cash value, pension accounts from which households can withdraw or take loans against, and miscellaneous financial assets. The exception is two common types of retirement plans, Social Security and employer sponsored defined benefit plans, and other assets with no equity interest. Nonfinancial assets include vehicles, primary residence, other residential real estate, net equity in nonresidential real estate, business equity and other nonfinancial assets. Debts include mortgage and home equity loan (mortgages and home equity lines of credit secured by primary residence), other residential debt (mortgages secured by residential real estate other than a primary residence), installment debt, credit card balance, and all other types of debt (personal debts to family, loans against life insurance or pension accounts, margin loan, and so forth). The median value of net worth of the total sample before rescaling was $125,514 and mean value was $593,685 in 2007; whereas, the analogous values in 2009 were $95,960 and $479,706 respectively. The mean difference
in net value values between the periods was $-113,979 and median difference was $-11,397.

As described in the previous section, the Great Recession had huge negative impacts on the housing market, stock market, and labor market at the same time. The market crash led to changes in wealth within households over the periods. If households experienced any of these crashes during the periods, their wealth should have been affected to a large degree. Although the aforementioned economic theories addressed the role of expectations on financial decisions, there would have been a limited number of households who actually anticipated such huge changes in stocks, real estate prices, or job markets.

In fact, unexpected saving, measured as net worth change, is known to largely come from appreciation or depreciation of home and other real estate property (Chang, 1993). Moreover, the idiosyncratic nature of the major components of net worth could cause substantial noise in the data over those periods such as geographic variation in values of houses and other real estate investments, since an increase or decrease in housing values, which account for a large portion of wealth (Pfeffer, Danziger, & Schoeni, 2013), is often derived from the factors in local housing market unrelated to financial decisions of households. Homeowner respondents in 2007 were 68.92% of the total households while homeowner respondents in 2009 were 70.34%. On the other hand, the percentage of households owning other residential real estate, including land contracts/notes household has made and properties other than the principal residence such as residences, time shares, and vacations homes, was 13.86% in 2007 and 12.96% in 2009. Therefore, to match the theoretical hypotheses regarding the effect of expectations
on saving decisions and to control an idiosyncratic effect unrelated to saving decisions, housing equity of the primary and other residential real estate equal to the current market values of the house less any remaining mortgage payments is excluded from net worth in each period (Chang, 1993). The median value of housing equity of the primary and other residential real estate of the total sample before rescaling was $51,779 and mean value was $138,450 in 2007; whereas, $36,000 and $107,516, respectively in 2009. The mean difference in housing equity values between the two periods was $ -30,934.

Also, to control the huge negative effect of the stock market on net worth change, capital gains and losses were excluded. Exclusion of capital gains and losses from net worth is consistent with the definition of savings defined both from NIPA and FFA (Parker, 2000). The SCF data provide information on the value of the Wilshire Stock Index at the points of being interviewed in each of the two periods for each household responding yes to stock ownership. According to the classification in the FRB released SAS code, this study defines stock related equity as financial assets invested in stock, including 1) directly-held stock, 2) stock mutual funds: full value if described as stock mutual fund, 1/2 value of combination mutual funds, 3) IRAs/Keoghs invested in stock: full value if mostly invested in stock, 1/2 value if split between stocks/bonds or stocks/money market, 1/3 value if split between stocks/bonds/money market, 4) other managed assets w/equity interest (annuities, trusts, MIAs): full value if mostly invested in stock, 1/2 value if split between stocks/MFs & bonds/CDs, or "mixed/diversified," 1/3 value if "other", 5) thrift-type retirement accounts invested in stock full value if mostly invested in stock 1/2 value if split between stocks and interest earning assets, and 6) savings accounts classified as 529 or other accounts that may be invested in stocks.
Equity related holders are measured as households with greater than 0 value of stock related equity. The percentage of the stock related equity holders of the total sample in 2007 was 53.66% while the percentage of the stock related equity holders in 2009 was 55.49%.

This study estimated such gains and losses for stock related equity holders in 2007 under the assumption that equity holders on the first survey in 2007 should have experienced any capital gains or losses on their original holdings in proportion to the percentage decrease in the Wilshire Index between the first and second interviews. As indicated in Bosworth et al (1991), this assumption will overstate losses for some households and underestimate gains for others households. However, this approach is considered to provide a reasonable estimate of gains and losses for average households. Therefore, this study used individual percentage change in the Wilshire Index between 2007 and 2009 at the time of being interviewed for each household holding stocks in 2007 multiplied by stock related equity to estimate capital gains and losses between the two periods.

\[
Capital \ gains \ and \ losses_{(2009,2007)} = % \Delta(Wilshire_{2009}, Wilshire_{2007}) \times Stock \ Related \ Equity_{2007}
\]

Thus, an estimation of saving obtained by comparing net wealth holdings at two points in time consists of change in value of (net worth-housing equity-capital gains and losses) between 2007 and 2009. The median value of equity related stocks of the total sample before rescaling was $932 and mean value was $124,288 in 2007; whereas, they were $1,500 and $87,771, respectively in 2009. The mean value of the differences between 2007 and 2009 was -36,516.
The Wilshire index in 2007 ranged from 12,800 to 15,800. The mean value of the index of the total sample was approximately 15,155 and the median was 15,300. In 2009, the index ranged from 10,100 to 11,800. The mean value of the index in 2009 was about 10,575 and the median was 10,400. The change in the mean value of the index between 2007 and 2009 was -4,580, approximately -30.1%. The mean value of total capital gains and losses over the two periods was $37,120 and its median was $265. Therefore, the derived mean value of saving between 2007 and 2009 was $-42,951 and the median was $-1,549.

4.2.2. Explanatory Variables

4.2.2.1. Reference Dependent Income and Uncertainty Variables

*Deviation from Normal Income*

Deviation from normal income indicates how a household evaluates their last year's income compared to a normal year’s income as a reference point. This evaluation of last year’s income is information about a relative change in income or deviation compared to a reference point instead of an absolute amount of change or dollar amount of income. Deviation from normal income is derived from answers to the following question in SCF, “Is this income unusually high or low compared to what you would expect in a "normal" year, or is it normal?” Answers to this question in 2007 are used to proxy for evaluated deviation of their 2006 income from the reference level, a normal year’s income. Three dichotomous variables are included: (1) positive deviation from normal income, (2) negative deviation from normal income, and (3) about the same as a normal year.
In particular, for those who answered about the same as a normal year, their 2007 year income would be normal and, therefore, reference income. Positive deviation from normal income is coded 1 if the household has a positive evaluation of last year’s income, and 0 otherwise. Negative deviation from normal income is coded as 1 if the household has a negative evaluation of last year’s income, and 0 otherwise. About the same as a normal year is coded 1 if the household has about the same evaluation of last year’s income, 0 otherwise. Positive deviation from normal income is used as a reference category and the two other categories are compared to this reference category. The percentage of the positive deviation from normal income of total sample was 9.50% and that of negative deviation from normal income was 14.96%. A majority of the households viewed their income as about the same as a normal year (75.54%).

*Expected Income Change*

The expected income change is measured in two ways: objective and subjective expectations. The first measure, the objective expected income change, was estimated by regressing actual normal income change between 2007 and 2009 on a set of demographic variables. RII technique with population weighted data was used.

The two period model assumes that households make saving and consumption decisions based on their first period income and expected second period income. This study also assumes that households predict their future income based on their current income and other socioeconomic factors, such as job status and age. Then, cohort income expectations, in which households having similar socio-demographic characteristics would have a similar pattern of income change is assumed (Chang, 1994). Future income change was estimated by regressing actual income change between 2007 and 2009 on
personal characteristics in the first period (Carroll, 1994; Limosani & Millemaci, 2011). Coefficients from the regression were then used to construct the measure of expected future income change. As opposed to subjective income change, which relies on perception about relative changes, estimation using the income prediction equation assumes a statistical relationship between income change and its determinants. The total variance of income change is to be explained by proposed explanatory variables selected from empirical studies (Carroll, 1994; Chang, 1993; Dominitz, 2001; Jappelli & Pistaferri, 2000; Limosani & Millemaci, 2011; Souleles, 2004). Explanatory variables measured in 2007, included normal income in 2006, head’s age in 2007, education attainment of head in 2007, marital status in 2007, work status in 2007, occupation in 2007, and the number of children in 2007. In particular, for the focus of this study, changes in income and income uncertainty relative to a reference point, lagged normal income and normal income change adjusted to inflation were used.

This study used head’s age, education, occupation, and work status under the assumption that the household’s characteristics are based on the household head and household income is largely affected by head’s income. SCF uses the word family or household to mean the primary economic unit (PEU). PEU consists of an economically dominant single individual or the most financially knowledgeable member of the couple in a household (Bricker et al., 2011). If a couple is economically dominant, then the head is considered the male in mixed sex couple households and the older partner in same-sex couple households (Lindamood et al. 2007). If a single individual is economically dominant, that person is considered the household head. A distinction between the respondent and the head may matter only for some variables, such as race which
sometimes is not representative of the household depending on the interviewee in the survey (Lindamood et al., 2007). This study assumes the head characteristics have a strong relationship with actual and predicted income change. Detailed characteristics of variables in the expected income change regression are described in the section on control variables.

\[
\text{Actual Normal income Change}_{(2009,2007)} = a_0 + b_1 \text{Lagged Normal Income}_{2007} + \\
b_2 \text{Age}_{2007} + b_3 \text{Education}_{2007} + b_4 \text{Marital Status}_{2007} + \\
b_5 \text{Working status}_{2007} + b_6 \text{Occupation}_{2007} + b_7 \text{Children}_{2007} + \epsilon
\]

Ordinary least square regression was used to estimate expected future income change under the assumption of a linear relationship between the dependent and the independent variables. To check this assumption, the relationship between normal income and actual normal income change was found to be linear tested using scatter plot. To detect the presence of multicollinearity, variance inflation factors were used. Variance inflation factors (VIF) measure how much the variances of the estimated regression coefficients are inflated as compared to when there is no linear relationship between the explanatory variables (Kutner, Nachtsheim, & Neter, 2004). To reduce multicollinearity, variables with high VIF were dropped from the model and thereby reduce the standard errors of the estimated regression coefficients of the explanatory variables remaining in the model as Kutner et al (2004) suggested.

By substituting the values of the explanatory variables for each observation in the prediction equation with population weight (Table 4.1), a predicted income change in thousands of dollar was obtained for each household.
Expected Normal Income Change\textsubscript{(2009,2007)} = -5.67168 + (-0.58304) * \\
Lagged Normal Income\textsubscript{2007} + (0.238538) * Age\textsubscript{2007} + (4.912693) * \\
Education\textsubscript{2007} + (-17.5258) * Partner\textsubscript{2007} + (-25.7588) * Divorced\textsubscript{2007} + \\
(-19.3796) * Widow\textsubscript{2007} + (-30.423) * Never Married\textsubscript{2007} + (27.49644) * \\
Self – employed\textsubscript{2007} + (-36.0592) * Retired\textsubscript{2007} + (-22.1989) * Sales\textsubscript{2007} + \\
(-22.8697) * Otherjob\textsubscript{2007} + (1.609311) * Children\textsubscript{2007}

Actual normal income change of the total sample before rescaling between 2007 and 2009 had a mean of $ -3,144 and median of $ 267 while the mean of the predicted income change between 2007 and 2009 using the above 2007 variables was $ -3,132 and median was $ 7,229. When comparing income change at 25\textsuperscript{th} percentile, actual income change was $ -1,018 and predicted income change was $ -8,256 (Table 4.2). A majority (62.32\%) of all households were classified into Group 1, having a positive change in expected normal income change based on the income prediction equation, while 58.04\% of households in Group 1 had an actual positive change in normal income and 41.96\% had a negative change in normal income.

The second measure of expected income change is subjective expectations about future income change, which refers to how a respondent thinks her/his future income will change relative to prices (Curtin, 2008; Dominitz & Manski, 2003; Fan & Wong, 1998). Subjective expected income change is about current perception of uncertain future income. This variable is based on answers to the following question in SCF, “Over the next year, do you expect your total (family) income to go up more than prices, less than prices, or about the same as prices?” Answers to this question in 2007 were used to proxy expectations about real income change in the second period, 2009, relative to the
reference level income in 2007. Three dichotomous variables are included for the subjective expected income change: (1) positive expectations, (2) negative expectations, and (3) about the same expectation. Positive expectation is coded 1 if the household expects real income to increase, and 0 otherwise. Negative expectation is coded 1 if the household expects real income to decrease, and 0 otherwise. About the same expectation is coded 1 if the household has about the same expectation for future real income as current income, 0 otherwise. Positive expectation is used as the reference group and two other categories are compared to this reference category. The percentage of total sample with positive income expectations was 20.91% and negative income expectations was 36.82%.

**Income Uncertainty Change**

Income uncertainty change is defined as change in degree of risk or uncertainty of future income. This can be understood as change in willingness to consume or save by taking risks, which is often captured in the Consumer Confidence Index (Desroches & Gosselin, 2004), or as a measure of characteristics that would lead each household to face the risk differently (Chang, 1993). In the SCF, respondents are asked whether they have a good idea of income next year. Four dichotomous variables, income uncertainty decreased, and income uncertainty increased, income uncertainty stayed positive, and income uncertainty stayed negative, are created to measure income uncertainty change by combining the answers in 2007 and 2009 to the following question, “At this time, do you have a good idea of what your (family's) income for next year will be?” The reference group is income uncertainty decreased (Figure 1). The percentage of total sample with stayed positive income uncertainty was 49.41% and stayed negative income uncertainty
was 16.88%. Income uncertainty increased between 2007 and 2009 for 19.22% while 14.69% felt income uncertainty decreased.
“At this time, do you have a good idea of what your (family's) income for next year will be?” in 2009

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Income uncertainty stayed positive</td>
<td>Income uncertainty increased</td>
</tr>
<tr>
<td>No</td>
<td>income uncertainty decreased</td>
<td>Income uncertainty stayed negative</td>
</tr>
</tbody>
</table>

Figure 1. Income Uncertainty Change
4.2.3. Control Variables

Besides the above explanatory variables, socio-demographic variables and financial attitude were used as control variables.

4.2.3.1. Socio-demographic Variables

Socio-demographic variables were composed of the head of household’s age, marital status, education, number of children, self-employment, retirement status, occupation, unemployment, perceived health condition, understanding of the SCF survey question, foreseeable expenses, lagged normal income, and credit constraints.

- **Age**: Age of head was measured with a continuous variable. The average age of head of total sample was about 49 in 2007.

- **Marital Status**: Marital status is used as a set of zero/one dummy variables: married, living with partner, separated or divorced, widow or widower, and never married. Married is the reference category. In 2007, approximately half of households of total sample were married (51.81%) and 14.22% of households were never married. Less than 8% of households consisted of unmarried partner couples (7.83%) and or households of a widow or widower were less than 10%. 7.83% and 8.62%, respectively.

- **Education**: Education was coded as a continuous variable. Average years of education of household head of total sample was 13.35 in 2007, respectively. Median value for both years was 13 years.
- **Number of children**: This was measured as a continuous variable. The mean value of total sample is about 1 child and median was no child in a household in 2007.

- **Self-employment**: Self-employed households are relatively more exposed to risk of income fluctuation than other occupations. A dichotomous variable was used to measure whether the respondent or spouse was self-employed. It was coded 1 if either the respondent or spouse was self-employed, and 0 otherwise. The percentage of total households who were self-employed in 2007 was 10.56% of the total households.

- **Retirement status**: A binary variable was also used for retirement status. If the head was retired or not working and aged 65 or older, it was coded 1 and it was 0 otherwise. The percentage of all heads who were retired was 23.65% in 2007.

- **Occupation**: Occupation was coded as a set of two dichotomous variables based on current job: 1) technical/sales/services and 2) other including production/craft/repair workers, operators, laborers, farmers, foresters, fishers. For total sample, working as a technical/sales/services accounted for 21.85% while other group was 21.01%. Other categories with high variance inflation factor (VIF), such as managerial (VIF =5.57) and not working group (VIF=5.50), with other demographic variables in the expected income equation were not used in the analysis.

- **Unemployment**: Whether the respondent and or spouse was either currently unemployed or had been unemployed over the past 12 months was used to
measure unemployment status. This is a dichotomous variable with a 1 indicating current unemployment or unemployment over the past year, and 0 otherwise. The percentage of total households who were unemployed in 2007 was 15.11%.

- **Perceived health condition**: Perceived health condition of head is measured as a zero/one dummy variable: poor vs. non poor health (fair, good, excellent). Poor health is the reference category. The percentage of household heads of total sample responding “non-poor health condition” in 2007 was 73.08%.

- **Understanding of the SCF survey questions**: Understanding of the SCF survey questions is measured as a set of zero/one dummy variables: excellent, good, fair, and poor understanding. Excellent is reference category in the multivariate analyses. Over 90% of households out of total sample were found to have good or excellent understanding of SCF survey questions in 2007.

- **Foreseeable expense**: Foreseeable expense is measured as a zero/one dummy variable indicating whether or not households have any foreseeable major expenses expected to have to pay for, such as educational expenses, purchase of a new home, health care costs, support for other family members, or anything else, in the next 5 to 10 years. Not having this foreseeable expense is the reference category. Approximately half of total households answered they did not have foreseeable expenses in the next 5 to 10 years in 2007 (47.4%).

- **Lagged normal income**: Annual normal income in 2006 was a continuous variable. The median value of income of total sample before rescaling was $52,184 and mean was $84,137 in 2006; whereas, median and mean income in
2008 were $51,803 and $80,993, respectively. The median decreased was $267 and the mean decrease was $3,144 between 2006 and 2008. For the multivariate analyses, normal income was divided by $1,000.

- **Credit Constraints**: Credit constraints of households were measured using the following two variables on credit history and availability which represents access to financial institutions. Whether households had experienced the following credit constraints in the past five years (2007 question) was coded as three separate dichotomized variables. A total of 17.71% of households in 2007 had credit constraints.

  - **Rejected**: To measure being rejected for credit, two variables were combined to create a dummy variable: Whether households had been turned down and were not able to obtain the full amount requested when reapplying to the same institution or by applying elsewhere was used. The binary variable was coded 1 if households had both experiences, otherwise it was coded as 0. A total of 4.79% of households had been rejected over the past five years in 2007.

  - **Afraid**: Whether households did not apply for credit because they thought they might be turned down even if they thought of applying for credit was used to measure fear of being turned down. The binary variable was coded as 1 if households did not apply for credit for this reason, otherwise it was coded as 0. 15.47% of the total households in 2007 were discouraged from applying for credit.
4.2.3.2 Financial Attitude Variables

A pair of variables indicating household tastes and preferences, planning horizon and risk tolerance, was included as financial attitude variables. Risk and time preference, risk tolerance and planning horizon, have been widely used in studies of financial decisions (Barsky, et al., 1997).

- **Risk tolerance**: Risk tolerance, which refers to a person’s attitude towards accepting risk, heavily influences the financial decisions of individuals with respect to risk and return relative to their needs (Droms, 1987). Risk preference is a categorical variable based on responses to the following question “Which of the statements on this page comes closest to the amount of financial risk that you and your (husband/ wife/ partner) are willing to take when you save or make investments?”. Responses were coded as zero/one dummy variables. Being unwilling to take any risk was the reference category. Most households did not want to take above average risk. The percentage of households of total sample who either did not want to take any risk (40.73%) or would take only average risk (38.33%) in 2007.

- **Planning horizon**: Planning horizon was measured by responses to the following question “In planning (your/your family’s) saving and spending which of the time periods-the next few months, the next year, the next few years, the next 5 to 10 years, or longer than 10 years- is most important to you/your family?” Each time period was coded as a zero/one dummy variable, and next few months was the reference category in the multivariate analysis. The most frequently selected horizons were next few years (27.59%) and next 5 to 10 years (24.80%) in 2007.
4.3. Analyses

This research has two dependent variables and different estimation techniques were used depending on the nature of the dependent variables. A linear regression model using Ordinary Least Square regression (OLS) and a logistic regression model using Logit were estimated. OLS was used for the continuous dependent variable, savings between 2007 and 2009; whereas, the logistic regression was used for the dichotomous dependent variable, whether households saved or not in 2009. For equality test, Paternoster’s z test was employed. All analyses employed the statistical program SAS 9.3 and Excel. Table 4.6 represents each hypothesis and employed tests.
<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Variable</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypothesis 1. Effect of deviation from normal income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H1-1$ Difference between negative deviation from normal income</td>
<td>Difference between negative deviation from normal income and about the</td>
<td>Paternoster’s</td>
</tr>
<tr>
<td></td>
<td>same as normal income.</td>
<td>$z$</td>
</tr>
<tr>
<td>$H1-2$ Difference between positive deviation from normal income</td>
<td>Difference between positive deviation from normal income and about the</td>
<td>F test,</td>
</tr>
<tr>
<td></td>
<td>same as normal income.</td>
<td>Wald’s $z$</td>
</tr>
<tr>
<td><strong>Hypothesis 2. Asymmetric effects of deviation from normal income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asymmetric effects of deviation from normal income between positive</td>
<td>F test,</td>
</tr>
<tr>
<td></td>
<td>deviation from normal income and negative deviation from normal income.</td>
<td>Wald’s $z$</td>
</tr>
<tr>
<td><strong>Hypothesis 3. Effect of expected income change</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H3a$ Effect of expected income change using objective measure</td>
<td></td>
<td>F test</td>
</tr>
<tr>
<td>$H3b-1$ Effects of expected income change using subjective measure</td>
<td></td>
<td>Paternoster’s</td>
</tr>
<tr>
<td></td>
<td>Difference between negative expected income change and about the same</td>
<td>$z$</td>
</tr>
<tr>
<td></td>
<td>expected income change.</td>
<td></td>
</tr>
<tr>
<td>$H3b-2$ Effects of expected income change using subjective measure</td>
<td></td>
<td>Wald’s $z$</td>
</tr>
<tr>
<td></td>
<td>Difference between positive expected income change and about the same</td>
<td></td>
</tr>
<tr>
<td></td>
<td>expected income change.</td>
<td></td>
</tr>
<tr>
<td><strong>Hypothesis 4. Asymmetric effects of expected income change</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H4a$ Asymmetric effects of expected income change between positive</td>
<td></td>
<td>F test</td>
</tr>
<tr>
<td></td>
<td>expected income change change and negative expected income change when</td>
<td>Paternoster’s</td>
</tr>
<tr>
<td></td>
<td>using objective expected income change measure.</td>
<td>$z$</td>
</tr>
<tr>
<td>$H4b$ Asymmetric effects of expected income change between positive</td>
<td></td>
<td>Wald’s $z$</td>
</tr>
<tr>
<td></td>
<td>expected income change change and negative expected income change when</td>
<td></td>
</tr>
<tr>
<td></td>
<td>using subjective expected income change measure</td>
<td></td>
</tr>
<tr>
<td><strong>Hypothesis 5. Effect of income uncertainty change</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H5-1$ Difference between increased income uncertainty and stayed</td>
<td></td>
<td>Paternoster’s</td>
</tr>
<tr>
<td></td>
<td>positive income uncertainty</td>
<td>$z$ test</td>
</tr>
<tr>
<td>$H5-2$ Difference between increased income uncertainty and stayed</td>
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<td>Paternoster’s</td>
</tr>
<tr>
<td></td>
<td>negative income uncertainty</td>
<td>$z$ test</td>
</tr>
<tr>
<td>$H5-3$ Difference between decreased income uncertainty and stayed</td>
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<td>F test,</td>
</tr>
<tr>
<td></td>
<td>same income uncertainty</td>
<td>Wald’s $z$</td>
</tr>
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</table>

Continued
Table 4. 6. Continued

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Variable</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypothesis 6. Asymmetric effect of income uncertainty change</strong></td>
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<td></td>
</tr>
<tr>
<td>$H6a$</td>
<td>Asymmetric effects of income uncertainty change between decreased income uncertainty and increased income uncertainty</td>
<td>F test, Wald’s $z$</td>
</tr>
<tr>
<td>$H6b$</td>
<td>Asymmetric effects of uncertainty change between stayed positive income uncertainty and stayed negative income uncertainty</td>
<td>Paternoster’s $z$ test</td>
</tr>
<tr>
<td><strong>Hypothesis 7. Equality test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equality test for group difference</td>
<td>Paternoster’s $z$ test</td>
</tr>
</tbody>
</table>
4.3.1. Ordinary Least Square (OLS) Regression Analysis

Change in net worth between 2007 and 2009 was a continuous variable. The OLS regression is appropriate when the dependent variable is continuous, unbounded, and measured on an interval or ratio level and when independent variables are either interval, ratio, or dichotomous (Menard, 2002). The ordinary least square (OLS) regression is considered one of the most popular statistical techniques used in the social sciences to predict values of a continuous dependent variable (Hutcheson & Sofroniou, 1999). The OLS regression assumes a linear relationship between the dependent variable and independent variables (Ramsey & Schafer, 2002). Saving between the two periods, \( Y_i \) the dependent variable, is determined by a set of independent variables denoted as the vector \( X_i \), including deviation from normal income, expected future income change, income uncertainty change, and both financial attitude and socio-demographic characteristics as control variables. \( \varepsilon_i \) is the error term which is assumed to follow a normal distribution with an expected mean value of zero and equal variance (Pohlman & Leitner, 2003).

\[
Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_i x_i + \varepsilon_i = X\beta + \varepsilon_i
\]

To test whether there is a statistically significant relation between \( Y \) and the set of \( X \), that is \( H_0: \beta_i = 0, \ H_0: \) at least one of \( \beta_i \neq 0 \), an F-test was used. If the F-statistic, defined as \( F^* = \frac{\text{Mean Square Regression (MSR)}}{\text{Mean Square Error (MSE)}} \), is greater than the critical value from a F distribution at a given significance level and degrees of freedom, or p value is less than a given significance level, the null hypothesis will be rejected (Kutner et al., 2004). The interpretation of the regression coefficient, \( \beta_i \) is the change in saving from 2007 to 2009 accompanying a one unit increase in an independent variable, other things being constant.
\( \beta_i \) is the rate of change in the mean response per one-unit increase in the explanatory variable. The units of \( \beta_i \) are the ratio of the units of the response variable to the units of the explanatory variable.

The OLS regression estimates the parameters by minimizing the sum of the error terms squared (SSE). Thus, the size of the sum of the squared errors is often used to measure the prediction strength of the regression model or how good the proposed regression model is in terms of fitting the data. A regression with smaller error terms or smaller error variance can be considered a better predictor, holding other things constant (Wooldridge, 2009). If the proposed regression model fits perfectly the data, or explains all the variability of \( Y \) at given explanatory levels of variables, all residuals are zero, SSE is zero. In this case, the coefficient of determination, \( R^2 \) used to measure the model fit by suggesting the proportion of variation in the dependent variable that is explained by the independent variables in the model will be 1. If the regression model barely explains any variability of \( Y \) at given \( x_i \), then \( R^2 \) will be close to 0.

\[
R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}
\]

Where \( SST = \) total sum of squares, \( SSR = \) sum of squares due to regression, \( SSE = \) sum of squared errors of prediction, and \( SST = SSR + SSE \).

However, \( R^2 \) increases even when variables which are not related to the dependent variable are added in the models; whereas, adjusted \( R^2 \) decreases whenever variables that are not related to the dependent variable are added by incorporating the sample size and the number of explanatory variables in the model (Evans, 2013).
4.3.2. Logistic Regression model

The second dependent variable, saved or not in 2009, is a categorical variable. The OLS assumptions of a normal distribution and homoscedasticity will be violated with a binary dependent variable. Therefore, when the interest of the research is the response probability, whether or not $\beta_i = 0$ can be ascertained through the logistic regression.

There are different assumptions for the logistic regression model compared to the OLS regression model (Kutner et al., 2004; Pohlman & Leitner, 2003; Ramsey & Schafer, 2002). First, unlike OLS, a dependent variable in the logit model takes a dichotomized form and the logit will have the predicted values in the range from 0 to 1 regardless of the values of $\beta_i$ and $X_i$. Second, the logit regression does not assume that a normal distribution for the $Y$ at the values of $X$ observed for case $i$. Instead, $Y_i$ is assumed to be a Bernoulli random variable with parameter $E\{Y\} = \pi$, the probability that $Y_i = 1$.

\[
P(Y_i = 1|X_i) = \pi_i
\]

\[
P(Y_i = 0|X_i) = 1-\pi_i
\]

The vector of $X_i$ represents a set of independent variables, including deviation from normal income, expected future income change, income uncertainty change, and both financial attitude and socio-demographic characteristics as control variables.

The model for dichotomous response is specified using a logit, or log-odds, function which is defined as $\log\left[\frac{\pi}{1-\pi}\right]$. This transformation is to convert a variable that ranges from 0 to 1 into a variable that has no upper or lower bounds (Allison, 1999). The inverse of the logit function is called the logistic function and is represented as follows;
Logit \((\pi) = \log \left[ \frac{\pi}{1 - \pi} \right] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_i x_i = X'\beta \quad \text{Eq. (4-1)}\)

Exponentiating the logit yields the odds so the odds that \(Y_i = 1\) at the levels \(X_i\) is given by \(\frac{\pi}{1 - \pi}\) and represented by,

\[
\text{Odds} = \left[ \frac{\pi}{1 - \pi} \right] = \frac{\text{Probability of occurrence}}{\text{Probability of non-occurrence}} = \frac{\pi (Y = 1|X_i)}{1 - \pi (Y = 1|X_i)}
\]

\[
= \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_i x_i) = \exp X'\beta \quad \text{Eq. (4-2)}
\]

The predicted probability for case \(i\) then can be given by,

\[
E[Y_i] = \pi_i = \left[ \frac{\text{Odds}}{1 + \text{Odds}} \right] = \frac{\exp(X'\beta)}{1 + \exp(X'\beta)} \quad \text{Eq. (4 - 3)}
\]

Therefore, the odds ratio of an event is the ratio of the expected number of times that an event will occur to the expected number of times it will not occur (Allison, 1999). The interpretation of the maximum likelihood estimates of the coefficients, \(\beta_i\), is that for one unit change in \(x_i\), the log odds is expected to change by \(\beta_i\), other variables being the same. If \(\beta_i = 0\), then the probability of categorizing as a saved household will be independent of the proposed vector, \(X_i\). If \(\beta_i > 0\), then the probability of categorizing as a saved household will increase as the proposed vector, \(X_i\) increases while If \(\beta_i < 0\), then the probability of categorizing as a saved household will decrease as the proposed vector, \(X_i\) increases.

The interpretation of the odds ratio is that if \(X_i\) increases by 1 unit, the odds that \(Y=1\) will change by a multiplicative factor of \(\exp (\beta_i)\), other variables being the same. If the odds ratio is greater than 1 at a given p-value, then the probability of categorizing as a
saved households will increase as X increases. If the odds ratio is less than 1, the probability of categorizing as a saved household will decrease as X increases. For instance, comparing a homeowner with a none-homeowner on the likelihood of saving, the estimated odds ratio is $\exp(2.1)$ implying a homeowner’s odds were about 2 times the odds of $Y=1$ (saved) of a non-homeowner, holding other things constant.

$Z$ test static from Wald test is used to test of individual coefficient, $\beta_i$ with $H_0: \beta_i = 0$ and $H_1: \beta_i \neq 0$. If the $Z$ statistic, defined as $z^* = \frac{\beta_i}{SE(\beta_i)}$, is greater than the critical value from a standard normal distribution at a given significance level, or $p$ value is less than a given significance level, the null hypothesis will be rejected (Kutner et al., 2004).

4.3.3. **Paternoster’s z test**

This study hypothesized that if $\beta_{111}$ is a coefficient of an independent variable $x_{111}$ in Group 1 and $\beta_{112}$ is a coefficient of the same variable, $x_{112}$, in Group 2, difference between two coefficients can be tested with $H_0: \beta_{111} - \beta_{112} = 0$. To test hypothesis on the difference between two regression coefficients of the same reference dependent income and uncertainty variable estimated separately from each group, Group 1 and Group 2, $Z$ test was employed, following Paternoster, Brame, Mazerole, and Piquero (1998).

Using $z$ test could derive the probability of rejecting the null hypothesis, $\beta_{111} - \beta_{112} = 0$, which is greater than reported alpha level, for equality test. Paternoster et al. (1998) suggested the following formula to reduce the incorrect conclusion that there are differences in the estimated coefficients between groups when there is no difference. The
numerator is the estimated difference between the sample coefficients, $\beta_{111} = \beta_{112}$, and the denominator is the square root of the sum of variances.

$$
z = \frac{\beta_{111} - \beta_{112}}{\sqrt{(SE_{\beta_{111}})^2 + (SE_{\beta_{112}})^2}} \quad \text{Eq. (1)}$$

To apply z test for logistic regression results, this study followed the assumption of Brame, Paternoster, Mazerolle, and Piquero (1998). Regression coefficients in logistic model relies on assumptions about the functional form and dispersion of the error term of a latent continuous response variable, thus, under the assumption that both the functional form and the dispersion of the error term for the latent response variable are identical for both groups, z test in Paternoster et al (1999) and Brame et al (1999) can be used.

In logistic regression, transforming the probabilities based on a dichotomized dependent variable into log odds represents a latent continuous variable. The predicted log odds have an observed variance and the error term in the logistic regression has a arbitrarily defined variance with the logistic distribution as $\frac{\pi^2}{3}$. Sum of the observed variance and the variance of the error term estimate the variance of the unobserved continuous dependent variable (Pampel, 2000). SAS provides standardized coefficients for logistic regression and uses the standard deviation of the logit distribution (1.8138 or $\sqrt{\frac{\pi^2}{3}}$) as the standard deviation of the dependent variable for all equations (Pampel, 2000). Thus, comparison of the coefficients for both groups based on the suggested assumptions.

Paternoster’s z tests for equality test are employed using coefficients of multivariate analyses as recommended in Paternoster et al (1999) and Brame et al (1999),
thus, the final coefficients from unweighted RII OLS and logistic procedure were used and consequently the implicate structure of the SCF data using RII was not taken into account.
Chapter 5. Results

This chapter presents the results of 1) means test of savings and a set of reference dependent income and uncertainty variables, 2) multivariate analyses using the OLS regression models and the logistic regression models, and 3) equality test on within group and between group differences. Model 1, OLS regression equations, test the effects of reference dependent income and uncertainty variables, such as deviation from normal income, expected income change, and income uncertainty change, on savings between 2007 and 2009. Model 2, logistic regression equations, test the effects of reference dependent income and uncertainty variables on whether households saved or not in 2009. As described in the previous section, each model consists of two sub models, the objective expectation model and the subjective expectation model. The objective expectation model used analyses of two subsamples while the subjective expectation model used the total sample.

Thus, Model 1, the OLS regressions, consists of three sub models: 1) objective expected income with Group 1, positive expected income, 2) objective expected income with Group 2, negative expected income, and 3) the total sample for subjective expected income. Model 2, the logistic regressions, is also composed of 1) objective expected
income with Group 1, positive expected income, 2) objective expected income with Group 2, negative expected income, and 3) the total sample for subjective expected income.

5.1. Means Test on Saved or Not

The percentage of households who saved in 2009 by reference dependent income and uncertainty variables is shown in Table 5.1. Means tests were implemented with the repeated-imputation-inference (RII) technique using population weight to analyze the percentage of households who saved. Three reference dependent income and uncertainty variables, deviation from normal year, expected income change, and income uncertainty change, were controlled in these tests. Although there were no statistically significant differences in the percentage of savers by deviation from normal income in both Group 1 and Group 2, the percentage of households who saved was slightly lower for those with a positive deviation (10.37% for Group 1 and 10.25% for Group 2) than a negative deviation (10.93% for Group 1 and 12.55% for Group 2). In the total sample, the percentage of savers was higher for those with a positive deviation from normal income (56.96%) and those with a negative (40.56%).

The percentage of savers in the negative expected income change group was smaller (40.02%) than in the positive expected income change group (59.98%). This mean difference in percentage of savers in each group was significant (p<0.001), implying asymmetric saving responses between negative income expectation and positive income expectation groups. However, the differences in percentage of savers by
subjective expected income change were not statistically significant, except the difference between positive expectation and about the same expectation in Group 1. The percentage of savers in the about the same group was the highest in each sub group but the highest the percentage of savers was found in the positive expectation category in the total sample.

In terms of income uncertainty change, there were the mean percentage difference between decreased income uncertainty and the rest categories in both groups. Those responding both their income uncertainty increased and stayed positive had a higher percentage of savers than the other categories, such as decreased and stayed negative, in each group. For the total sample, a higher percentage of households with decreased and stayed positive income uncertainty change responded their spending was less than income in 2009 than those with increased and stayed negative income uncertainty change.
Table 5.1. Proportion of Households who Saved in 2009 with Reference Dependent Income and Uncertainty Variables (Means Test)

<table>
<thead>
<tr>
<th>Variables a</th>
<th>Deviation from Normal Year</th>
<th>Expected Income Change</th>
<th>Income Uncertainty Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Restricted Sample</td>
<td>Non Restricted Sample</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group 1</td>
<td>Group 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saved or not 2009</td>
<td>Mean Diff. b</td>
<td>Saved or not 2009</td>
</tr>
<tr>
<td>Positive</td>
<td>10.37%</td>
<td>N/A</td>
<td>10.25%</td>
</tr>
<tr>
<td>Negative</td>
<td>10.93%</td>
<td>-0.56%</td>
<td>12.55%</td>
</tr>
<tr>
<td>Same</td>
<td>78.70%</td>
<td>-68.33%</td>
<td>77.20%</td>
</tr>
<tr>
<td>Objective</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>59.98%</td>
<td>19.96%***</td>
<td>40.02%</td>
</tr>
<tr>
<td>Subjective</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>20.88%</td>
<td>N/A</td>
<td>24.04%</td>
</tr>
<tr>
<td>Negative</td>
<td>36.98%</td>
<td>-16.10%</td>
<td>32.93%</td>
</tr>
<tr>
<td>Same</td>
<td>42.14%</td>
<td>-21.26%</td>
<td>43.03%</td>
</tr>
<tr>
<td>Decreased</td>
<td>15.63%</td>
<td>N/A</td>
<td>12.54%</td>
</tr>
<tr>
<td>Increased</td>
<td>17.18%</td>
<td>-1.55%**</td>
<td>18.6%</td>
</tr>
<tr>
<td>Stayed positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased</td>
<td>53.63%</td>
<td>-38.00%***</td>
<td>59.19%</td>
</tr>
<tr>
<td>Stayed negative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stayed positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased</td>
<td>13.55%</td>
<td>2.08%***</td>
<td>9.67%</td>
</tr>
<tr>
<td>Increased</td>
<td>17.18%</td>
<td>-1.55%**</td>
<td>18.6%</td>
</tr>
<tr>
<td>Stayed positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased</td>
<td>53.63%</td>
<td>-38.00%***</td>
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</tr>
<tr>
<td>Stayed negative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stayed positive</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Population weighted data; RII technique was used.

The reference category used in the mean test is indicated in bold face.

b,c,d Significance test is for mean difference from reference category for each variable. Significance level: ***α=0.01, **α=0.05, *α=0.1

c Objective income change is a continuous variable thus, mean difference between positive objective change category and negative change category is the same as mean difference in Group 1 and Group 2.

Table 5.2 and Table 5.3 provide the estimated coefficient, standard error, and p-value for each independent variable associated with savings between 2007 and 2009 using the unweighted RII OLS regression procedure. Since this study used RII techniques, the coefficient and the standard error of each independent variable were calculated using the coefficients and the standard errors in five different implicates. For each model, the value of R square is also provided with the value of pseudo R square and the range of R squares from the minimum to the maximum values across the five implicates.

5.2.1. Objective Expected Income Change

Hypothesis 3a and hypothesis 5-3 were partly supported (See Table 5.2). Deviation from normal income and income uncertainty change were not significant in Group 1 and Group 2. The effect of expected income change was significant only in Group 1 (p<0.001), indicating that one unit increase in expected income change led to 33,741 dollars decrease in saving to for households with positive expected income change. Hypothesis 3a was partly supported. For income uncertainty change, households with stayed positive income uncertainty had a more positive saving than households with decreased income uncertainty (p<0.05) in Group 2, supporting hypothesis 5-3.

In financial attitude and demographic variables, risk tolerance, and age were significant in both groups. Households taking substantial risk had a negative saving regardless of either positive or negative expected income change. Risk tolerance is
related to portfolio asset mix in households and, in general, risk taking households are more likely to have risky assets, which would have been largely affected by the recession. Older households had less saving in both groups. Marital status was only significant in Group 1; households living with partner had less saving than married households.

On the other hand, education, the number of children, foreseeable expense, unemployment, understanding of the SCF survey questions, credit constraints, perceived health status, and planning horizon were not found to have significant effects in both groups.

5.2.2. Subjective Expected Income Change

Hypothesis 3b-2 and hypothesis 5-3 were partly supported (See Table 5.3). Deviation from normal income was not significant. Although the difference between negative and positive expected income change was not significant, the difference between about the same and positive expected income change was significant, supporting hypothesis 3b-2. Households with about the same expected income had a greater positive effect on savings than those with a positive expected income change (p<0.1). In terms of income uncertainty change, stayed positive uncertainty change had a greater positive effect on saving than decreased uncertainty change (p<0.1), partly supporting hypothesis 5-3.

Substantial risk takers had a more negative saving than no risk takers. Age and education were negatively related to saving while separated/divorced households increased their savings more than married households over the period. However, effects
of the number of children, foreseeable expense, unemployment, understanding of the SCF survey questions, perceived health, and planning horizon were not significant.
<table>
<thead>
<tr>
<th>Variable a</th>
<th>Group1 (Positive Expectation)</th>
<th>Group2 (Negative Expectation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>P-value</td>
</tr>
<tr>
<td><strong>Reference Dependent Income and Uncertainty Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation from Normal (Positive)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>182.294</td>
<td>0.568</td>
</tr>
<tr>
<td>About the same</td>
<td>25.318</td>
<td>0.922</td>
</tr>
<tr>
<td><strong>Expected Income Change</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective</td>
<td>-33.741</td>
<td>0.000</td>
</tr>
<tr>
<td>Income Uncertainty Change (Decrease)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase</td>
<td>101.746</td>
<td>0.707</td>
</tr>
<tr>
<td>Stays +</td>
<td>196.465</td>
<td>0.414</td>
</tr>
<tr>
<td>Stays -</td>
<td>-167.640</td>
<td>0.555</td>
</tr>
<tr>
<td><strong>Financial Attitude Variables</strong></td>
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<td></td>
</tr>
<tr>
<td>Risk tolerance (No risk)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>-90.938</td>
<td>0.626</td>
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<tr>
<td>Above average</td>
<td>-248.516</td>
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<td>Sub risk</td>
<td>-1800.294</td>
<td>0.000</td>
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<tr>
<td>Planning horizon (Next few month)</td>
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<td></td>
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<tr>
<td>Next year</td>
<td>-172.483</td>
<td>0.539</td>
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<tr>
<td>Next few year</td>
<td>-191.885</td>
<td>0.461</td>
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<tr>
<td>Next 5 to 7 years</td>
<td>-185.767</td>
<td>0.506</td>
</tr>
<tr>
<td>Longer than 10 years</td>
<td>-156.878</td>
<td>0.687</td>
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<tr>
<td><strong>Demographic Variables</strong></td>
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<td></td>
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<tr>
<td>Age</td>
<td>-16.849</td>
<td>0.008</td>
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<tr>
<td>Education</td>
<td>14.588</td>
<td>0.727</td>
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<tr>
<td>Marital Status</td>
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<tr>
<td>Partner</td>
<td>-897.732</td>
<td>0.012</td>
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<td>Separated/ Divorced</td>
<td>79.519</td>
<td>0.729</td>
</tr>
<tr>
<td>Widow/ widower</td>
<td>187.156</td>
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</table>

*Continued*
<table>
<thead>
<tr>
<th>Variable a</th>
<th>Coefficient</th>
<th>P-value</th>
<th>S.E.</th>
<th>Coefficient</th>
<th>P-value</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never married</td>
<td>-205.741</td>
<td>0.440</td>
<td>266.349</td>
<td>196.195</td>
<td>0.964</td>
<td>4289.273</td>
</tr>
<tr>
<td>Child</td>
<td>39.328</td>
<td>0.596</td>
<td>74.105</td>
<td>-705.574</td>
<td>0.528</td>
<td>1119.045</td>
</tr>
<tr>
<td>Foreseeable expense in the next 5 to 10 years (No)</td>
<td>Yes</td>
<td>-53.992</td>
<td>0.196</td>
<td>41.772</td>
<td>-9.476</td>
<td>0.988</td>
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<td>Unemployment Status (No)</td>
<td>Yes</td>
<td>226.385</td>
<td>0.308</td>
<td>222.119</td>
<td>1528.901</td>
<td>0.735</td>
</tr>
<tr>
<td>Understanding of the SCF survey questions (Excellent understanding)</td>
<td>Good</td>
<td>-126.629</td>
<td>0.453</td>
<td>168.877</td>
<td>2347.757</td>
<td>0.305</td>
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<td>Fair</td>
<td>-51.917</td>
<td>0.869</td>
<td>314.593</td>
<td>1383.353</td>
<td>0.783</td>
<td>5023.478</td>
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<tr>
<td>Poor</td>
<td>-408.852</td>
<td>0.686</td>
<td>1012.765</td>
<td>3474.882</td>
<td>0.837</td>
<td>16842.521</td>
</tr>
<tr>
<td>Perceived health status (Not Poor Health)</td>
<td>Poor health</td>
<td>-144.107</td>
<td>0.429</td>
<td>182.136</td>
<td>-142.726</td>
<td>0.949</td>
</tr>
<tr>
<td>Credit constraints (No)</td>
<td>Yes</td>
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<td>0.789</td>
<td>217.159</td>
<td>-1750.259</td>
<td>0.655</td>
</tr>
<tr>
<td>Intercept</td>
<td>1601.029</td>
<td>0.045</td>
<td>797.219</td>
<td>15064.222</td>
<td>0.165</td>
<td>10848.258</td>
</tr>
</tbody>
</table>

R²: 0.053 – 0.061 (Adjusted: 0.038 – 0.047)  
R²: 0.025 – 0.068 (Adjusted: 0.012 – 0.056)

Note: Non weighted data; RII technique was used

a Reference category in parentheses
Table 5.3 Model 1. OLS Regression Results: Subjective Expected Income Change

<table>
<thead>
<tr>
<th>Variable a</th>
<th>Coefficient</th>
<th>Pvalue</th>
<th>S.E.</th>
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</thead>
<tbody>
<tr>
<td>Reference Dependent Income and Uncertainty Variables</td>
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<td></td>
</tr>
<tr>
<td>Deviation from Normal (Positive)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>-216.367</td>
<td>0.933</td>
<td>2577.675</td>
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<tr>
<td>Same</td>
<td>-1814.06</td>
<td>0.386</td>
<td>2093.388</td>
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<tr>
<td>Expected Income Change (Positive)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>1817.931</td>
<td>0.215</td>
<td>1466.456</td>
</tr>
<tr>
<td>Same</td>
<td>2655.248</td>
<td>0.057</td>
<td>1393.02</td>
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<tr>
<td>Income Uncertainty Change (Decrease)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Increased</td>
<td>124.3354</td>
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<tr>
<td>Stayed positive</td>
<td>4076.633</td>
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<tr>
<td>Stayed negative</td>
<td>1392.239</td>
<td>0.488</td>
<td>2007.545</td>
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<td>Financial Attitude</td>
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<td></td>
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</tr>
<tr>
<td>Risk tolerance (No risk)</td>
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<tr>
<td>Average</td>
<td>820.201</td>
<td>0.597</td>
<td>1549.031</td>
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<tr>
<td>Above average</td>
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<td>Planning horizon (Next few month)</td>
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<tr>
<td>Next year</td>
<td>266.06</td>
<td>0.907</td>
<td>2276.731</td>
</tr>
<tr>
<td>Next few year</td>
<td>419.829</td>
<td>0.812</td>
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<td>Next 5 to 7 years</td>
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<td>1789.727</td>
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<td>Longer than 10 years</td>
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<td>0.121</td>
<td>2188.545</td>
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<tr>
<td>Demographic Variables</td>
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<td>Age</td>
<td>-144.52</td>
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<td>47.79029</td>
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<td>Education</td>
<td>-432.156</td>
<td>0.087</td>
<td>252.2145</td>
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<tr>
<td>Marital Status</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Partner</td>
<td>-2992.66</td>
<td>0.185</td>
<td>2258.17</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>2610.13</td>
<td>0.136</td>
<td>1751.922</td>
</tr>
<tr>
<td>Widow/Widower</td>
<td>2287.654</td>
<td>0.373</td>
<td>2567.82</td>
</tr>
<tr>
<td>Never married</td>
<td>229.665</td>
<td>0.910</td>
<td>2020.851</td>
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<tr>
<td>Child</td>
<td>-488.719</td>
<td>0.412</td>
<td>595.419</td>
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</table>

Continued
Table 5. 3 Continued

<table>
<thead>
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<th>Variable</th>
<th>Coefficient</th>
<th>Pvalue</th>
<th>S.E.</th>
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</thead>
<tbody>
<tr>
<td>Foreseeable expense in the next 5 to 10 years (No)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-43.077</td>
<td>0.898</td>
<td>334.849</td>
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<tr>
<td>Unemployment Status (No)</td>
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<td></td>
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<tr>
<td>Yes</td>
<td>831.204</td>
<td>0.644</td>
<td>1801.031</td>
</tr>
<tr>
<td>Understanding of the SCF survey questions (Excellent understanding)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>1141.939</td>
<td>0.341</td>
<td>1199.41</td>
</tr>
<tr>
<td>Fair</td>
<td>975.509</td>
<td>0.685</td>
<td>2405.609</td>
</tr>
<tr>
<td>Poor</td>
<td>1375.509</td>
<td>0.859</td>
<td>7756.037</td>
</tr>
<tr>
<td>Perceived health status (Not Poor Health)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Poor health</td>
<td>-402.495</td>
<td>0.745</td>
<td>1238.948</td>
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<tr>
<td>Credit constraints (No)</td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-486.29</td>
<td>0.775</td>
<td>1702.084</td>
</tr>
<tr>
<td>Intercept</td>
<td>9521.956</td>
<td>0.092</td>
<td>5647.492</td>
</tr>
</tbody>
</table>

R square                                      | 0.019–0.024 |
(Adjusted-R square)                             | (0.012–0.017)|

Note: Non weighted data; RII technique is used

*a Reference category in parentheses
5.3. Model 2. Whether or not saved in 2009 (Logistic Regression)

Table 5.4 and Table 5.5 are the results of the analysis of the probability of saving in 2009 using the logistic regression procedure. They include the estimated coefficient, standard error, p-value, odds ratio, and R squares. Like Model 1, results for Model 2 were also derived from RII techniques and the range of both R square and pseudo R square are reported with the minimum and the maximum values across the five implicates.

5.3.1. Objective Expected Income Change

Hypothesis 2 was supported (See Table 5.4). Negative deviation from normal income was negatively related to the likelihood of saving in 2009 compared to positive deviation households (p<0.05 in Group 1 and p<0.001 in Group 2) in both groups. In other words, households whose 2006 income was lower than a normal income were less likely to save in 2009 than households whose 2006 income was higher than normal. This result shows asymmetric saving responses to positive and negative change in a reference point. Both size of influence in saving decision and its direction were different between positive and negative evaluation of last year’s income compared to a normal income.

Hypothesis 3a was supported in both groups (See Table 5.4). Expected income change was negatively related to the likelihood of saving (p<0.1 in Group1 and p<0.05 in Group2), indicating households with negative income expectations were less likely to save in 2009 than households with positive income expectations. These results using objective expected income change provide evidence of an asymmetric saving response to expected income change.
Some categories of income uncertainty change had significant effects (p<0.05) in both groups, partly supporting hypothesis 5-3. Households whose income uncertainty change stayed negative had a less likelihood of saving in 2009 than households whose income uncertainty change was positive in Group 1, but stayed positive households had a positive effect on the likelihood of saving in Group 2, supporting hypotheses 5-3.

Financial attitude variables such as risk tolerance and planning horizon were significant. In both groups, average and above average risk takers were more likely to save in 2009 than no risk takers. Overall, longer planning horizon than a year had greater positive effects on the likelihood of saving in 2009 than a horizon of a few months in Group 1 and Group 2.

Many household demographic characteristics, including, education, marital status, the number of children, and credit constraints, had significant effects: Higher education led to a greater likelihood of saving in both groups. Married households were more likely to save in 2009 than the other types of marital status in Group 1. The number of children had a negative effect on the probability of saving in Group 2. As opposed to Model 1, credit constraints were negatively related to the likelihood saving in 2009 for both groups, indicating that whether or not saved in 2009 would have been affected by such restrictions. Age, foreseeable expense, understanding of the SCF survey questions, unemployment, and perceived health status were not significant in both models.

5.3.2. Subjective Expected Income Change

Three reference dependent income and uncertainty variables presented consistent results with each other, supporting hypothesis 2, hypothesis 3b-2, hypothesis 4b, and...
hypothesis 5-3 (See Table 5.5). Households with a negative deviation from normal income in 2007 (p<0.001) were less likely to save in 2009 than households with a positive deviation from normal income, supporting hypothesis 2.

Expected income change was negatively related to the likelihood of saving. Households with negative income expectations (p<0.001) and about the same expectations (p<0.05) were less likely to save in 2009 than households with positive expectations, supporting both hypotheses 4b and 3b-2.

Households whose income uncertainty stayed negative were less likely to save in 2009 than households whose income uncertainty level decreased (p<0.01); whereas, households whose income uncertainty stayed positive were more likely to save in 2009 than households whose income uncertainty decreased negative (p<0.05). These two results supported hypothesis 5-3. This result was also consistent with the objective expectation model of whether or not saved in 2009.

Households with average and above average risk tolerance were more likely to save than those with no risk tolerance while households with a longer horizon than a few months were more likely to save in 2009 than those with a few month long horizon. Age (positive), education (positive), marital status (married were more likely to save), the number of children (negative), poor health (positive), and credit constraints (negative in both Group 1 and Group 2) had significant effects.
## Table 5.4. Model 2. Logistic Regression Results: Objective Expected Income Change

<table>
<thead>
<tr>
<th>Variable Type</th>
<th>Group 1 (Positive Expectation)</th>
<th>Group 2 (Negative Expectation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable: Whether saved or not in 2009</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference Dependent Income and Uncertainty Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation from Normal (Positive)</td>
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<td></td>
</tr>
<tr>
<td>Negative</td>
<td>-0.539</td>
<td>-0.742</td>
</tr>
<tr>
<td>About the same</td>
<td>-0.188</td>
<td>-0.117</td>
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<tr>
<td>Expected Income Change</td>
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<td></td>
</tr>
<tr>
<td>Objective</td>
<td>-0.005</td>
<td>-0.0001</td>
</tr>
<tr>
<td>Income Uncertainty Change (Decrease)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase</td>
<td>-0.254</td>
<td>-0.164</td>
</tr>
<tr>
<td>Stayed +</td>
<td>0.092</td>
<td>0.374</td>
</tr>
<tr>
<td>Stayed -</td>
<td>-0.377</td>
<td>-0.274</td>
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<tr>
<td>Financial Attitude Variables</td>
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</tr>
<tr>
<td>Risk tolerance(No risk)</td>
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</tr>
<tr>
<td>Average</td>
<td>0.281</td>
<td>0.264</td>
</tr>
<tr>
<td>Above average</td>
<td>0.293</td>
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<tr>
<td>Sub risk</td>
<td>0.124</td>
<td>-0.030</td>
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<tr>
<td>Planning horizon(Next few month)</td>
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<td></td>
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<tr>
<td>Next year</td>
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<td>0.114</td>
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<tr>
<td>Next few year</td>
<td>0.506</td>
<td>0.251</td>
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<tr>
<td>Next 5 to 7 years</td>
<td>0.546</td>
<td>0.585</td>
</tr>
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<td>Longer than 10 years</td>
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<td>0.467</td>
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<tr>
<td>Demographic Variables</td>
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<td>Age</td>
<td>-0.006</td>
<td>0.003</td>
</tr>
<tr>
<td>Education</td>
<td>0.097</td>
<td>0.044</td>
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<tr>
<td>Marital Status</td>
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<tr>
<td>Partner</td>
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<td>-0.286</td>
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<tr>
<td>Separated/Divorced</td>
<td>-0.531</td>
<td>-0.245</td>
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<tr>
<td>Widow/ Widower</td>
<td>-0.153</td>
<td>-0.153</td>
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Continued
Table 5.4. Continued

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<th>Variable</th>
<th>Coefficient</th>
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<th>S.E.</th>
<th>ExpB</th>
<th>Coefficient</th>
<th>P value</th>
<th>S.E.</th>
<th>ExpB</th>
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<td></td>
<td></td>
<td></td>
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<tr>
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<td>-0.277</td>
<td>0.164</td>
<td>0.199</td>
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<td>0.048</td>
<td>0.937</td>
<td>-0.110</td>
<td>0.029</td>
<td>0.050</td>
<td>0.896</td>
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<tr>
<td>Group2 (Negative Expectation)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>-0.065</td>
<td>0.173</td>
<td>0.048</td>
<td>0.937</td>
<td>-0.110</td>
<td>0.029</td>
<td>0.050</td>
<td>0.896</td>
</tr>
<tr>
<td>Foreseeable expense in the next 5 to 10 years (No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.022</td>
<td>0.407</td>
<td>0.026</td>
<td>1.022</td>
<td>-0.008</td>
<td>0.762</td>
<td>0.027</td>
<td>0.992</td>
</tr>
<tr>
<td>Unemployment Status (No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.089</td>
<td>0.540</td>
<td>0.144</td>
<td>0.915</td>
<td>0.192</td>
<td>0.390</td>
<td>0.224</td>
<td>1.212</td>
</tr>
<tr>
<td>Understanding of the SCF survey questions (Excellent understanding)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>-0.146</td>
<td>0.166</td>
<td>0.105</td>
<td>0.864</td>
<td>-0.014</td>
<td>0.896</td>
<td>0.110</td>
<td>0.986</td>
</tr>
<tr>
<td>Fair</td>
<td>0.008</td>
<td>0.969</td>
<td>0.200</td>
<td>1.008</td>
<td>-0.038</td>
<td>0.871</td>
<td>0.234</td>
<td>0.963</td>
</tr>
<tr>
<td>Poor</td>
<td>-0.106</td>
<td>0.873</td>
<td>0.666</td>
<td>0.899</td>
<td>-0.320</td>
<td>0.706</td>
<td>0.849</td>
<td>0.726</td>
</tr>
<tr>
<td>Perceived health status(Not Poor Health)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor health</td>
<td>0.117</td>
<td>0.322</td>
<td>0.118</td>
<td>1.124</td>
<td>0.132</td>
<td>0.232</td>
<td>0.110</td>
<td>1.141</td>
</tr>
<tr>
<td>Credit constraints (No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.244</td>
<td>0.078</td>
<td>0.139</td>
<td>0.783</td>
<td>-0.665</td>
<td>0.001</td>
<td>0.191</td>
<td>0.514</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.817</td>
<td>0.092</td>
<td>0.485</td>
<td>0.442</td>
<td>-0.555</td>
<td>0.230</td>
<td>0.462</td>
<td>0.574</td>
</tr>
<tr>
<td>R square</td>
<td>0.083-0.085</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.117</td>
<td>0.124</td>
<td></td>
</tr>
<tr>
<td>(Adjusted R Square)</td>
<td>(0.110-0.114)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.162</td>
<td>0.170</td>
<td></td>
</tr>
</tbody>
</table>

Note: Non weighted data; RII technique is used

a Reference category in parentheses
Table 5. Model 2. Logistic Regression Results: Subjective Expected Income Change

<table>
<thead>
<tr>
<th>Variable a</th>
<th>Coefficient</th>
<th>P value</th>
<th>S.E.</th>
<th>ExpB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference Dependent Income and Uncertainty Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation from Normal (Positive)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>-0.643</td>
<td>0.000</td>
<td>0.143</td>
<td>0.526</td>
</tr>
<tr>
<td>Same</td>
<td>-0.177</td>
<td>0.107</td>
<td>0.110</td>
<td>0.838</td>
</tr>
<tr>
<td>Expected Income Change (More)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>-0.471</td>
<td>0.000</td>
<td>0.095</td>
<td>0.624</td>
</tr>
<tr>
<td>Same</td>
<td>-0.306</td>
<td>0.001</td>
<td>0.090</td>
<td>0.737</td>
</tr>
<tr>
<td>Income Uncertainty Change (Decrease)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased</td>
<td>-0.177</td>
<td>0.136</td>
<td>0.119</td>
<td>0.838</td>
</tr>
<tr>
<td>Stayed positive</td>
<td>0.251</td>
<td>0.018</td>
<td>0.106</td>
<td>1.285</td>
</tr>
<tr>
<td>Stayed negative</td>
<td>-0.353</td>
<td>0.004</td>
<td>0.124</td>
<td>0.703</td>
</tr>
<tr>
<td><strong>Financial Attitude Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk tolerance(No risk)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>0.303</td>
<td>0.001</td>
<td>0.090</td>
<td>1.354</td>
</tr>
<tr>
<td>Above average</td>
<td>0.471</td>
<td>0.000</td>
<td>0.110</td>
<td>1.601</td>
</tr>
<tr>
<td>Sub risk</td>
<td>0.090</td>
<td>0.597</td>
<td>0.171</td>
<td>1.094</td>
</tr>
<tr>
<td>Planning horizon(Next few month)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Next year</td>
<td>0.102</td>
<td>0.461</td>
<td>0.138</td>
<td>1.107</td>
</tr>
<tr>
<td>Next few year</td>
<td>0.418</td>
<td>0.000</td>
<td>0.112</td>
<td>1.519</td>
</tr>
<tr>
<td>Next 5 to 7 years</td>
<td>0.615</td>
<td>0.000</td>
<td>0.113</td>
<td>1.849</td>
</tr>
<tr>
<td>Longer than 10 years</td>
<td>0.470</td>
<td>0.000</td>
<td>0.124</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Demographic Variables</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.002</td>
<td>0.564</td>
<td>0.003</td>
<td>1.002</td>
</tr>
<tr>
<td>Education</td>
<td>0.047</td>
<td>0.002</td>
<td>0.015</td>
<td>1.048</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partner</td>
<td>-0.343</td>
<td>0.020</td>
<td>0.147</td>
<td>0.709</td>
</tr>
<tr>
<td>Separated/ Divorced</td>
<td>-0.362</td>
<td>0.000</td>
<td>0.103</td>
<td>0.696</td>
</tr>
<tr>
<td>Widow/Widower</td>
<td>-0.145</td>
<td>0.350</td>
<td>0.156</td>
<td>0.865</td>
</tr>
<tr>
<td>Never married</td>
<td>-0.223</td>
<td>0.080</td>
<td>0.127</td>
<td>0.8</td>
</tr>
<tr>
<td>Child</td>
<td>-0.086</td>
<td>0.010</td>
<td>0.033</td>
<td>0.918</td>
</tr>
</tbody>
</table>
Table 5. 5 Continued

<table>
<thead>
<tr>
<th>Variable a</th>
<th>Coefficient</th>
<th>Pvalue</th>
<th>S.E.</th>
<th>ExpB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foreseeable expense in the next 5 to 10 years (No)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.006</td>
<td>0.737</td>
<td>0.019</td>
<td>1.006</td>
</tr>
<tr>
<td><strong>Unemployment Status (No)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.05</td>
<td>0.670</td>
<td>0.117</td>
<td>0.951</td>
</tr>
<tr>
<td><strong>Understanding of the SCF survey questions (Excellent understanding)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>-0.112</td>
<td>0.136</td>
<td>0.075</td>
<td>0.894</td>
</tr>
<tr>
<td>Fair</td>
<td>-0.027</td>
<td>0.861</td>
<td>0.151</td>
<td>0.974</td>
</tr>
<tr>
<td>Poor</td>
<td>-0.267</td>
<td>0.607</td>
<td>0.519</td>
<td>0.766</td>
</tr>
<tr>
<td><strong>Perceived health status (Not Poor Health)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor health</td>
<td>0.130</td>
<td>0.095</td>
<td>0.078</td>
<td>1.139</td>
</tr>
<tr>
<td><strong>Credit constraints (No)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.428</td>
<td>0.000</td>
<td>0.110</td>
<td>0.652</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.317</td>
<td>0.333</td>
<td>0.328</td>
<td>0.729</td>
</tr>
<tr>
<td>R square (Adjusted-R square)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.110 ~ 0.111</td>
<td>(0.148 ~ 0.150)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Non weighted data; RII technique is used

* Reference category in parentheses
5.4. Equality Tests

Equality tests for coefficients were conducted both for within group difference and between group difference. The within group equality test was employed to test whether or not a coefficient of negative deviation from normal income, compared to positive deviation from normal income as a reference is different from a coefficient of about the same as normal income, compared to the same reference, positive deviation from normal income, in Group 1. The between group equality test was used to compare a coefficient of negative deviation from normal income, for example, between Group 1 and Group 2. For within group equality tests on individual coefficients $\beta_{1j1}$ and $\beta_{2j1}$ estimated from one regression model with the null hypothesis $\beta_{1j1} - \beta_{2j1} = 0$, a z-test was conducted.

Equality tests for coefficients between categories within each group in Model 1 using both objective expected income measure and subjective expected income measure were not found significant (Table 5.6); whereas, deviation from normal income and income uncertainty change showed significant differences between categories in each group (using objective expected income measure) and a total sample (using subjective expected income measure) in Model 2 (Table 5.7), supporting hypotheses 1-1, 5-1, and 6b.

In Mode 2 and Group 1, a significant difference was found between stayed positive and stayed negative income uncertainty, supporting hypothesis 6b. In Mode 2 and Group 2, a significant difference between negative deviation from normal income and about the same as normal income, supporting hypothesis 1-1, between increased income
uncertainty change and stayed positive, supporting hypothesis 5-1, and between stayed positive and stayed negative income uncertainty change, supporting hypothesis 6b, were found.

When using subjective expected income change in Model 2, hypothesis 1-1, hypothesis 5-1, and hypothesis 6b were also supported, as Model 2 using objective expected income change. There were significant differences between a negative deviation from normal income and about the same as normal income, between increased income uncertainty change and stayed positive income uncertainty, and between stayed positive and stayed negative income uncertainty change. However, a difference between negative subjective expected income change and about the same subjective expected income change was not significant.

Thus, in Model 2 there was a significant difference between negative deviation from normal income and about the same as normal income in Group 2 and total sample, supporting hypothesis 1-1. Differences between increased income uncertainty and stayed positive and between stayed positive and stayed negative were significant in Group 1, Group 2, and total sample, which all support hypothesis 5-1 and hypothesis 6b. Thus, in Model 2 with both expected income change measures, asymmetric saving responses between stayed positive and stayed negative income uncertainty change were identified.

When it comes to between group equality tests, individual coefficients for deviation from normal year, expected income change, and income uncertainty change in Group 1 were compared to their counterparts in Group 2. Results are presented in Table 5.8, partly supporting hypothesis 4a and hypothesis 7.
In Model 1, group differences were found in expected income change and in stayed positive income uncertainty compared to decreased income uncertainty, and in stayed negative income uncertainty compared to decreased income uncertainty; whereas, in Model 2, group differences were not significant. An asymmetric response of saving between negative and positive expected income change was significant in in Model 1 but not in Model 2, partly supporting hypothesis 4a and hypothesis 7: The effect of expected income change was significantly different between Group 1 and Group 2 in Model 1. A group difference in income uncertainty change was significant also only in Model 1.
### Table 5.6 Model 1 Equality Test of Within Group

**Dependent variable: Saving between 2007 and 2009**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Objective Expected Income Change</th>
<th>Subjective Expected Income Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1</td>
<td>Group 2</td>
</tr>
<tr>
<td>Reference Dependent Income and Uncertainty Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation from Normal (Positive)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neg. vs. Same</td>
<td>0.382</td>
<td>0.380</td>
</tr>
<tr>
<td>Expected Income Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Subjective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neg. vs. Same</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Income Uncertainty Change (Decrease)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incr vs. Sp</td>
<td>-0.262</td>
<td>-1.253</td>
</tr>
<tr>
<td>Incr vs. Sn</td>
<td>0.687</td>
<td>-0.457</td>
</tr>
<tr>
<td>Sp vs. Sn</td>
<td>0.979</td>
<td>0.720</td>
</tr>
</tbody>
</table>

Note: Significance level: ***$\alpha$=0.01, **$\alpha$=0.05, *$\alpha$=0.1

- Negative deviation from normal income compared to about the same as normal income
- Objective income change is a continuous variable, thus, this is the same as group difference between positive objective change category and negative change category presented in Table 5.8.
- Negative expected real income compared to about the same real income
- Increased income uncertainty compared to Stayed positive income uncertainty
- Increased income uncertainty compared to Stayed negative income uncertainty
- Stayed positive income uncertainty compared to Stayed negative income uncertainty
Table 5.7. Model 2 Equality Test of Within Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dependent variable: Whether or not Saved in 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objective Expected Income Change</td>
</tr>
<tr>
<td></td>
<td>Group1</td>
</tr>
</tbody>
</table>

Reference Dependent Income and Uncertainty Variables

*Deviation from Normal (Positive)*
- Neg. vs. Same \textsuperscript{a} \quad -1.294 \quad -2.487*** \quad -2.593***

*Expected Income Change*

Objective \textsuperscript{b}
- NA

Subjective
- Neg. vs. Same \textsuperscript{c} \quad NA \quad NA \quad -1.264

*Income Uncertainty Change (Decrease)*
- Incr vs. Sp \textsuperscript{d} \quad -1.510 \quad -2.344*** \quad -2.688***
- Incr vs. Sn \textsuperscript{e} \quad 0.507 \quad 0.442 \quad 1.021
- Sp vs. Sn \textsuperscript{f} \quad 2.031** \quad 2.687*** \quad 3.700***

Note: Significance level: ***\( \alpha=0.01 \), **\( \alpha=0.05 \), *\( \alpha=0.1 \)

\textsuperscript{a} Negative deviation from normal income compared to about the same as normal income

\textsuperscript{b} Objective income change is a continuous variable, thus, this is the same as group difference between positive objective change category and negative change category presented in Table 5.8.

\textsuperscript{c} Negative expected real income compared to about the same real income

\textsuperscript{d} Increased income uncertainty compared to Stayed positive income uncertainty

\textsuperscript{e} Increased income uncertainty compared to Stayed negative income uncertainty

\textsuperscript{f} Stayed positive income uncertainty compared to Stayed negative income uncertainty
Table 5.8. Coefficients Equality Test Between Group 1 and Group 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Objective Expected Income Change Measure</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
</tr>
<tr>
<td>Deviation from Normal (Positive)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>0.353</td>
<td>0.698</td>
<td></td>
</tr>
<tr>
<td>About the same</td>
<td>1.036</td>
<td>-0.308</td>
<td></td>
</tr>
<tr>
<td>Expected Income Change</td>
<td></td>
<td>-5.623***</td>
<td>-1.640</td>
</tr>
<tr>
<td>Objective</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased</td>
<td>-0.216</td>
<td>-0.374</td>
<td></td>
</tr>
<tr>
<td>Stayed Positive</td>
<td>-2.032***</td>
<td>-1.285</td>
<td></td>
</tr>
<tr>
<td>Stayed Negative</td>
<td>-0.882</td>
<td>-0.407</td>
<td></td>
</tr>
</tbody>
</table>

Note: Significance level: ***α=0.01, **α=0.05, *α=0.1

a Reference category in parentheses
Chapter 6. Summary and Discussion

This research found a significant relationship between reference point and expectations and future saving and found asymmetric saving responses within groups (each category compared to a reference category) in each model and between groups (Group 1 and Group 2) in Model 1, although significant relationships were not found in all models or groups. Details on specific significant relationships were different between groups and models and the summary of hypothesis test results are presented in Table 6.1.

Depending on whether the objective or subjective measure of expected income change was used, the results were different. Deviation from normal income was significant in Model 2 using both objective and subjective measure, and asymmetric saving responses between positive and negative deviation from normal income was found. Model 2 using the objective expected income change estimate, households who answered negative deviation from normal income had $539 and $742 lower saving than households who said it was higher in Group 1 and Group 2, respectively. For Model 2 using the subjective expected income variable, negative coefficients and odds ratio less than 1 for negative deviation from normal income indicate households with a positive deviation were more likely to save than households with negative deviation from normal income. In other words, households who in 2007 evaluated their 2006 year income lower than normal income were less likely to save in 2009 and saved less over the period
compared to households who evaluated their 2006 income as higher than normal income. When even their objective expected income was positive, households who evaluated their 2006 income as higher than normal income had a greater likelihood of saving than households who evaluated their 2006 income as lower than normal.

Loss aversion can explain these asymmetric responses. Households who negatively assessed their 2006 year income compared to normal income as a reference point, must have felt relative losses but would not reduce their consumption level since disutility of expected loss in the current period is perceived as smaller than their expected gain in the next period, leading to a negative impact on whether or not saved in 2009. This negative coefficient is consistent with reference dependent consumption and saving decisions because a non-zero coefficient indicates first period income (consumption) affects second period saving (Bowman et al., 1999), as opposed to LCH/PIH that hypothesizes $\alpha = 0$. Thus, habit formation may explain to some extent the reference dependence of consumption and saving decisions. According to Boyer (1983), although households negatively assessed past income, their consumption level for current standard of living cannot be instantly lower than their reference level or decrease at the same rate as income decreases due to reference dependent decisions. However, habit formation posits households with positive evaluations, thus with relative gains, should have increased their consumption at the same growth rate of expected income, $\alpha = 1$, and increased consumption level over the periods made households save less by raising utility of current consumption to those with positive assessment of deviation from normal income in 2007 (Boyer, 1983), captured as a symmetric response.
As described above, evidence of within group asymmetric saving responses between positive deviation and negative deviation from normal income was found both in Group 1 and Group 2 of Model 2 but when comparing the coefficient between Group 1 and Group 2, the between group asymmetric saving responses were not found in either model. However, for within group equality test, in Model 2 a difference between negative deviation from normal income and about the same as normal income was significant in Group 2 using objective expected income change and total sample using subjective expected income change in Group 1.

Expected income change showed some variation in effects across groups, measurements, and models. There was a significant group difference in saving using objective expected income change in Model 1, while there was a significant within group difference between negative and about same in both Model 1 and Model 2.

Objective expected income change was significant in Model 1, Group 1, and Model 2, Group 1 and Group 2 and it was negative effect on saving decisions. On unit increase in objective expected income change led to $33,741 decrease in saving between 2007 and 2009 in Group 1 while the likelihood of saving in 2009 was negatively affected for households with negative expected income change. Both models provide evidence of an asymmetric saving response to objectively estimated expected income change. The difference between positive and negative expected income in Model 1 was also supported through between group equality test.

When using a subjective measure of expected income change, overall results were consistent with results for the objective measure of expected income change and
significant effects were found in both models. Households expecting either a future real income decrease or about the same real income were less likely to save in 2009 than those expecting a future real income to increase. However, difference between negative real income expectations and about the same real income expectations was not significant.

Income uncertainty change also had a significant effect on saving decisions across groups, measurements, and models. Households answering ‘income uncertainty decreased’ had negative savings in Group 2 in Model 1 using objective expected income change as well as in total sample of Model 1 using subjective expected income change. Households answering ‘income uncertainty decreased’ were less likely to save than households choosing ‘income uncertainty stayed positive’ Group 2 in Model 2 using objective expected income change as well as in total sample of Model 2 using subjective expected income change. But uncertainty decreased households were more likely to save than households responding ‘income uncertainty stayed negative’ in Group1 using the objective expected income and total sample using the subjective income measure. In terms of asymmetric saving responses to income uncertainty change, a difference between decreased income uncertainty and increased income uncertainty were not significant; whereas, there was a significant difference between stayed positive and stayed negative income uncertainty on saving decisions.

These results are partly inconsistent with loss aversion in Bowman et al (1999)’s proposition on saving describing the relationship with income uncertainty in terms of loss aversion. When income uncertainty changes, household saving in the next period is
affected in either way, increase or decrease, and this study did not find any significant
difference between decreased income uncertainty and increased income uncertainty in
saving decisions but found a significant difference between stayed positive and stayed
negative. Strictly speaking, this income uncertainty measure is qualitative and does not
directly measure the uncertainty level itself. Even though perceived income uncertainty
level did not change, these income uncertainty changes were measured separately at two
periods and showed a perceived negative income uncertainty in both periods had a
negative effect on saving compared to positive income uncertainty in both periods.

Previous studies have focused only on possible asymmetry in response to income
uncertainty change between increased and decreased income uncertainty. This study
found asymmetric saving responses between stayed positive and stayed negative income
uncertainty in Group 1 and Group 2 in Model 2 using objective expected income change
measure and total sample in Model 2 using the subjective expected income change
measure. How households perceive their income uncertainty affects saving as well as
their perception of changes in uncertainty from the previous period.

Another difference between the finding of this research and Bowman et al
(1999)’s proposition is within group differences in the effect of income uncertainty on
saving. Bowman et al (1999) proposed a role for income uncertainty change compared to
no uncertainty for expected income changes. For instance, even if negative future income
is expected as supposed in Group 2 of this study, households would decrease saving as
long as there is an increase in the probability of being able to consume above the
reference level, which was consistent with the results in this study.
Although asymmetry between groups was not significant in both models and only a difference between stayed positive and positive income uncertainty change was found significant between groups in Model 1, this study tried to extend the examination of asymmetric saving responses between negative and positive income uncertainty change to within group asymmetric responses as well as between group asymmetric responses, although direct links to the proposition of Bowman et al (1999) would be limited.

There were differences in both savings between 2007 and 2009 and likelihood of saving in 2009 by household characteristics, such as demographic and financial attitude variables. Overall, more control variables were found significant in Model 2 than Model 1 but no noticeable differences between groups were found: Risk tolerance, age, and marital status were significant both in Model 1 and Model 2 while education, the number of children, and credit constraints were significant in Model 2. In particular, credit constraints considered an important factor leading to negative saving decisions, were significant only in Model 2. Significant credit constraints would muddy the role of loss aversion in whether or not saved in 2009 and particularly contribute to a small effect for objective income change in Model 2.

However, according to van Treeck (2008; 2010), both loss aversion and credit constraints can explain asymmetric saving responses to positive and negative income change. According to his studies, in the long-run, loss aversion had more explanatory power but in the short-run credit constraints had more. Although the two period SCF panel data did not clearly distinguish between long term and short term, Model 1, savings between 2007 and 2009, and Model 2, whether saved or not in 2009, make a clearer
distinction. In fact, credit constraints were not found significant in Model 1, in which households had to make saving decisions for a relatively longer time period than in Model 2 concentrating on one year saving decision. Although Group 1 seemed to have greater restrictions on credit availability and less net worth, asymmetric saving responses were fairly evenly distributed across groups and related variables, including deviation from normal income, expected income change, and income uncertainty change. Thus, the related results in this study would open the possibility of credit constraints contributing to asymmetric saving responses in the short term, while also supporting loss aversion.

Besides significance of variables in the models, differences between groups, categories, and measurements, were tested. For instance, the explanatory power was different between models. Overall, R squares and adjusted R squares were higher for Model 2 than Model 1. Within models, using the objective expected income change measure led to higher R squares in Model 1, but R squares and adjusted R squares were similar between objective and subjective measure in Model 2.
Table 6.1. Summary of the Hypotheses Test Results

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Results</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypothesis 1. Effect of deviation from normal income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between negative deviation from normal income and about the same</td>
<td>N.S</td>
<td>N.S</td>
<td>P.S</td>
</tr>
<tr>
<td>as normal income.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between positive deviation from normal income and about the same</td>
<td>N.S</td>
<td>N.S</td>
<td>N.S</td>
</tr>
<tr>
<td>as normal income.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypothesis 2. Asymmetric effects of deviation from normal income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetric effects of deviation from normal income between positive deviation from normal income and negative deviation from normal income.</td>
<td>N.S</td>
<td>N.S</td>
<td>S</td>
</tr>
<tr>
<td><strong>Hypothesis 3. Effect of expected income change</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect of expected income change using objective measure</td>
<td>P.S</td>
<td>NA</td>
<td>S</td>
</tr>
<tr>
<td>Effects of expected income change using subjective measure:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between negative expected income change and about the same expected income change.</td>
<td>NA</td>
<td>N.S</td>
<td>NA</td>
</tr>
<tr>
<td>Effects of expected income change using subjective measure:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between positive expected income change and about the same expected income change.</td>
<td>NA</td>
<td>S</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Hypothesis 4. Asymmetric effects of expected income change</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetric effects of expected income change between positive expected income change and negative expected income change when using objective expected income change measure.</td>
<td>S</td>
<td>NA</td>
<td>N.S</td>
</tr>
<tr>
<td>Asymmetric effects of expected income change between positive expected income change and negative expected income change when using subjective expected income change measure</td>
<td>NA</td>
<td>N.S</td>
<td>NA</td>
</tr>
</tbody>
</table>

Continued
<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypothesis 5. Effect of income uncertainty change</strong></td>
<td></td>
</tr>
<tr>
<td><strong>H5-1</strong> Difference between increased income uncertainty and stayed positive income uncertainty</td>
<td>N.S N.S P.S S</td>
</tr>
<tr>
<td><strong>H5-2</strong> Difference between increased income uncertainty and stayed negative income uncertainty</td>
<td>N.S N.S N.S N.S</td>
</tr>
<tr>
<td><strong>H5-3</strong> Difference between decreased income uncertainty and stayed same income uncertainty</td>
<td>P.S P.S P.S S</td>
</tr>
<tr>
<td><strong>Hypothesis 6. Asymmetric effect of income uncertainty change</strong></td>
<td></td>
</tr>
<tr>
<td><strong>H6a</strong> Asymmetric effects of uncertainty change between decreased income uncertainty and increased income uncertainty</td>
<td>N.S N.S N.S N.S</td>
</tr>
<tr>
<td><strong>H6b</strong> Asymmetric effects of uncertainty change between stayed positive income uncertainty and stayed negative income uncertainty</td>
<td>N.S P.S S S</td>
</tr>
<tr>
<td><strong>Hypothesis 7. Equality test</strong></td>
<td></td>
</tr>
<tr>
<td>Equality test for within group and group difference</td>
<td>P.S NA P.S P.S</td>
</tr>
</tbody>
</table>

Note: N.S=Not supported; P.S=Partially Supported; S=Supported
Chapter 7. Conclusions

7.1. Conclusions and Significance

This study examined how households’ perception of their past and future income compared to reference points in the first period and how households’ perception of their income uncertainty change affect saving decisions between periods and in the second period using the 2007-2009 SCF panel data. Based on loss aversion theory with a two period model for inter-temporal decisions, subsamples were used to analyze possible asymmetric saving responses to a set of reference dependent income and uncertainty variables. This study found that a set of reference dependent income and uncertainty variables had significant effects on saving decisions of households and asymmetric saving responses to negative and positive changes.

The results provide empirical evidence consistent with a line of studies (Alessie & Lusardi, 1997; Campbell & Deaton, 1989; Shea, 1995a, 1995b). A set of reference dependent income and uncertainty variables had statistically significant effects on both savings between 2007 and 2009 and whether saved or not in 2009. The coefficients of these variables were significantly different from 0 and the coefficients were also significantly different between groups and within groups.

The findings in this study support gain-loss comparison utility that depends not only the level of consumption but also consumption compared to come norm or standard,
a reference point. Households compare their income or standard of living to those of a reference group or/and to those of their past experience (McBride, 2001). Although this study cannot rule out social comparison to a reference group, the SCF data contain information only about how households assess their own income and income uncertainty changes compared to such references and how the assessments affected inter temporal decisions.

Asymmetric saving responses to negative and positive changes, found in all three reference dependent income and uncertainty variables, such as deviation from normal income, expected income change, and income uncertainty change, were explained by loss aversion theory; risk taking attitudes led to relatively negative saving decisions because households would resist lowering current consumption even for both the negative expected income group and category, compared to positive expected income group and category (Bowman et al., 1999; van Treeck, 2008; 2010).

This study contributes to an extension of the discussion about asymmetric consumption and saving response in four ways. Most studies focused on asymmetric consumption change in response to expected income change, not asymmetry of saving. Although Bowman et al. (1999) hypothesized asymmetric saving in response to income uncertainty change under the given expected income change, whether negative or positive, they did not provide empirical evidence of asymmetry in saving. This study concentrated on saving decisions and provides empirical evidence of asymmetric saving response.
Also, this study found that saving responds asymmetrically not only to expected income change but also to assessment of past income deviation compared to normal income and of income uncertainty change. In particular, asymmetric saving response was found between stayed positive income uncertainty change and stayed negative income uncertainty change, even when income uncertainty did not change. These findings suggest a prevailing asymmetric saving response across perception of income and income uncertainty and an important role for loss aversion in determining effects of perception on saving behavior.

Unlike previous studies comparing groups, e.g. negative and positive expectation, this study also analyzed and found different saving responses within groups by employing both subjective and objective measures and sample restriction. There was a significant difference between increased income uncertainty and stayed positive income uncertainty within group (Group 2 of Model 1) and between decreased income uncertainty and stayed positive income uncertainty between Group 1 and Group 2 in Model 1. Although a difference between positive deviation and negative deviation from normal income and between decreased income uncertainty and increased income uncertainty was not found significant between group equality tests, an asymmetric influence of expected income change on saving was found between Group 1 and Group 2.

This study used two types of saving and expected income change measurements. Although there were certain inconsistencies between types of measures, the differences in results illustrate the importance of measuring in research and focus of interpretation. The
approach and findings support the importance of analyzing asymmetric saving responses to references and expectations with more empirical cases and circumstances.

7.2. Limitations and Recommendations for Future Research

Many studies of household saving that have not relied on classical models have used consumption theory without additional explanation or assumptions about the relationship between consumption and saving. But, this could bring confusion in theoretical interpretation and in consistency, thus, this study tried to connect the relationship. Although this study converted a consumption model to a saving model, classic economic theories basically assume utility of households is not derived directly from saving, but from consumption.

Application of loss aversion theory was used to develop the hypotheses and interpret the results. Although measuring loss aversion of households in saving decisions was not a direct focus of this study, further refining measures of loss aversion using the empirical data for saving decisions could improve both theoretical applications to empirical evidence and understanding of asymmetric saving decisions. When related to measuring loss aversion, the significant relationship between credit constraints and the likelihood of saving in 2009 suggested that additional measures and propositions are required to distinguish the effect of each variable on saving. As van Treek (2010) suggested, controlling the effects of time horizon between long term and short term would be one way to separate the influences.

Lastly, although this study diversified saving measures, whether or not saved in
2009 and savings between 2007 and 2009, based on the related studies and models suitable for characteristics of the dataset, the SCF does not provide a direct measure of saving. Thus, each proposed measure gives limited information on actual household saving decisions. In particular, whether or not saved in 2009 was the likelihood of saving and that saving was conditional on whether or not people report their spending was less than their income.

Objectively estimated future income change did not perform well in explaining saving decisions. The difference between actual normal income change and the predicted normal income change showed that only 58.55% were categorized correctly. This difference between predicted and actual income change could be due to a number of reasons, including: Demographic variables used in the forecasting equation of estimated income difference were in 2007 before the recession occurred. This variable may not reflect the macroeconomic effects on the difference, thus, explanatory power was not significant or noticeable unlike the assumptions.

Although this study confirmed the linearity between the main continuous variables in the income prediction equation, controlled the multicollinearity issue between explanatory variables, and employed population weighted data with the RII technique to represent the U.S. population as provided by the SCF, skewness of the distribution due to oversampling the wealthy population would have not been completely controlled. Although least squares methods provides a general approach to estimating conditional mean functions, it is fragile to outliers in either independent or dependent variable observations (Kutner et al., 2004). For skewed distributions, applying robust alternatives
to least squares could improve estimations by accommodating situation in which residuals showed long tails, such as quantile regression (Koenker, 2005). Quantile regression can differentiate the estimation of conditional quantile functions, in which quantiles of the conditional distribution of the variables in the regression are used as functions of observed covariance (Koenker & Hallock, 2001). Median regression as a special case of quantile regression can be applied to skewed distributions of the variables by minimizing a sum of absolute errors (Koenker & Hallock, 2001).

Heteroscedasticity would have been inherent in the case of the response variable in the regression analysis following a distribution where the variance can be functionally related to the mean (Kutner et al 2004). In this connection, normal income as an independent variable and normal income change as the dependent variable would have been exposed to the high possibility of heteroscedasticity. Transformation methods to control possible heteroscedasticity and non-normality could have improved the results instead of using simply rescaled normal income and normal income change (Kutner et al 2004). Therefore, refining measurements of saving and expected income change are desired in the future research.

7.3. Implications

This study analyzed household saving decisions in a manner that made it possible to identify a different pattern of behavior from the one described in classic models on saving, such as the life cycle hypothesis and permanent income hypothesis. Increased uncertainty and expected future income declines should have increased levels of saving
according to all theories but Loss Aversion Theory of Consumption, but the effects of uncertainty and expected income change were somewhat differently captured. Households with negative expected income change had a smaller saving and less likelihood of saving than households with positive expected income change. Different decisions made between negative and positive change imply a role for relative gains and losses compared to past and current income and uncertainty in inter-temporal decisions. Households make consumption and saving decisions not only by considering total amount of consumption or income based on a fraction of lifetime wealth and lifetime uncertainty, but also perceiving relative gains and losses compared to a reference point, described as gain-loss utility in prospect theory. Income was important but many other factors affect consumption/saving decisions.

Even if some assumptions, such as the effects of income uncertainty and demographic characteristics on income and life cycle of households, are shared with classic models, when economic volatility increases, such as during the Great Recession, predicting future income change is difficult for households. Gain-loss utility may play a more prominent role in inter-temporal decision making in this than in other economic situations. Comparing own past and current financial situation would be a practically easy but conservative way of making saving and consumption decisions. But for optimal choice on how much to save, dissave, or consume out of income and net worth, objectively estimated values, such as objectively measured expected income or income change, can be also used together. Financial planners, educators, and policy makers can
utilize these empirical results and assumptions of the gain-loss utility in this study to improve household saving decisions.

This study confirmed the importance of a psychological characteristic of human beings, so called loss aversion, to financial decisions of households. Households would be unwilling to realize their possible loss in the future and cut current consumption until the loss is realized even if their realized disutility of losses is greater than utility of gains. Default allocation of saving could be considered. The saving plans and programs, such as Save More Tomorrow (SMarT) and Quick Enrollment by the Pension Protection Act of 2006, where the funds are deducted from individuals’ paychecks automatically and transferred to a saving account before receiving the money could reduce this feeling of loss and improve saving. For instance, the saving level was higher for employees who participate in Save More Tomorrow (Smart) program than their counterparts who did not (Thaler & Benartzi, 2004).

On the other hand, increased active choice of saving has forced households to take more responsibility; for instance, transition from defined benefit to defined contribution plans for retirement saving. (Carroll, Choi, Laibson, Madrian & Metrick, 2009). Advice on a difference between subjectively assessed and objectively estimated income and uncertainty or between disutility of losses and utility of gains can control such unwillingness to avoid unrealized loss. Financial planners and educators can provide more practically useful advice on choice and allocation of active saving and default saving plans to households using each household characteristics framed on loss aversion and gain-loss utility function.
Policy makers can improve household saving by evaluating the effect of default saving plans and active choice in terms of gain and loss utility function and by expanding more saving options which could control the unwillingness leading to a negative effect on saving.
References


Butterfield, A. (2009). It was the best of times, it was the worst of times. *Journal of Community Practice, 17*(4), 353-357.


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Appendix A:
SAS code for measurement of Variables
1. Dependent Variable

1.1 Model 1: Saving between 2007 and 2009

\[ \text{NETWORTH=ASSET-DEBT;} \]
\[ \text{IF (NETWORTH<=.Z) THEN PUT Y1= &PID= FIN= NFIN= DEBT= LIQ= CDS=} \]
\[ \text{NMFM= STOCKS= BOND= RETQLIQ= SAVBND= CASHLI= OTHMA= OTHFIN=} \]
\[ \text{VEHIC= HOUSES= ORESRE= NNRESRE= BUS= OTHNFIN= MRTEL= RESDBT=} \]
\[ \text{OTHLOC= CCBAL= INSTALL= ODEBT=} ; \]

\textbf{data} oresre;
\textbf{set} incomedif;
oreeq07=oresre07-resdbt07;
oreeq09=oresre09-resdbt09;
oredif=oreeq09-oreeq07;
\textbf{IF} (oreeq09>.Z \& oreeq07>.Z) \textbf{THEN} oreeqdif= oreeq09- oreeq07;
\textbf{IF} (oreeq07<0) \textbf{THEN} oreeqdifPCT=-1*(100*(oreeq09-
\text{oredif})/oreeq07);
\textbf{ELSE IF} (oreeq09>.Z \& oreeq07>.Z \& oreeq07^=0) \textbf{THEN}
\text{oreeqdifPCT=100*(oreeq09-oreeq07)/oreeq07;}
\textbf{ELSE IF} (oreeq09>.Z \& oreeq07=0) \textbf{THEN}
\text{oreeqdifPCT=100*(oreeq09-oreeq07)/(oreeq07+1);}
realeteq07=homeeq07+oreeq07;
realeteq09=homeeq09+oreeq09;
realeteqdif=realeteq09-realeteq07;
\textbf{IF} (realeteq09>.Z \& realeteq07>.Z) \textbf{THEN} realeteqdif= realeteq09-
\text{realeteq07;}
\textbf{IF} (realeteq07<0) \textbf{THEN} realeteqdifPCT=-1*(100*(realeteq09-
\text{realeteq07)/realeteq07);}
\textbf{ELSE IF} (realeteq09>.Z \& realeteq07>.Z \& realeteq07^=0) \textbf{THEN}
\text{realeteqdifPCT=100*(realeteq09-realeteq07)/realeteq07;}
\textbf{ELSE IF} (realeteq09>.Z \& realeteq07) \textbf{THEN}
\text{realeteqdifPCT=100*(realeteq09-realeteq07)/(realeteq07+1);}

\textbf{data} homeequity1;
\textbf{set} oresre;
Nnetworth07=networth07-realeteq07;
\textbf{IF} (nNETWORTH07<=.Z) \textbf{THEN PUT} Y1= FIN07= NFIN07= DEBT07= LIQ07=
\text{CD07= NMFM07= STOCKS07= BOND07= RETQLIQ07= SAVBND07=}
\text{CASHLI07= OTHMA07= OTHFIN07= VEHIC07= ORESRE07= NNRESRE07=}
\text{BUS07= OTHNFIN07= RESDBT07= OTHLOC07= CCBAL07= INSTALL07=}
\text{ODEBT07=;}
Nnetworth09=networth09-realeteq09;
\textbf{IF} (nNETWORTH09<=.Z) \textbf{THEN PUT} Y1= FIN09= NFIN09= DEBT09= LIQ09=
\text{CD09= NMFM09= STOCKS09= BOND09= RETQLIQ09= SAVBND09=}
\text{CASHLI09= OTHMA09= OTHFIN09= VEHIC09= ORESRE09= NNRESRE09=}

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BUS09= OTHNFIN09= RESDBT09= OTHLOC09= CCBAL09= INSTALL09=
ODEBT09=;

Nnetworthdif=nnetworth09-nnetworth07;
  IF (nnetworth09>.Z & nnetworth07>.Z) THEN nnetworthDIF=
nnetworth09- nnetworth07;
  IF (nnetworth07<0) THEN nNETWORKPCT=-1*(100*(nnetworth09-
nnetworth07)/ nnetworth07);
  ELSE IF (nnetworth09>.Z & nnetworth07>.Z & nnetworth07^=0) THEN
  nNETWORKPCT=100*(nnetworth09-nnetworth07)/nnetworth07;
  ELSE IF (nnetworth09>.Z & nnetworth07=0) THEN
  nNETWORKPCT=100*(nnetworth09-nnetworth07)/(nnetworth07+1);

Nnetworthdif2=Nnetworthdif-equitygain;
  IF (Nnetworthdif>.Z & equitygain>.Z) THEN nnetworthDIF2=
Nnetworthdif- equitygain;
  IF (equitygain<0) THEN nNETWORKPCT2=-1*(100*(Nnetworthdif-
equitygain)/ equitygain);
  ELSE IF (Nnetworthdif>.Z & equitygain>.Z & equitygain^=0) THEN
  nNETWORKPCT2=100*(Nnetworthdif-equitygain)/equitygain;
  ELSE IF (Nnetworthdif>.Z & equitygain=0) THEN
  nNETWORKPCT2=100*(Nnetworthdif-equitygain)/(equitygain+1); run;

1.2 Model 2
  Saved09

2. Rescaled Variables

resnnetworthdif2=nnetworthdif2/1000;
resnormincdif=normincdif/1000;
resnorminc07=norminc07/1000;

3. Reference Dependent Income and Uncertainty Variables

3.1 Deviation from Normal Income

exp2=&V7650;
  if exp2=1 then ppinc=1; else ppinc=0;
  if exp2=2 then npinc=1; else npinc=0;
  if exp2=3 then spinc=1; else spinc=0;

3.2 Expected Income Change

3.2.1 Objective Expected Income Change (Income Prediction Equation)
Newexpindcif = \(-5.671684\)\((-0.583041)\)\(\text{resnorminc07} + (0.2385377)\)\(\text{age07} + (4.9126925)\)\(\text{educ07} + (-17.5258)\)\(\text{partner} + (-25.7588)\)\(\text{spdivorced} + (-19.37956)\)\(\text{widow} + (-30.42303)\)\(\text{nmarried} + (27.496437)\)\(\text{slefem} + (-36.05919)\)\(\text{retired} + (-22.1989)\)\(\text{sales} + (-22.86966)\)\(\text{otherjob} + (1.6093107)\)\(\text{kids07};

\[
\text{if } \text{Newexpindcif}\geq 0 \text{ then } \text{pexpindcif1}=1; \text{ else } \text{pexpindcif1}=0;
\]
\[
\text{if } \text{Newexpindcif}\leq 0 \text{ then } \text{nexpindcif1}=1; \text{ else } \text{nexpindcif1}=0;
\]

3.2.2 Subjective expected income change

\(\text{exp1} = \&V7364;\)
\[
\text{if } \text{exp1} = 1 \text{ then } \text{emore}=1; \text{ else } \text{emore}=0;
\]
\[
\text{if } \text{exp1} = 2 \text{ then } \text{eless}=1; \text{ else } \text{eless}=0;
\]
\[
\text{if } \text{exp1} = 3 \text{ then } \text{esame}=1; \text{ else } \text{esame}=0;
\]

3.3 Income Uncertainty Change

\(\text{aincome}=\&V7586;\)
\[
\text{if } \text{aincome07}=1 \text{ and } \text{aincome09}=5 \text{ then } \text{unctyin}=1; \text{ else } \text{unctyin}=0;
\]
\[
\text{if } \text{aincome07}=5 \text{ and } \text{aincome09}=1 \text{ then } \text{unctyde}=1; \text{ else } \text{unctyde}=0;
\]
\[
\text{if } \text{aincome07}=1 \text{ and } \text{aincome09}=1 \text{ then } \text{unctysp}=1; \text{ else } \text{unctysp}=0;
\]
\[
\text{if } \text{aincome07}=5 \text{ and } \text{aincome09}=5 \text{ then } \text{unctysn}=1; \text{ else } \text{unctysn}=0;
\]