

## **Financial Literacy and Suboptimal Financial Decisions among the Elderly**

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## Financial Literacy and Suboptimal Financial Decisions among the Elderly

### *Abstract*

This paper assesses how financial literacy shapes financial decision-making among older adults. We devised a special module in the Singapore Life Panel survey to measure financial literacy to study its relationship with three aspects of household financial and investment behaviors: credit card debt repayment, stock market participation, and adherence to age-based investment glide paths. We find that the majority of respondents age 50+ have some grasp of concepts such as interest compounding and inflation, but fewer know about risk diversification. We provide evidence of a statistically significant positive association between financial literacy and each of the three aspects of suboptimal financial decision making, controlling on many other factors. A one-unit increase in the financial literacy score is associated with 8.0 percentage points greater chance of stock market participation; and 1.6 percentage points higher likelihood of following an age-appropriate investment glide path. Financial literacy score is not significantly associated with number of credit card repayment errors. Results also show that formal education plays a role – over and beyond financial literacy – in older adults’ decisions relating to investment and stock market participation, but not for credit card repayment decisions. Our findings have important implications for targeted interventions to assist older adults make better financial choices.

*Keywords:* Retirement, financial literacy, credit card debt, stock market nonparticipation, life cycle investment, household portfolio

JEL Codes: D14, E21, G11, J32

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# Financial Literacy and Suboptimal Financial Decisions among the Elderly

## 1. Introduction

Sound financial decision-making becomes more difficult as people grow older (Hammond et al. 2017). One reason is that older people tend to have more wealth and resources to manage than during their working lives. Another reason is that financial liberalization has led to a proliferation of new financial products and services, many of which are unfamiliar to retirees. This increased complexity can be exacerbated by declining cognitive abilities at older ages, making financial decision-making more challenging. Older adults are thus at increased risk of making financial decisions that would be considered suboptimal according to standard consumer finance theory (Agarwal et al. 2009; Choi et al. 2011; Klapper et al. 2013).

A large literature has examined the variety of poor financial choices or financial mistakes that households commit.<sup>1</sup> For instance, with regard to credit card financing, several studies report that people often fail to repay their card loans in a timely manner and end up paying excessive fees (Agarwal et al. 2009; Stango and Zinman 2009; Scholnick et al. 2013; Jørring 2018). Other studies examining saving and investment decisions document that people tend to save too little, fail to diversify their investment portfolios (Bhamra and Uppal 2019), and fail to annuitize in retirement (Madrian and Shea 2001; Calvet et al. 2007; Choi et al. 2011). Problem behavior in the mortgage market includes failure to understand adjustable rate mortgages and refinancing opportunities (Andersen et al. 2015; Keys et al. 2016). There is also evidence that many people do not participate

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<sup>1</sup> Economists have used the terms suboptimal financial decisions and financial mistakes interchangeably. A financial mistake is typically defined as a financial decision where an unambiguous optimal choice exists, and this optimal choice is not chosen by the consumer. This follows from the literature on household finance which has identified numerous consumer choices that are hard to rationalize using models of optimal choice (see, e.g., Campbell 2016; Jørring 2018).

in the stock market (van Rooij et al. 2011; Klapper et al. 2013). Nevertheless, few previous studies have focused on the particular financial challenges confronting the older population, and there is some ambiguity in what to expect. For instance, it is possible that older adults perform better in some aspects of financial decision-making, but worse in other regards. In addition, it is unclear whether the determinants of suboptimal financial behavior are common across the various types of errors. For instance, if education and financial knowledge are associated with stock market participation, are the same factors also associated with good credit card repayment behavior?

This paper analyzes how financial literacy is associated with three types of consumer financial decisions particularly pertinent to older individuals. Specifically, we focus on how well older adults manage credit card repayments, whether they invest in the stock market, and whether they take on levels of risk in their wealth holdings that are deemed age-appropriate. To measure financial literacy and assess its relationship to financial decision-making, we have developed and fielded a special module for the Singapore Life Panel (SLP®) survey, a panel data set covering a representative sample of adults aged 50-70 in Singapore. These questions are linked to a rich set of data on socio-demographic and health characteristics, as well as investment holdings. The SLP stands out for the richness of the information it collects. Most importantly for this study, it collects detailed high-quality economic information on assets, income, and *monthly* information on household spending and credit card repayment, following the same households over time (Vaithianathan et al. 2018). We use the high-frequency panel nature of the SLP to observe households' credit card repayments behavior on a monthly basis over the course of two years.

We find that many older adults in Singapore appear to make less than optimal financial decisions, particularly with regard to not participating in the stock market (60%), and failing to diversify their wealth holdings (82%). Most older adults, however, do demonstrate good credit

card repayment behavior, and they do not roll over their credit card debts. Among the handful (4.6%) of credit card holders who fail to repay credit card debt despite having sufficient liquidity, avoidable annual interest costs range from S\$405-2,210, depending on the number of repayment errors committed each year. Importantly, we find that the correlation among the three types of suboptimal behavior (credit card repayment error, stock market non-participation, and age-inappropriate risk exposure) is low, and two of the three measures investigated in this paper are significantly associated with financial literacy. Specifically, a one-unit increase in the financial literacy score is associated with 8.0 percentage points greater chance of stock market participation; and 1.6 percentage points higher likelihood of following an age-appropriate investment glide path, other factors held constant. Financial literacy score is not significantly associated with credit card repayment errors.

Our work is distinguished from prior studies in that we consider not one but three suboptimal financial behaviors. We document the prevalence of each and how it varies by individual and household characteristics. Interestingly, we find that the three suboptimal financial decisions are only weakly correlated among each other. As a result, they are not simply concentrated among a small fraction of the population, but instead the vast majority exhibits at least one. Our focus on older adults in Singapore, a city-state in Asia, also fills an important gap in the literature. Specifically, it is useful to determine whether the associations between financial literacy and stock market participation – and separately, between financial literacy and credit card repayment errors – observed in data from the U.S., Canada, the Netherlands, and other Western industrialized nations, also hold in the Asian context. Singapore is an interesting setting for such investigation since the country has been a developed nation for many years and it is widely seen as having an educated populace and well-informed investors. Despite important differences in

institutional settings across industrialized countries, there are common patterns in individuals' financial behaviors.

In what follows, we first review prior studies on financial literacy and financial behaviors, particularly those relating to credit card debt and stock market participation. Next, we describe our dataset including our financial literacy measure, and we explain how we constructed the three measures of suboptimal financial behaviors that we study. Subsequently we report the results of our empirical analysis, followed by discussion and robustness checks. A final section concludes.

## **2. Prior studies**

One explanation for apparent errors in household financial decision-making is financial illiteracy, and Bernheim (1995, 1998) was among the first to show that many U.S. households could not perform very simple financial calculations due to their lack of basic financial knowledge. Using a database of U.S. credit transactions, Agarwal et al. (2009) found that many households paid too-high interest rates on credit card debt, home equity loans, and mortgages. Moreover, such behaviors were more prevalent among those with the lowest levels of financial knowledge. Scholnick et al. (2013) studied the relationship between wealth/income and credit card repayment mistakes in Canada, and they reported that poorer individuals made such mistakes because of lower levels of financial literacy, education, and financial sophistication. Importantly, their subjects did not understand the unnecessary costs they incurred for failing to pay on time.

Other work has also examined the links between financial literacy and investment choices. Calvet et al. (2007) showed that many Swedish households held under-diversified portfolios or did not participate in financial markets at all, with non-negligible welfare costs. Yet because the authors lacked good financial literacy measures, they relied mainly on proxies for financial

sophistication such as wealth, education, and the ratio of private pension contributions to income. Bucher-Koenen and Ziegelmeyer (2011) found that Germans with low levels of financial literacy were less likely to have invested in the stock market, and they also reacted to financial crises by selling assets that lost value. Using Dutch data, van Rooij et al. (2011) assessed the links between financial literacy and stock market participation, testing the direction of causality between literacy and stock market participation by including instrumental variables for respondents' literacy levels (e.g. financial experiences of the respondents' family and peers). They concluded that financially unsophisticated people were less likely to invest in stocks and tended to rely on family and friends as their main source of financial advice.

Also related to this topic is a large literature on the stockholding puzzle: in a nutshell, analysts find it puzzling that many households do not hold any stocks at all, despite the fact that shares tend to pay higher expected returns than safer instruments (Campbell 2006). One explanation for this phenomenon is that there may be entry costs to access the stock market, so that people only buy shares when the expected excess return from participation exceeds the fixed costs. An implication of this is that wealthy investors will be more likely to be stockholders, a hypothesis corroborated by Guiso et al. (2003) who found that wealth and stock market participation were positively associated across many industrialized countries.<sup>2</sup> The costs can be monetary as well as non-monetary in nature, such as the effort required to become informed about investing in the stock market. The effort to acquire relevant knowledge is likely to be higher for people with low cognition and/or low financial knowledge (Delavande et al. 2008), implying that it may be rational for some low wealth households not to hold stocks. Other possible explanations for stock nonparticipation include inertia, borrowing or short sale constraints, lack of trust,

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<sup>2</sup> Moreover, the higher return earned in the stock market applied to their higher wealth helped wealthier households more.

inability to plan ahead, influence of peers, and low financial literacy. In particular, van Rooij et al. (2011) found that financial illiteracy reduced Dutch households' propensity to buy stock.

In sum, the literature to date on household financial decision-making and investment choices has suggested that several factors could drive suboptimal financial behaviors including financial illiteracy, poor education, and low wealth. Nevertheless, none of these studies has focused on older persons, notwithstanding the fact that this group is likely to have accumulated more wealth than the younger population. In what follows, we evaluate financial behavior among the older population in Singapore whose population has one of the highest life expectancies in the world. Singaporean older households may have to finance spending at older ages for many years in a setting with limited annuitized retirement income. Poor financial decision-making may increase the risk of running out of money at advanced old age. Accordingly, it is of interest to learn whether and how financial literacy may be associated with financial decision-making as older persons near and move through retirement, particularly in Singapore.

### **3. Data: The Singapore Life Panel**

Singapore is an ethnically diverse country. Its population is mainly composed of Chinese, Indians and Malays. Although there is a suggestion that working-age Singaporeans rank well against their peers in other countries in terms of financial literacy, the country also has many older residents with relatively low education, implying substantial heterogeneity across the population (OECD 2016). A 2016 survey, for example, found that Singapore topped the Asia-Pacific region in terms of financial literacy (assessed based on knowledge of basic money management, financial planning, and investment matters), outperforming 16 other regional markets including Hong Kong, South Korea, and Japan (Lee 2016). A different market survey reported that around 60% of all



adult Singaporeans were financially literate, compared to 18% in Nepal and Cambodia (Karekar 2015). Koh et al. (2018) using SLP data documented that financial literacy among older adults in Singapore was comparable to, but slightly lower than, levels of similar-aged persons in the United States. Nonetheless, to date, there is little evidence on the extent to which older Singaporeans undertake suboptimal financial decisions, and whether poor financial choices are linked to financial illiteracy.

To investigate these associations, we rely on data from the 2015-2017 SLP®, a high-frequency internet-based survey conducted by the Centre for Research on the Economics of Ageing at the Singapore Management University.<sup>3</sup> It is a longitudinal survey of about 15,000 Singaporean citizens and permanent residents initially aged 50-70 as well as their spouses. Participants have been surveyed every month since August 2015, and thus far, over 45 waves have been completed. The survey is conducted over the internet, and respondents who need assistance or lack internet access can answer the survey over the phone or at centers located conveniently around Singapore. Consequently, attrition rates are low. The SLP® collects extensive information on respondent and household socio-demographic characteristics, such as health, wealth and income, investments, retirement expectations, family support, and spending.

Particularly valuable for our study is the high frequency at which the survey is carried out allowing monthly observations on credit card debt rollover behavior so we can assess the number of months that credit card balances were not paid off resulting in penalty interest charges and the associated cost. Our analytic sample is composed of respondents age 50-70 in the SLP® Dec 2015 wave who answered all three financial literacy questions, responded to the January/February 2016 asset and income module and – among credit card holders – who participated in nine or more

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<sup>3</sup> See Vaithianathan et al. (2018) and <https://crea.smu.edu.sg/singapore-monthly-panel> for a detailed description of the SLP® and a discussion of data quality.

monthly surveys of the year ( $N=6,647$ ). Further sample restrictions are applied as called for in specific analyses noted below (see also Appendix Table 1 for further details). Most assets and information on credit card ownership are elicited at the household level (i.e. respondent and spouse for married persons). Financial literacy is assessed at the individual level. Our analyses are conducted at the respondent level, assuming resource sharing in married households.

#### **4. Measurement of suboptimal financial behaviors**

This section describes how the three suboptimal financial behaviors that we analyze are derived from the information available in the SLP®. We also explain how financial literacy is assessed, and the definition of control variables used in regressions.

##### *4.1 Three suboptimal financial behaviors*

*Credit card repayment errors.* Previous work has defined the incurrence of an avoidable credit card late fee and/or penalty interest charges as an unambiguous financial mistake (Stango and Zinman 2009; Scholnick et al. 2013). A credit card late fee or penalty interest charge is deemed avoidable if, on the due date for payment, the consumer had sufficient cash in a deposit account to cover the credit card bill.<sup>4</sup> Thus, for our purpose, a credit card repayment error is deemed to have occurred in a given month if the respondent rolled over credit card debt despite having sufficient checking and savings balances, leading to the imposition of an interest charge for that month.

Credit card repayment errors are evaluated among respondents who owned at least one credit card ( $n=4,360$ ). We further require that respondents participated in nine or more monthly surveys in a year to ensure sufficient information on credit card repayment habits without reducing

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<sup>4</sup> Some studies also allow an additional provision for a month of average consumption expenditures, to allow for normal consumption patterns after paying off the minimum balance.

the sample by much (additional details are provided in Appendix Table 1).<sup>5</sup> The analytic sample for studying credit card repayment error hence represents 66% of the full sample. We extract monthly records of individuals' credit card debt rollovers to identify those who undertook at least one rollover transaction in 2016 or 2017. For these persons, we evaluate for each of their rollover transaction(s) whether it constituted a repayment error: if the dollar amount of their credit card debt rolled over in a given month was less than the respondent's total deposits in checking and saving accounts, then a repayment error is coded as having occurred (else not). The SLP® elicits checking and saving account balances only annually at the start of each year. For our evaluation we therefore use the nearest observation on checking and saving balances prior and the nearest following the month the rolled over credit card debt is observed. For example, if a rollover transaction occurred in the month of June 2016, we check whether the rolled over credit card debt exceeds checking and saving balances in January 2016 and January 2017. If it is smaller than the checking and saving balances in both of the nearest observations on checking and savings then we consider this a repayment error.

Our dependent variable is defined as the average number of credit card repayment errors committed per year: that is, the sum of all errors committed in 2016 and 2017, divided by two. This yields one observation per respondent. For some respondents we only have enough information to assess credit card repayment behavior in one calendar year (see Data Appendix for details). Penalty interest charges are also elicited every month in the SLP. We use these to compute

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<sup>5</sup> Among married respondents the SLP asks "Do you and/or your spouse have one or more credit cards?" Therefore, among married respondents we do not observe whether both or only one of the spouses holds one or more credit cards. In the absence of detailed information on ownership, we assume that both respondents in a couple have access to a credit card if the respondent answers the credit card ownership question with yes. See Appendix B for the wording of the relevant survey sequence.

the annual costs associated with the observed repayment errors and then take the average for each respondent across the two years of observation, calendar years 2016 and 2017.

*Stock market non-participation* constitutes a suboptimal financial behavior in that households who hold no stocks at all forego the equity risk premium. In Singapore, older adults can invest in stocks or mutual funds using both non-pension and pension monies. Retail customers must open accounts with authorized brokers to buy and sell stocks or mutual funds using their private assets. Members of the national defined contribution scheme, the Central Provident Fund (CPF), may also use their pension savings to buy and sell shares. The CPF program is mandatory, has almost universal coverage, and requires current contribution rates ranging from 37% of wages (17% by employers and 20% by employees) for young working adults aged 35 and below, to 12.5% of wages for those age 65+.<sup>6</sup> Investment in stocks or mutual funds using CPF savings is allowed via the CPF Investment Scheme (or CPF-IS), subject to the CPF member meeting certain saving balance thresholds.<sup>7</sup>

Following van Rooij et al. (2011), we consider stock market participation, both through direct holdings of stocks, and indirect holdings via participation in mutual funds; the latter include managed funds and unit trusts, which in turn, hold shares, bonds, and other investments. The SLP® elicits direct holdings of stock and/or mutual funds at the household level and asks separate questions for the respondent's and the spouse's (if applicable) stock holdings in the CPF system. We define stock market non-participation as an individual holding no stocks or mutual funds over the entire two-year period (indicator variable=1, else=0), as reported in the annual SLP asset

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<sup>6</sup> Contribution rates decline progressively from 37% to 12.5% over seven age bands. (See <https://www.cpf.gov.sg/Employers/EmployerGuides/employer-guides/paying-cpf-contributions/cpf-contribution-and-allocation-rates/otherstab#Others>.)

<sup>7</sup> CPF members can invest their pension accumulations under the CPF Investment Scheme only after setting aside \$20,000 in their Ordinary Account (OA) and/or \$40,000 in their Special Account (SA). In addition, investment of CPF-OA savings in stocks or shares is capped at 35% of investible savings.

module in 2016 and 2017. We exclude from this analysis respondents living in households with extremely low net worth (<S\$1,000) to account for the possibility that they may not be able to cover the fixed costs of accessing the stock market. The remaining sample has  $N=6,636$  observations (99.8% of the full analytic sample, see Appendix Table 1).

*Failure to follow an age-based investment glide path.* Strictly speaking, decisions with respect to investment risk exposure are a function of peoples' risk preferences, knowledge of the financial instruments, liquidity, and several other factors. While a complete optimal assessment at the individual is quite complicated the "100-minus-age" rule, where the portfolio share of equity is equal to one's age subtracted from 100, has been shown to be a good proxy for rising risk aversion with age (e.g. Bodie and Crane 1997; Lankford 2005; Mayer et al. 2011; and Arshanapalli and Nelson 2012). It is also consistent with theoretical work by Bodie et al. (1992) who showed that it is sensible to reduce one's portfolio risk at older ages, so as to maintain a constant overall risk exposure due to declining human capital. For a typical 60-year-old, the age-based investment glide path would suggest 40% of the portfolio be held in stocks (or risky assets, overall), and the remaining 60% in relatively safe assets like bonds.

We categorize investments in stocks and mutual funds as risky assets. As described above, such investments may be made using non-pension and/or pension monies. The net value of a respondent's primary residence, and where applicable, the net value of a secondary residence, are also considered risky assets. This approach is broadly consistent with numerous studies in the literature on household life cycle models (e.g., Yao and Zhang 2005; Cardak and Wilkins 2009; Yogo 2016; and Chang et al., 2018, to name just a few). Figure 1, which plots the residential house price index in Singapore, documents the evolution of house values over the last four decades.

During the financial meltdown of 2008, residential property prices fell by about 10% in real terms (Yeo 2016).

*[Figure 1 here]*

We define the household's risky investment share as the net value of stocks, mutual funds, and real estate, divided by total net wealth. Our dependent variable indicates failure to follow the 100-age rule within a +/-10% bound: for instance, if a 60-year-old invested 30-50% of his portfolio in risky assets, he would be following the 100-age rule (indicator variable=0). Conversely, if the respondent's risky share did not fall within +/-10% of the 100 minus his age percent, his financial behavior would deviate from this rule (indicator variable=1).

It is important to keep in mind the institutional framework for saving and investment in Singapore and that its evolution over time has influenced the portfolios of older Singaporeans. For example, the CPF provides a risk-free rate of return of 2.5-5% on funds held in its default account and limits how much of government-managed CPF accounts can be held in equity. Furthermore, the government has provided financial incentives to purchase housing with CPF funds. As a result, stock holdings are relatively low while housing makes up a large share of portfolios among many older Singaporean households and the possibilities to diversify may be constrained. For example, a household that is "house-rich" thanks to house price appreciation, having used CPF balances to purchase a home many years ago, cannot easily withdraw equity from the house to invest the funds in a safe asset instead, nor would this necessarily be an advantageous move.<sup>8</sup> Nevertheless, even if these institutional factors provided a reasonable explanation for observed portfolio structures that often do not conform to the age-rule, households will be exposed to the associated imbalanced portfolio risk. Hence, we argue that it is useful to examine older Singaporean's adherence to the

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<sup>8</sup> Housing monetization schemes have been introduced by the Singapore government in recent years e.g. Lease Buyback Scheme, to help older households to reduce their housing equity over time.

age-rule in a way that can be compared to household investment behavior in other countries. This analysis is restricted to respondents with complete information on asset allocation in Jan/Feb 2017,<sup>9</sup> and with total household net worth of \$1,000 or more ( $n=6,153$ , or 92.6% of the full sample).

#### *4.2 Financial Literacy Score*

Financial literacy is measured using the “Big Three” questions testing key concepts underlying economic saving and investment decisions (Lusardi and Mitchell 2008, 2011*a, b*).<sup>10</sup> These concepts include numeracy and capacity to do calculations related to interest rates; understanding of inflation; and understanding of risk diversification. Specifically, SLP® respondents were asked in December 2015 (wave 5):

- (i) Suppose you had \$100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: **more than today**, equal to today, less than today.
- (ii) Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy: more than, exactly the same as, or **less than today** with the money in this account?
- (iii) Do you think that the following statement is true or **false**? “Buying a single company stock usually provides a safer return than a Unit Trust (or Mutual Fund).”

Correct answers are shown in bold-face here, but that was not the case in the survey instrument.

We use responses to these three questions to compute a FinLit Index (range 0-3) which equals the total number of questions each person answered correctly. If the respondent checked “Don’t know”

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<sup>9</sup> We used asset information from Jan/Feb 2017 for this analysis, because additional detail on asset allocation was included in this wave compared to Jan/Feb 2016.

<sup>10</sup> The Big Three financial literacy questions perform well in the population at large, though more detailed and sophisticated questions have been devised for more financially-savvy subpopulations; see Clark et al. (2017).

it was treated the same way as an incorrect answer. Respondents who did not answer all three financial literacy questions (i.e., left one or more questions blank) were excluded from the analysis. Breakdowns by question item show that 81% of respondents answered the interest rate question correctly, 72% answered the inflation question correctly, and 46% answered the risk diversification question correctly. See Koh et al. (2018) for detailed analyses how FinLit varies in the Singapore population.

#### *4.3 Other control variables*

Multivariate regressions include the following additional demographic controls: indicator variables for sex, marital status, education (<secondary, secondary, >secondary education), race/ethnicity, and age (in Dec 2015) in four age bands (50-54, 55-59, 60-64, and 65-70). We control for home ownership and self-employment to account for those exposed to real estate and labor market risk, who may therefore be less likely to hold stocks (Heaton and Lucas 2000). We also control on whether the respondent indicates managing the household's finances, to account for individuals with experience in managing household finances and who therefore might be less likely to engage in suboptimal financial behaviors. An indicator for high risk tolerance concerning financial decisions is also included. Finally, we include total household income and total household net worth in logs (van Rooij et al. 2011), and indicators for missing values in key control variables. For further details on question wording and variable definitions, see the Data Appendix.

Table 1 presents descriptive statistics for the full sample ( $N= 6,647$ ). Respondents' mean age is 59.3; slightly over half (53%) are female; and over one-third (36%) has a post-secondary education (10+ years of schooling).<sup>11</sup> The mean FinLit index score is 2.01 with a standard

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<sup>11</sup> Prior to higher education, Singaporean students attend primary and secondary school for a combined total of 10 years: six years in primary and four years in secondary. Some students then proceed to junior colleges for another two years of education (junior college graduates would have attained the equivalent of a U.S. high school education) before entering university.



deviation of 0.97, implying that older Singaporeans average two of three correct answers to the “Big Three” questions fielded. Only 46% answered the last question on risk diversification correctly, suggesting that older adults in their 50s and 60s are not well-informed about stocks and mutual funds. Most respondents are married (80%) and own a home (88%). Respondents exhibit general low risk tolerance: only 15% score greater than 5 on a 0 to 10 scale. Slightly more than half of the sample report that they are currently employed and working for pay.<sup>12</sup> Average annual household income is S\$60,240(US\$42,165) and median income is S\$27,850 (US\$19,495). Mean and median total net worth are S\$1.16M (US\$0.81M) and S\$0.66M (US\$0.46M) respectively. Most of the elderly respondents are in good health, while about one-third (34%) report fair/ poor health.

*[Table 1 here]*

## 5. Results

We begin by presenting descriptive statistics on each of the three potentially suboptimal financial behaviors.

### 5.1 Credit card repayment error

Of the 6,647 older SLP respondents, about two-thirds (66%) held at least one credit card.<sup>13</sup> This is consistent with recent evidence suggesting that credit card use is low among older Singaporeans, as they exhibit a greater reliance on debit card spending (Agarwal et al. 2015).<sup>14</sup> Among older cardholders, 91% (or 3,978) paid off any accrued balances every month over the 24-

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<sup>12</sup> Many respondents were still participating in the labor force since the statutory retirement age in Singapore is 62, with re-employment encouraged up to age 67.

<sup>13</sup> Credit card holding is asked at the household level in the SLP. In couple households we cannot identify if only one of the spouses owns a credit card or both.

<sup>14</sup> This could be because credit card firms require a minimum income for card application, or due to older peoples' preference to carry and use cash for daily transactions.

month period; 4.3% (186) rolled over their credit card debt with insufficient balances in their checking and savings accounts, and 4.5% (196) rolled over credit card debt despite having sufficient savings balances. The 196 respondents who committed a credit card repayment error therefore represent 2.9% of the full sample.

Next, we sort respondents with repayment errors by their frequency of these errors, depicted in Figure 2. The primary vertical axis of the Figure depicts the average number of errors committed per year; the secondary vertical axis shows the corresponding average annual penalty charges. These interest charges are avoidable since the respondents had sufficient savings to settle the debt.<sup>15</sup> A sizeable proportion of these individuals (43%) made one or fewer repayment errors per year on average (>0 to 1 bin), costing them \$405 on an annual basis. One-fifth (23%) of the sample committed >1 to 3 errors annually, at an average annual cost of around \$1188; 15% of the sample committed >3 to 6 errors annually costing them \$2005 on average; and 10% had >6 to 10 avoidable charges per year, costing them \$1933 annually. Finally, 9% of this group had over 10 avoidable interest charges costing them \$2122 annually in average interest payments.

*[Figure 2 here]*

Table 2 reports the demographic and financial characteristics of respondents living in households with at least one credit card, sorted by the average number of repayment errors they made per year. The first column represents people making no repayment error in the 24-month period, while the next four columns focus on those making at least one error, sorted into quartiles. Interestingly, we find that respondents who committed no errors tend to be older, have higher FinLit scores, and have higher mean as well as median net wealth. The mean total net wealth of respondents making no repayment error (\$1.54M) is substantially higher than that of those making

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<sup>15</sup> To estimate the average annual cost of errors, we tally the repayment errors with non-zero interest charge across all persons in a given bin and compute the average dollar interest charge incurred; see Appendix for details.

at least one error (\$0.944-1.298M). Average income across the repayment error bins varies less: \$82,000 for respondents with none, and \$58,080-95,140 for respondents with errors. The latter finding is consistent with Jørring (2018) who showed that U.S. consumers who paid avoidable late fees were less wealthy than those who rarely exhibited these costly financial behaviors. As such, credit card debt rollover behavior can exacerbate wealth inequality over the life-cycle.

*[Table 2 here]*

### *5.2 Stock market non-participation*

Next, we analyze investment in stocks and mutual funds for respondents with total net wealth exceeding \$1,000. Some 60% of the older Singaporean respondents did not invest in stocks or mutual funds over the two-year survey period, and hence they were deemed to not have participated in the stock market (see Table 3). The remaining 40% invested in stocks or mutual funds: 24% (or 1,567 persons) invested in both years, and 16% (or 1,068 persons) in a single year. Among older Singaporeans who invested, shares (or stocks) were the preferred asset class. For example, 72% of those who invested in both years owned individual stocks and no mutual funds (the corresponding percentage among those who invested in a single year was 80%). Also noteworthy is that most respondents who participated in the stock market did so using private savings, rather than pension assets. Among respondents who invested in stocks in both years, 74% used private savings only, 7% used CPF savings only, and 19% used both private and CPF savings (among respondents who invested in a single year, 85% used private savings only and 5% used both channels).

*[Table 3 here]*

Table 3 also reports the demographic and financial characteristics of respondents sorted by stock/fund ownership. Those who did not participate in the stock market were less educated and

scored lower on the financial literacy index: specifically, only 24% of those lacking any stock exposure had post-secondary education, compared to older adults who held stocks of whom 48-63% had a post-secondary education. In addition, the average FinLit index score of those who did not participate in the stock market was only 1.8, lower than the average score of 2.3-2.5 for those who held shares. Older adults lacking stock market exposure also had substantially less net wealth and lower household income: for instance, the net worth of those who consistently held stocks averages S\$2.2M, almost three times that of those owning no stocks (S\$0.7M). So while some people may avoid the stock market due to lack of knowledge, many older individuals may fail to invest because they lack the means (this could indicate support for the entry cost hypothesis discussed above). The final row in the Table indicates whether individuals not engaged in the stock market were more prone to credit card delinquency. There is no evidence of this, suggesting that our dependent variables pick up different aspects of suboptimal financial behavior.

### *5.3 Failure to follow an age-based investment glide path*

Adherence to the age-based investment glide path is analyzed among respondents with total net wealth exceeding \$1,000 and having provided complete information on how their assets were allocated. We find that the vast majority, or 82% (5,058), failed to adhere to the 100-minus-age investing rule within +/-10% bounds. According to this criterion, most older Singaporeans did not follow an age-based glide path frequently recommended by financial advisors. Almost two thirds of the total sample “over-invested” in risky assets, while 16% “under-invested” (see Table 4). Of the three risky asset classes considered (stocks, mutual funds, and property), real estate investment typically constituted the largest component of risky asset share. Consequently, persons who under-invested either did not own a home or had relatively low home equity.<sup>16</sup> Conversely, older adults

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<sup>16</sup> The average gross value of the primary residence is S\$184,000 among those who under-invested, S\$559,000 among those who invested in accordance to the age-rule, and S\$782,000 among those who over-invested.

who over-invested (i.e. took on high risk) were those with considerable net property assets. For instance, 79% (3,177 of 4,045) of those holding risky portfolios for their age had home values exceeding 50% of their net wealth, while 52% (2,094 of 4,045) had home values exceeding 70% of their net wealth. Such large holdings in risky home equity surpasses the risky asset bounds prescribed by the 100-minus-age rule, which, given the subgroup's mean age of 60, was only 40%.

*[Table 4 here]*

We recognize that the government of Singapore has, over the past five decades, encouraged homeownership among the population. In fact, the CPF explicitly permits borrowing for buying a property, allowing young workers to contribute to their CPF accounts and then take out a mortgage repaid from their CPF contributions.<sup>17</sup> Accordingly, it is not surprising that so many Singaporeans have invested heavily in a single property. Nevertheless, recent evidence indicates that housing has turned out to be a rather risky investment, inasmuch as those inhabiting older flats are now learning that these are depreciating assets (Silvam 2018). Having a home of course provides a stream of housing services free of price fluctuations (while living in the same home), and as an investment, a home can provide old-age resources. Yet it is also important to note that older peoples' home values are uncertain in the current environment. For this reason, we included property values in the risky set of assets held at older ages.

#### *5.4 Propensity to engage in multiple suboptimal financial behaviors*

When considering all three suboptimal financial behaviors jointly, we focus on the subset of respondents holding credit cards, so that all are at risk of engaging in up to three suboptimal

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<sup>17</sup> McCarthy et al. (2002) note that Prime Minister Lee Kuan Yew introduced the Home Ownership Scheme in 1968 which allowed workers to use their CPF accumulations to purchase public housing built under the auspices of the Housing Development Board (the government authority controlling most of the island's housing stock). HDB 'standardized' flats were constructed in the thousands by government-operated firms and sold at highly subsidized rates to workers with mortgages of 99 years.

behaviors. For this subgroup, we find that 14% engaged in none of them (see Table 5), whereas 49% engaged in one, 35% in two and the remaining 2% engaged in all three suboptimal behaviors. Those who managed to avoid all of them scored highest on financial literacy, were better educated and healthier, and were more likely to manage their household finances. They were also more well-to-do (higher assets and income).

*[Table 5 here]*

It is also worth evaluating whether people exhibiting one type of suboptimal financial behavior also exhibited other types. To this end, we examined the correlation across the three behaviors (credit card delinquency, stock non-participation, and not following the 100-age glide path). Inasmuch as those without credit cards cannot make a card repayment error, the correlation analysis uses only the subset of 4,360 credit card holders (or 66% of the full sample).<sup>18</sup> Table 6 shows that the correlation between credit card repayment errors and not participating in the stock market is -0.008, while it is 0.140 for stock non-participation and not following the glide path. The correlation between credit card repayment errors and deviation from the 100-age glide path is -0.005. These low correlations may be attributable to different factors driving each behavior. For instance, those who do not pay off their credit cards may lack self-discipline or have poor financial habits (see, e.g., Thaler 2008). Stock non-participation may be the result of ambiguity aversion (Dimmock et al. 2016), while not following the 100-age glide path may reflect individuals' lack of awareness of the riskiness of holding much wealth in a single home.

*[Table 6 here]*

### *5.5 Multivariate regression results*

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<sup>18</sup> This is the same subsample identified in Table 2.

Next, we report estimates from multivariate regression models to determine the partial correlations between financial behaviors of interest and control variables.

*Credit card repayment errors.* The first column of Table 7 reports results from a multivariate linear regression model of credit card repayment errors among cardholders; coefficients and standard errors are presented. The dependent variable in the linear regression model is the average annual number of credit card repayment errors as defined above. Results show that the literacy score is not significantly associated with number of repayment errors, holding other factors constant. Women and wealthier persons made fewer errors, while higher income respondents made more. Marital status was not statistically significant, nor were age, education, employment status (working for pay), self-reported health, and home ownership controls.

[Table 7 here]

One possible explanation for why higher-income Singaporeans made more credit card repayment errors attracting penalty interest charges might be that higher-earners are likely to be pressed for time, as argued by Hamermesh and Lee (2007). If true, they have a higher opportunity cost of undertaking actions required to ensure that credit card payments are made on time and they would have a lower marginal utility of money.

*Stock market non-participation.* The second column of Table 7 provides marginal effects from a Probit regression of the probability of stock non-participation. Results confirm that financial literacy is significantly and negatively associated with this outcome, holding other factors constant. The estimated marginal effect of -0.080 for financial literacy indicates that, on average, a one-point increase in the FinLit score is associated with a 8.0 percentage point decrease in the probability of not investing in stocks ( $p < 0.01$ ). In other words, those who are more financially savvy are more likely to own stocks or mutual funds.

The other correlates are also of interest. For instance, homeowners are less likely to own stock, perhaps because older Singaporeans who own their primary residences recognize they are already holding a risky asset in the form of their homes. (Real estate is risky because it is less liquid and less diversified relative to other investments). Conversely, the better-educated, higher income, and wealthier are more likely to participate in the stock market, consistent with the proposition that stocks and mutual fund investments require fixed learning and setup costs, which are worthwhile only if deployable assets are sufficiently large. Similar results in other countries have been reported by van Rooij et al. (2011), Calvert et al. (2007), and Guiso et al. (2003).

In contrast with studies focusing on Western populations, stock market participation is higher among older Singaporeans; the negative significant coefficient implies that older people are less likely to be non-participants. For instance, respondents age 60+ are about 5% more likely to participate compared to those in the age 50-54 reference group. This finding is consistent with Koh et al. (2008) who showed that older Singaporean CPF members were more concentrated in shares and unit trust investments. This may be a unique cultural phenomenon where the elderly in Singapore demonstrate a general preference for stock investing and taste for risk, while having more time devote to investments.

*Not following an investment glide path.* We examine whether people in our survey invested according to the 100-age rule of thumb; results appear in the last column of Table 7. Here again, more financially savvy respondents are more likely to conform to this investment rule, although the estimated effects are smaller than for stock market participation. On average, a one-point increase in the FinLit score is associated with a 1.6 percentage points decrease in the probability of not following an age-based investment glide path ( $p < 0.01$ ), holding other factors constant. We also learn that the probability of not following the chronological age glide path is higher among



relatively older groups. For instance, respondents age 60-64 were 7.3% more likely to fail to adhere compared to their younger counterparts, while those age 65-70 were 12.8% more likely to do so. This may be because the large investment holding in (risky) home equity surpasses the rather narrow risky asset bounds prescribe by 100-minus-age rule, for individuals at advanced ages.<sup>19</sup> Similar to the regression results for stock non-participation, both income and wealth are negatively associated with not following the investment age-rule ( $p < 0.01$ ).

### *Multiple suboptimal financial behaviors*

Next we estimate a multivariate regression model to examine potential predictors of the total number of suboptimal financial behaviors out of the three types considered. To this end we estimated an ordered Probit model (see Table 8). The results largely confirm the patterns observed previously in Table 5. Higher financial literacy is associated with reduced chances of making multiple mistakes; so is higher education and higher economic resources (assets and income). Working for pay and home ownership are predictors of an increased number of suboptimal behaviors, where the first may be due to being pressed for time to take care of finances while the second like is the result of housing making up such a large portion of household portfolios, conditional on homeownership.

## **6. Robustness Analysis**

Next, we conduct sensitivity analysis along two dimensions. First, we explore whether the main results are robust when we use financial net wealth in the regressions in lieu of total net wealth. Arguably, financial net wealth comes into sharper focus when evaluating credit card delinquency and stock market participation behaviors, since it better proxies liquid resources that

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<sup>19</sup> In empirical extensions presented in the next section, we investigate less stringent bounds by using +/- 20% of the recommended 100-minus-age investing rule instead of 10%.

individuals have to repay their credit card debts or with which to buy stocks.<sup>20</sup> The effects of the FinLit index, our main explanatory variable of interest, is robust to this empirical variation (see Appendix Table 2). When financial net wealth is used as a control, a one-point higher FinLit score is associated with a 6.6% ( $p < 0.01$ ) greater probability of stock market participation, holding other factors constant.

Second, we explore whether the proportion following the 100-age rule rises change if wider risky asset bounds are used. Specifically, we found in the preceding analysis that many older Singaporeans continue to hold large investment holdings in (risky) home equity into advanced ages. Allowing for wider risky asset bounds might better account for this investment practice, for instance using +/- 20% (instead of +/- 10%) bounds. Doing so implies that a 60-year-old could hold 20-60% (instead of 30-50%) of his/her portfolio in risky assets without being seen as contravening the conventional age-based glide path. Using this wider bound reduces the number of respondents violating the investment rule, from 5,058 to 4,102, equivalent to 82.2% and 66.6% of the analytical sample. The point estimate of the coefficient on financial literacy is double the size of the original specification: a one-unit higher FinLit score is now associated with a 3.3% lower probability of *not* following the age-based investment glide path ( $p < 0.01$ ), holding other factors constant (see Appendix Table 3).

## 7. Conclusions

As the population ages, it is of interest to evaluate whether older persons are likely to exhibit suboptimal financial behaviors in later life, and to determine how financial literacy may alleviate these problems. Using the Singapore Life Panel<sup>©</sup>, we find that costly investment and

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<sup>20</sup> We did not re-estimate the model for the investment age-rule because the relevant covariate is total net wealth. It prescribes a certain portfolio mix for *total net wealth*.

asset allocation choices are prevalent among older Singaporeans, in that 6 of 10 older respondents do not invest in stocks (shares) or mutual funds, despite publicly-available schemes allowing pension monies and private savings to be channeled to such investments. Findings from other industrialized countries are similar: for example, in Netherlands, about 70% of older adults above age 50 do not participate in the stock market.<sup>21</sup> Most (82%) of the older adults in our sample allocated their assets in ways that did not follow the age-linked glide path commonly proposed by financial investors, mainly due to illiquid home equity. Government policies in Singapore have encouraged home ownership by providing financial incentives. However, for many older households, this has resulted in asset portfolios that are disproportionately invested in housing. On a more positive note, we did find that the vast majority of older Singaporeans who held credit cards managed their credit card accounts well. Only 4.5% of credit card holders failed to pay their card debts despite having sufficient deposit balances.

Our empirical results also indicate that financial knowledge tends to be associated with more competent financial behaviors. Financially savvy individuals were more likely to make better investment decisions. A one-unit increase in the literacy score was associated with a 8.0 percentage points ( $p<0.01$ ) greater chance of stock market participation, and 1.6 percentage points ( $p<0.01$ ) higher chance of adherence an age-appropriate investing guideline, other factors held constant. However, financial literacy score is not significantly associated with number of credit card repayment errors.

These findings are generally consistent with the literature on adults in Western countries which report a positive relationship between financial literacy and investment skill (Calvet et al.

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<sup>21</sup> Comparative statistics are available from van Rooij et al. (2011) who used data from the 2005-2006 De Nederlandsche Bank Household Survey. See also Campbell (2006) for statistics on levels of stock ownership among U.S. households.

2007; Stango and Zinman 2009; van Rooij et al. 2011; Scholnick et al. 2013; Klapper et al. 2013). It is also worth recalling here that – similar to their Western counterparts – older Singaporeans we studied were relatively sophisticated: 7 in 10 respondents grasped the concepts of interest compounding and inflation, and about half knew the basics of risk diversification. Whether this is true for older adults in other Asian countries is not yet known.

Our work is distinguished from prior studies in that we have examined multiple measures of suboptimal financial behaviors, instead of just one. We further verified that the strong association observed between financial literacy and each of the three potentially costly financial behaviors is not due to high inter-correlations of the behaviors themselves. Indeed, pairwise correlations across the behavioral measures are low, implying that they are picking up different aspects of suboptimal financial behavior. This distinction across the financial behaviors examined here is critical to explaining some of our empirical findings. For example, we found that education is an important predictor of diversified household investment portfolios, but not for credit card repayment errors.<sup>22</sup> One interpretation is that investment-related decisions are linked to an individual's capacity to acquire knowledge and learn concepts (e.g. workings of the stock market) which increases with education, whereas credit card repayment behavior is tied more closely to personal habits, financial discipline, or time pressure. Another interpretation follows from Scholnick et al. (2013)'s observation that education can have a significant impact when the decisions are rare and difficult to understand (e.g., investment-related decisions), but it can have a smaller impact when decisions to be taken are frequent and easy to understand (e.g., monthly credit card repayments).

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<sup>22</sup> Similar to earlier studies, our results show that literacy is not necessarily a good proxy for schooling and it is important to separate the independent effect of financial knowledge from the impact of education level.

Our findings are relevant to the policy discussion. The fact that credit card rollovers are concentrated among a small group of older individuals, while lack of diversification is widely prevalent, suggests that policy interventions can be differentially targeted. Financial literacy programs on investment and saving can aim for broad reach through platforms such as school-based programs and the training for the elderly.<sup>23</sup> By contrast, financial education on debt and credit card management are likely to be more effective if targeted at specific groups of the older population, specifically those lacking financial discipline. Regulators and industry might also move toward financial products that help “nudge” older consumers’ behaviors: for example, automatic bill payment systems can help elders reduce credit card fees.<sup>24</sup> Life-cycle fund investing can also encourage older individuals to invest in age-linked glide paths. Some effort has been made towards this direction in recent years in the Singaporean context; for instance, the government has announced plans to set up a new CPF investment scheme offering savers the chance to invest their pension monies in a few well-diversified low cost and passively managed life-cycle funds.<sup>25</sup>

Our discussion of empirical findings has couched the discussion in terms of associations rather than causal relationships. This is because a causal model of financial behaviors would recognize that people’s decisions are influenced by behavioral and economic factors where investing in financial knowledge is endogenous. While we do not pursue the identification question here, there is substantial evidence supporting the conclusion that financial knowledge does drive more saving, better retirement planning, better investment outcomes, and more informed decisions about retirement payouts (Lusardi and Mitchell 2014). Nevertheless, there is evidence that

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<sup>23</sup> For instance, the National Silver Academy launched in 2015 in Singapore comprises a network of course providers including universities and polytechnics offering non-examinable courses to seniors age 50+.

<sup>24</sup> The GIRO (General Interbank Recurring Order) system in Singapore refers to an automatic electronic payment service permitting one to make monthly auto-payments to a billing organization from one’s bank account directly, as long as there are sufficient balances in the account.

<sup>25</sup> This program, known as the CPF Lifetime Retirement Investment Scheme, is still under discussion (see Fong and Koh, 2018).

consumers must devote time and money to learn about financial products and the workings of the capital market, and consequently the least-educated and lowest-paid may optimally invest little in financial literacy (Kim et al. 2016; Lusardi et al. 2018). An implication of that research is that peoples' financial literacy can be endogenously related to their wealth and portfolio diversification, requiring care to identify the causal relationships.

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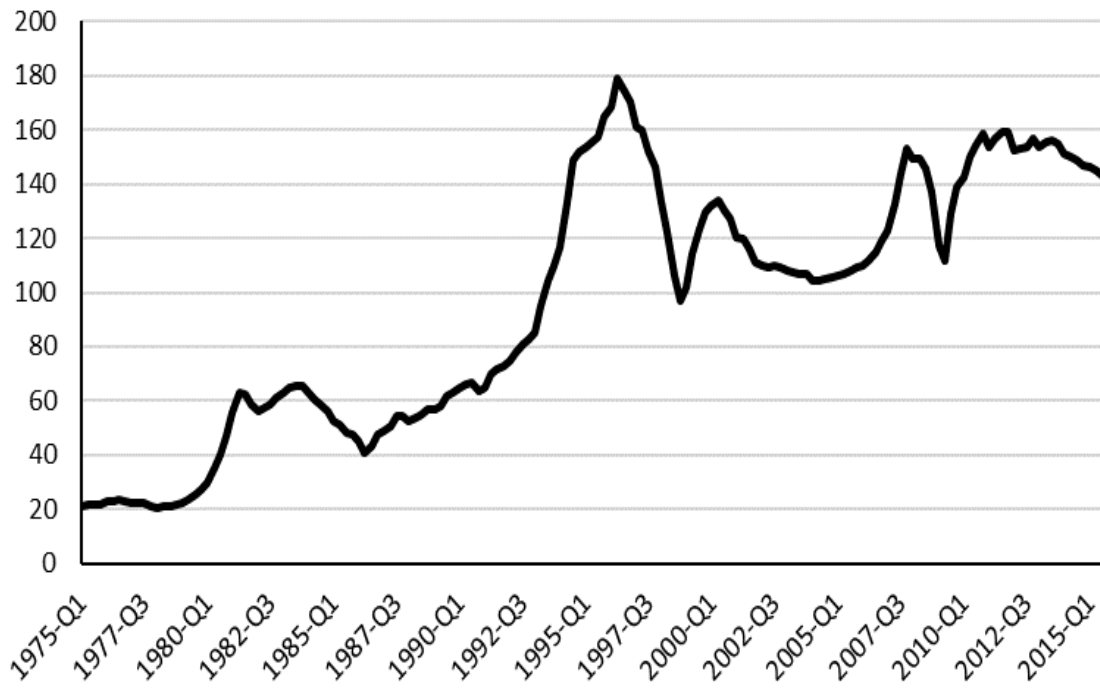
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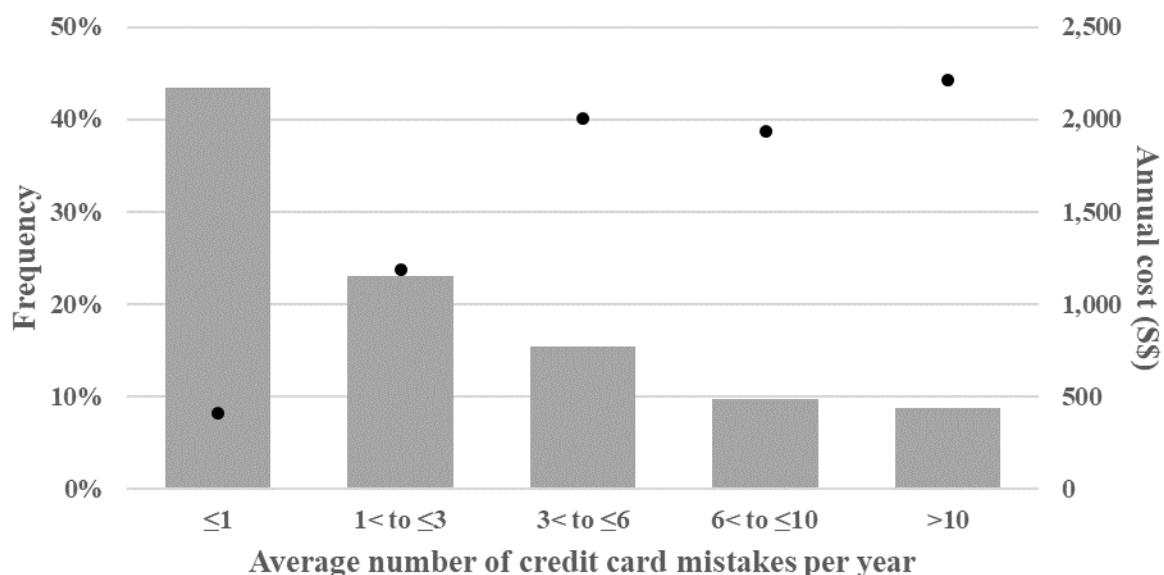
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**Figure 1: Singapore residential house price index in real terms (1975-2015)**

Source: Koh (2016); DOS (2019). Consumer price index, base year 2014.

**Figure 2: Frequency of Credit Card Repayment Mistakes and Annual Costs**



**Source:** Authors' calculations using the SLP®. **Note:** We define a Repayment Mistake as rolling over credit card debt despite having sufficient liquidity; see text. This analysis only pertains to the 196 credit card holders who committed at least one mistake over the 24-month period. Respondents are sorted into bins based on the average number of mistakes committed per year. The total penalty interest charges for each individual are then summed and averaged within each bin to derive the annual cost estimates for the respective bins.

**Table 1. Descriptive Statistics of Full Sample**

<b>Variable</b>	<b>Means (SD)</b>
Female	53%
Married	80%
FinLit Score	2.01 (0.97)
Baseline age	59.3 (5.44)
<i>Age bands</i>	
50-54	24%
55-59	31%
60-64	24%
65-70	21%
<i>Education</i>	
Less than secondary	22%
Secondary	42%
Post-secondary	36%
Manage household finances	84%
Homeowner	88%
High risk tolerance	15%
Work for pay	54%
Fair/poor health	34%
Total net wealth (S\$'000s)	1,162 (1,711)
<i>Median total net wealth (S\$'000s)</i>	660
Annual Income (S\$)	60,236 (144,981)
<i>Median Annual Income (S\$)</i>	27,850
<b>N</b>	<b>6,647</b>

**Source:** Authors' calculations using the SLP®. Note: The sample includes respondents age 50-70 who answered the Financial Literacy questionnaire and relevant financial and investment questions fielded in other survey waves; see text for details. Percentages are shown for categorical variables. Means (and standard deviations in parenthesis) are shown for continuous variables.

**Table 2: Characteristics of respondents with and without credit card repayment errors**

	No error	Credit card errors			
		Lowest Errors=0.5	2Q 0.5<errors≤1.5	3Q 1.5<errors≤5.5	Highest 5<errors≤12
Baseline age	58.6	59.3	56.6	57.7	57.3
FinLit score	2.2	2.1	2.1	1.8	2.1
Post-secondary education	50%	53%	55%	43%	57%
Manage household finances	87%	90%	82%	78%	88%
Total net wealth (S\$'000s)	1,538	930	944	1,380	1,298
Median total net wealth (S\$'000s)	934	782	686	648	830
Annual income (S\$)	82,004	66,386	74,011	58,077	95,138
Median annual income (S\$)	47,050	43,519	59,140	39,000	55,320
<i>N</i>	4,164	49	49	49	49

**Source:** Authors' calculations using the SLP®. **Note:** Credit card repayment error: =1 if rolled over credit card debt despite having sufficient liquidity, 0 else. Only the 4360 respondents who are credit card holders are included in this analysis; non-credit card holders are excluded. The 'no error' category comprises those without credit card debt rollover activity for all waves participated and those who rolled over debt but did not have sufficient liquidity for all waves participated. Respondents who committed at least one repayment error are split into quartiles. Mean values of the characteristics are shown unless otherwise stated.

**Table 3: Characteristics of respondents with and without stock market participation**

	Participate		Did not participate
	For both years	for one year	
Baseline age	59.3	59.0	59.3
FinLit score	2.5	2.3	1.8
Post-secondary education	63%	48%	24%
Manage household finances	89%	86%	82%
Total net wealth (S\$'000s)	2,215	1,406	687
Median total net wealth (S\$'000s)	1,500	873	500
Annual income (S\$)	108,543	76,563	37,066
Median annual income (S\$)	61,533	42,869	18,100
% who make credit card mistake	3.0%	3.7%	2.7%
<i>N</i>	1,567	1,068	4,001

**Source:** Authors' calculations using the SLP®. **Note:** Stock market non-participation: = 1 if respondent held no stocks or mutual funds over the 24-month period. The full sample is used for this tabulation, except for subjects with total net wealth below \$1,000. Mean values of the characteristics are shown unless otherwise stated.

**Table 4: Characteristics of respondents by whether they follow investment age-rule**

	Follow age- rule	Not follow age-rule		
		Under-invested	Over-invested	
Baseline age	57.2	58.3	60.0	
FinLit score	2.3	1.9	2.0	
Post-secondary education	52%	35%	35%	
Manage household finances	88%	81%	84%	
Home owner	95%	61%	95%	
Total net wealth (S\$'000s)	1,363	847	1,261	
Median total net wealth (S\$'000s)	1,041	477	645	
Annual income (S\$)	86,660	68,656	55,227	
Median annual income (S\$)	59,261	20,620	26,160	
% who make credit card mistake	3.6%	2.8%	3.1%	
	<i>N</i>	1,095	1,013	4,045

**Source:** Authors' calculations using the SLP®. **Note:** Not follow investment age-rule: =1 if % total net wealth in risky assets outside +/-10% of 100-minus-age investing rule, 0 else. The subsample of 6,153 respondents with non-missing information on total net wealth and asset allocation is included in this tabulation; see text. Mean values of the characteristics are shown unless otherwise stated.

**Table 5: Characteristics of respondents by the number of non-optimal behaviors**

	Number of suboptimal behaviors				
	Zero	One	Two	All Three	
Baseline age	57.4	59.0	58.6	58.1	
FinLit score	2.5	2.3	1.9	1.7	
Female	46%	50%	50%	44%	
Married	86%	84%	84%	87%	
Post-secondary education	61%	57%	37%	34%	
Manage household finances	88%	88%	84%	82%	
Home owner	96%	92%	89%	93%	
Risk tolerance	21%	21%	12%	17%	
Work for pay	62%	56%	59%	64%	
Fair/poor health	28%	30%	33%	37%	
Total net wealth (S\$'000s)	1,747	1,887	966	701	
Median total net wealth (S\$'000s)	1,363	1,129	640	540	
Annual Income (S\$)	100,386	97,242	54,369	47,590	
Median Annual Income (S\$)	75,000	56,015	31,900	32,767	
	<i>N</i>	611	2,129	1,533	87
	<i>N (in %)</i>	14%	49%	35%	2%

**Source:** Authors' calculations using the SLP®. **Notes:** The three types of suboptimal financial behaviors evaluated are: making credit card repayment error, stock market non-participation, and did not follow investment age-rule. Subsample of 4,360 respondents who are credit card holders are included in this analysis; respondents with no credit cards excluded.

**Table 6: Correlation matrix for the three types of suboptimal financial behavior**

	Number of credit card repayment errors	Stock non- participation	Did not follow investment age-rule
Number of credit card repayment errors	1.000		
Stock non-participation	-0.008	1.000	
Did not follow investment age-rule	-0.005	0.140	1.000

**Source:** Authors' calculations using the SLP®. **Note:** Number of credit card repayment errors per year: continuous variable (range 0-12). Stock market non-participation: = 1 if respondent held no stocks or mutual funds over the 24-month period. Did not follow investment age-rule: =1 if % total net wealth in risky assets outside +/-10% of 100-minus-age investing rule, 0 else. The subsample of 4,397 respondents who are credit card holders are included in this analysis; respondents having no credit cards are excluded.



**Table 7: Multivariate analysis of individual suboptimal financial behaviors**

This table shows the effect of financial literacy on credit card repayment, stock market participation, and portfolio risk exposure, respectively, controlling for race and dummy variables for missing values of controls. The first column reports OLS estimates of the effect of financial literacy on number of credit card (CC) repayment errors (range 0-12; mean= 0.15). The second column reports the Probit estimates (marginal effects) of financial literacy on stock market non-participation (=1 if no stocks or mutual funds held over entire 24-month period, 0 else; mean= 0.60). The last column reports the Probit estimates (marginal effects) of financial literacy on whether follow investment age-rule (=1 if % total net wealth in risky assets outside +/-10% of 100-minus-age investing rule, 0 else; mean= 0.82). The data are from the 2015-2017 SLP survey.

	Number of CC repayment errors	Stock non- participation	Not follow investment age-rule	
	OLS	Probit	Probit	
<b>FinLit Score</b>	<b>-0.032</b> <b>(0.023)</b>	<b>-0.080</b> *** <b>(0.008)</b>		<b>-0.016</b> *** <b>(0.006)</b>
Female	-0.040 (0.025)	-0.022 * (0.012)		0.020 ** (0.008)
Married	0.033 (0.041)	0.124 *** (0.021)		-0.011 (0.013)
Age (Base group: 50-54)				
55-59	-0.037 (0.042)	-0.015 (0.019)		0.036 *** (0.011)
60-64	0.000 (0.049)	-0.032 (0.021)		0.073 *** (0.011)
65-70	-0.030 (0.057)	-0.063 *** (0.024)		0.128 *** (0.011)
Education (Base group: Less than secondary)				
Secondary	-0.024 (0.075)	-0.206 *** (0.021)		-0.090 *** (0.017)
Post-secondary	0.011 (0.078)	-0.300 *** (0.024)		-0.095 *** (0.019)
Manage HH finances	-0.034 (0.047)	-0.001 (0.019)		-0.008 (0.013)
Home owner	0.070 (0.048)	0.178 *** (0.031)		-0.053 *** (0.016)
Risk tolerance	0.118 ** (0.051)	-0.109 *** (0.021)		0.017 (0.013)
Ln total net wealth	-0.039 ** (0.016)	-0.178 *** (0.012)		-0.024 *** (0.006)
Ln annual income	0.015 (0.009)	-0.031 *** (0.005)		-0.013 *** (0.004)
Work for pay	0.045 (0.036)	0.053 *** (0.015)		-0.022 ** (0.010)
Fair/poor health	0.004 (0.032)	-0.007 (0.015)		0.002 (0.011)
<i>N</i>	4,360	6,636		6,153
<i>BIC</i>	12486.1	6730.7		5460.4

**Source:** Authors' calculations using the SLP®. **Note:** Robust standard errors clustered at household level in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

**Table 8: Multivariate analysis of multiple suboptimal financial behaviors**

This table shows the effect of financial literacy on number of suboptimal financial behaviors using an ordered probit regression, controlling for race and dummy variables for missing values of controls. The three columns report the Probit estimates (marginal effects) of financial literacy on number of non-optimal financial behaviors (range 0-3). The data are from the 2015-2017 SLP survey.

Variable	Number of non-optimal financial behaviors					
	1 vs. 0		2 vs. 0		3 vs. 0	
<b>FinLit Score</b>	<b>0.031</b>	<b>***</b>	<b>-0.059</b>	<b>***</b>	<b>-0.005</b>	<b>***</b>
	<b>(0.004)</b>		<b>(0.008)</b>		<b>(0.001)</b>	
Female	0.001		-0.002		0.000	
	(0.005)		(0.011)		(0.001)	
Married	-0.019	**	0.040	**	0.003	**
	(0.008)		(0.017)		(0.001)	
Age (Base group: 50-54)						
55-59	-0.006		0.012		0.001	
	(0.009)		(0.017)		(0.001)	
60-64	-0.019	*	0.035	*	0.003	*
	(0.011)		(0.019)		(0.002)	
65-70	-0.038	***	0.066	***	0.006	***
	(0.013)		(0.020)		(0.002)	
Education (Base group: Less than secondary)						
Secondary	0.060	***	-0.124	***	-0.010	***
	(0.010)		(0.021)		(0.002)	
Post-secondary	0.079	***	-0.154	***	-0.014	***
	(0.012)		(0.023)		(0.003)	
Manage HH finances	0.010		-0.018		-0.002	
	(0.010)		(0.018)		(0.002)	
Home owner	-0.026	***	0.057	***	0.004	***
	(0.008)		(0.021)		(0.002)	
Risk tolerance	0.013	*	-0.026	*	-0.002	*
	(0.007)		(0.016)		(0.001)	
Ln total net wealth	0.046	***	-0.088	***	-0.007	***
	(0.005)		(0.008)		(0.001)	
Ln annual income	0.006	***	-0.012	***	-0.001	**
	(0.002)		(0.005)		0.000	
Work for pay	-0.013	*	0.025	*	0.002	*
	(0.007)		(0.013)		(0.001)	
Fair/poor health	-0.004		0.008		0.001	
	(0.007)		(0.014)		(0.001)	
<i>N</i>	4,360		4,360		4,360	
<i>BIC</i>	8836.9					
<i>Pseudo R-sq</i>	0.08					

**Source:** Authors' calculations using the SLP®. **Note:** Robust standard errors clustered at household level in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

## Appendix Tables

**Appendix Table 1. Sample selection criteria for each suboptimal behavior**

<b>Description</b>	<b>N</b>
Responded to Dec 2015 wave	8,566
Age 50-70 in Dec 2015	8,063
answered all 3 FinLit questions	7,759
Merged with wave 6-29	7,598
Dropped 4 persons with outlier value for interest charge	7,594
Dropped missing HH net wealth	7,250
Dropped card holder who was observed less than 9 months in each of 2016 and 2017	6,647
<b>Final analytic sample</b>	<b>6,647</b>
<b>Added restriction for credit card repayment error analysis</b>	6,647
respondent lives in HH that owns credit card(s)	4,360
<b>Final sample for CC repayment error analyses</b>	<b>4,360</b>
<b>Added restriction for analyzing stock market participation</b>	6,647
responded to wealth module in 2016 or 2017	6,636
<b>Final sample for analyzing stock market participation</b>	<b>6,636</b>
<b>Added restriction for analyzing whether follow investment age-rule</b>	6,647
responded to wealth module in 2017	6,337
sufficient information to compute portfolio allocation	6,153
<b>Final sample for analyzing whether follow investment age-rule</b>	<b>6,153</b>

Source: Authors' calculations using the SLP®

**Appendix Table 2: Multivariate analysis of suboptimal financial behaviors among households** (with financial net wealth as control)

This table shows the effect of financial literacy on credit card repayment, stock market participation, and portfolio risk exposure, respectively, controlling for race and dummy variables for missing values of controls. This table is analogous to Table 7 except that household financial net wealth is used as a control instead of total net wealth. The first column reports OLS estimates of the effect of financial literacy on number of credit card (CC) repayment errors (range 0-12; mean= 0.15). The second column reports the Probit estimates (marginal effects) of financial literacy on stock market non-participation (=1 if no stocks or mutual funds held over entire 24-month period, 0 else; mean= 0.60). The data are from the 2015-2017 SLP survey.

Variable	Made CC repayment errors	Stock non-participation
	Probit	Probit
<b>FinLit Score</b>	<b>-0.025</b> <b>(0.023)</b>	<b>-0.066 ***</b> <b>(0.009)</b>
Female	-0.032 (0.025)	-0.005 (0.012)
Married	0.026 (0.040)	0.072 *** (0.020)
Age (Base group: 50-54)		
55-59	-0.034 (0.042)	-0.018 (0.020)
60-64	0.009 (0.051)	-0.026 (0.022)
65-70	-0.010 (0.060)	-0.024 (0.024)
Education (Base group: Less than secondary)		
Secondary	-0.002 (0.070)	-0.206 *** (0.021)
Post-secondary	0.044 (0.071)	-0.293 *** (0.024)
Manage HH finances	-0.026 (0.047)	0.002 (0.020)
Home owner	0.030 (0.043)	0.008 (0.025)
Risk tolerance	0.131 ** (0.052)	-0.109 *** (0.021)
Ln total net wealth	-0.060 *** (0.018)	-0.116 *** (0.006)
Ln annual income	0.027 ** (0.011)	-0.021 *** (0.005)
Work for pay	0.033	0.043 ***

Variable	Made CC repayment errors	Stock non-participation
	Probit	Probit
	(0.035)	(0.015)
Fair/poor health	0.000	-0.009
	(0.032)	(0.016)
<i>N</i>	4,360	6,636
<i>BIC</i>	12464.8	6290.1

**Source:** Authors' calculations using the SLP®. **Note:** Robust standard errors clustered at household level in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

**Appendix Table 3: Sensitivity analysis for whether follow investment age-rule**

This table shows the effect of financial literacy on portfolio risk exposure, controlling for race and dummy variables for missing values of controls. It reports the Probit estimates (marginal effects) of financial literacy on whether follow investment age-rule (=1 if % total net wealth in risky assets outside +/-20% of 100-minus-age investing rule, 0 else; mean= 0.66). This table is analogous to the results in the last column of Table 7 except that 20% bounds are used instead of 10% bounds. The data are from the 2015-2017 SLP survey.

Variable	Not follow investment age-rule	
	Probit	
<b>FinLit Score</b>	<b>-0.033</b>	<b>***</b>
	<b>(0.008)</b>	
Female	0.026	**
	(0.011)	
Married	-0.043	**
	(0.018)	
Age (Base group: 50-54)		
55-59	0.077	***
	(0.016)	
60-64	0.161	***
	(0.016)	
65-70	0.269	***
	(0.015)	
Education (Base group: Less than secondary)		
Secondary	-0.113	***
	(0.020)	
Post-secondary	-0.108	***
	(0.023)	
Manage HH finances	-0.061	***
	(0.017)	
Home owner	-0.102	***
	(0.023)	
Risk tolerance	0.008	
	(0.018)	
Ln total net wealth	-0.051	***
	(0.009)	
Ln annual income	-0.024	***
	(0.005)	
Work for pay	-0.041	***
	(0.014)	
Fair/poor health	0.005	
	(0.014)	
<i>N</i>	6,153	
<i>BIC</i>	7022.5	

**Source:** Authors' calculations using the SLP®. **Note:** Robust standard errors clustered at household level in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

## Data Appendix

### *Data Appendix 1. Variable definitions*

The financial literacy questions were fielded in the Singapore Life Panel® in Dec 2015 (wave 5). Based on these, we construct our key variable of interest, the Financial Literacy Index, which counts the number of correct answers among those who answered all three financial literacy questions. Most of the other control variables are also drawn from the Dec 2015 wave including age, sex, marital status, and self-reported health. The asset and income module is fielded annually in the January/ February wave of the SLP® survey. For the present study, we extracted wealth and income variables from the Jan/Feb 2016 wave,<sup>26</sup> elicited just one month after the financial literacy questions. *Total net wealth* is defined as the sum of financial wealth, bank accounts, insurance, pensions, vehicles, as well as primary and secondary residences, all net of debt.

Home ownership and work for pay variables are also elicited from respondents on an annual basis at the start of the year. Time-invariant characteristics such as race and education are taken from the baseline survey that respondents completed when recruited into the SLP. Whether manage household finances is also taken from the baseline wave. We conducted the analyses at the respondent level, using individual-level information on financial literacy. Several other variables are elicited at the household level in the SLP, such as assets and income items. For those variables we attach the household-level information to the individual-level records. See Table below for detailed definitions.

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<sup>26</sup> To increase the number of available observations on assets and annual income, the asset and income module is also fielded in February to respondents who did not complete the survey in the preceding January wave.

Variable	Definition
Made CC repayment mistake	=1 if R rolled over CC debt (in a given month of 2016 or 2017) and debt amount < savings balances in the Jan month of the same year and the Jan month of the year after, 0 otherwise
Stock non-participation	=1 if R reports not having stocks or mutual funds (inclusive of CPFIS stocks and mutual funds) in both 2016 & 2017, 0 otherwise
Not follow investment age-rule	=1 if R if % total net wealth in risky assets (stocks +mutual funds+primary & secondary housing) not within +/-10% of 100-minus-age rule, 0 otherwise. Sensitivity analysis considered +/-20% of 100-minus-age rule.
Number of suboptimal behaviors	=0-3, sum of three types of suboptimal behaviors
FinLit total score	# of correct answers to 3 financial literacy questions
Female	=1 if R is female, 0 otherwise
Married	=1 if R is married, 0 otherwise
Age	= age as at wv 5
Age 50-54	=1 if R's age between 50-54, 0 otherwise
Age 55-59	=1 if R's age between 55-59, 0 otherwise
Age 60-64	=1 if R's age between 60-64, 0 otherwise
Age 65-70	=1 if R's age between 65-70, 0 otherwise
Race, Chinese	=1 if R is Chinese, 0 otherwise
Race, Malay	=1 if R is Malay, 0 otherwise
Race, Indian	=1 if R is Indian, 0 otherwise
Race, others	=1 if R is other races, 0 otherwise
Education, primary	=1 if R has primary education, 0 otherwise
Education, secondary	=1 if R has secondary education, 0 otherwise
Education, post-secondary	=1 if R has post-secondary education, 0 otherwise
R manages finances	=1 if R manages household finance fully or partially, 0 otherwise
Home owner	=1 if R owns home, 0 otherwise
Risk tolerance	=1 if R reports willing to take financial risks rate >5 from 0-10, 0 otherwise
Work for pay	=1 if R works for pay in wv 5, 0 otherwise
Fair/poor health	=1 if R reported health status fair or poor in wv5, 0 otherwise
Ln household total net wealth	A continuous variable equal to log of household total net wealth (S\$) in wv 18/19.
Ln household net financial wealth	A continuous variable equal to log of household net financial wealth (S\$) in wv 18/19.
Negative total net wealth	=1 if household total net wealth<=0
Negative financial net wealth	=1 if household financial net wealth<=0
Ln annual household income	A continuous variable equal to log of household annual income (S\$) in wv 18/19.



*Data Appendix 2. Question wording of key variables*

**Variables relevant to constructing credit card repayment error (elicited every wave)**

**C102.** The next questions are about credit cards. Do [you and or your spouse] have one or more credit cards?

- 1 Yes
- 5 No

**C103.** Last month, did [you and or your spouse] pay off all your credit card debt or was there an unpaid debt that you carried over to this month?

- 1 Paid off all
- 2 Carried over unpaid debt

**C104.** How much credit card debt did [you and or your spouse] carry over from last month to this one?

We would like to know the amount on which you are charged interest.

If you paid off the amount required to avoid interest charges, then please enter zero.

**C105.** How much interest were [you and or your spouse] charged last month on your credit cards?

**Stock market non-participation (Jan/Feb'16; Jan/Feb'17; Jan/Feb'18)**

**A4240.** Aside from anything you have already told us about, do [You and your spouse] have any shares or stocks?

- 1 Yes
- 5 No

**A4400.** Aside from anything you have already told us about, do [You and your spouse] have any managed funds, mutual funds or unit trusts; which hold shares, bonds, money and other investments?

- 1 Yes
- 5 No

**A1110.** Do you currently have any investments made through the CPFIS-OA scheme?

- 1 Yes
- 5 No
- 98 Don't know

**A1122.** Which assets have you invested in through the CPFIS-OA scheme? Please check all that apply.

- 1 Fixed Deposits
- 2 Government Bonds (Singapore Government Bonds, Statutory Board Bonds, Bonds Guaranteed by the Singapore Government)
- 3 Corporate Bonds
- 4 Annuities
- 5 Endowment Insurance Policies

6 Shares

7 Collective Investments such as Unit Trusts, Exchange Traded Funds, Fund Management Accounts, Property Funds, or Real Estate Investment Trusts

8 Investment-Linked Insurance Products

9 Gold

**A1130.** Do you have any investments made through the CPFIS-SA scheme?

1 Yes

5 No

98 Don't know

**A1142** Which assets have you invested in through the CPFIS-OA scheme? Please check all that apply.

1 Fixed Deposits

2 Government Bonds (Singapore Government Bonds, Statutory Board Bonds, Bonds Guaranteed by the Singapore Government)

3 Annuities

4 Endowment Insurance Policies

5 Collective Investments such as Unit Trusts, Exchange Traded Funds, Fund Management Accounts, Property Funds, or Real Estate Investment Trusts

6 Investment-Linked Insurance Products

**Age-rule mistake (asset variable from Jan/Feb'17 only)**

**Ragedobok.** Respondent's age verified by module Demographics (Fixed from Baseline)

**Hatotbw.** Total wealth (housing own share - incl. secondary residence) (impw) Derived Variable

**A4240.** Aside from anything you have already told us about, do [You and your spouse] have any shares or stocks?

1 Yes

5 No

**A4400.** Aside from anything you have already told us about, do [You and your spouse] have any managed funds, mutual funds or unit trusts; which hold shares, bonds, money and other investments?

1 Yes

5 No

**A1110.** Do you currently have any investments made through the CPFIS-OA scheme?

1 Yes

5 No

98 Don't know

**A1122.** Which assets have you invested in through the CPFIS-OA scheme? Please check all that apply.

- 1 Fixed Deposits
- 2 Government Bonds (Singapore Government Bonds, Statutory Board Bonds, Bonds Guaranteed by the Singapore Government)
- 3 Corporate Bonds
- 4 Annuities
- 5 Endowment Insurance Policies
- 6 Shares
- 7 Collective Investments such as Unit Trusts, Exchange Traded Funds, Fund Management Accounts, Property Funds, or Real Estate Investment Trusts
- 8 Investment-Linked Insurance Products
- 9 Gold

**A1130.** Do you have any investments made through the CPFIS-SA scheme?

- 1 Yes
- 5 No
- 98 Don't know

**A1142** Which assets have you invested in through the CPFIS-OA scheme? Please check all that apply.

- 1 Fixed Deposits
- 2 Government Bonds (Singapore Government Bonds, Statutory Board Bonds, Bonds Guaranteed by the Singapore Government)
- 3 Annuities
- 4 Endowment Insurance Policies
- 5 Collective Investments such as Unit Trusts, Exchange Traded Funds, Fund Management Accounts, Property Funds, or Real Estate Investment Trusts
- 6 Investment-Linked Insurance Products

**A5050.** Primary residence

What would that house or apartment be worth if sold?

Raw integer plus imputed bracket values & winsorized

**A5080.** Primary residence mortgage owed

About how much do you still owe on the mortgage?

Raw integer plus imputed bracket values & winsorized

**A6010.** Secondary residence

If you sold all those properties about how much money would you get?

Raw integer plus imputed bracket values & winsorized

**A6060.** Secondary residence mortgage owed

About how much in total do you still owe on the mortgage?

Raw integer plus imputed bracket values & winsorized

### ***Data Appendix 3. Construction of credit card repayment errors and associated costs***

A credit card repayment error is deemed to have occurred in a given month if the respondent rolled over credit card debt despite having sufficient saving balances, leading to a non-zero interest charge being imposed that month. Credit card repayment errors are evaluated only among respondents who own at least one credit card ( $n=4,360$ ); this represents 64% of the analysis sample. Only credit card holders who participated in the SLP® survey for at least nine months during a year are included to ensure that ample monthly observations of credit card repayment behavior are available over a year.

Based on monthly records of credit card debt rollover, 387 of the 4,360 credit card holders had at least one rollover transaction during the 24-month period covering 2016 and 2017. For these 387 persons, we evaluate whether each of their rollover transaction(s) constituted a repayment error. If the dollar amount of credit card debt rolled over in a given month was less than the household's balances held in checking and savings accounts reported in the asset modules in the previous and the following annual assessment, then a repayment error occurred (indicator variable=1); otherwise, no error (indicator variable=0). For example, if the rollover transaction occurred in June 2016, we compare the amount rolled over against checking and saving balances in Jan/Feb 2016 and Jan/Feb 2017. If the rollover transaction occurred in February 2017, we compare the amount rolled over against saving balances in Jan/Feb 2017 and Jan/Feb 2018. This approach assumes that total checking and saving account balances of respondents do not vary widely over the year. We find that 195 of 387 persons with rollover transactions committed at least one credit card repayment error over the 24-month period.

Next we sorted these 195 persons into bins based on their frequency of errors, and we computed an annualized statistic given by the average number of credit card repayment errors

committed per year. For most subjects (87% or 169 persons), the annualized statistic simply equals the sum of all errors committed divided by two, since they were observed in both 2016 and 2017.<sup>27</sup> For the handful of subjects where sufficient information is only available in one year (mostly due to responding to fewer than 9 of 12 months in the year), the annualized statistic was based on information from that year.

Penalty interest charges associated with each repayment error are elicited in the SLP by asking: “How much interest were [you and or your spouse] charged last month on your credit cards?” Any applicable fees for late payment were not queried and therefore are not included in our cost calculations. The records of interest charges are relatively complete: 87% of observed repayment errors were associated with a report of positive interest charges (7% had zero values, and the remaining 6% had missing values). We imputed the missing values applying the average penalty interest rate observed in the data set, applied to the reported carried over balance. For the few remaining missing values we imputed the median interest penalty charge of \$200. To estimate of the average annual cost of errors, we tally the repayment errors with non-zero interest charge across all persons in a given bin and compute the average dollar interest charge incurred (see Figure 2).

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<sup>27</sup> If a subject had a positive number of errors in one year and zero error in the other year, we include both data points in computing the average.