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Financial literacy and financial decision-making at older ages

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ABSTRACT

How well older households manage their wealth holdings is an important determinant of their financial security during retirement, yet little is known about their financial decision-making and how this relates to their financial literacy. Our paper fills this gap by measuring financial literacy among older persons in the Singapore Life Panel and examining its association with timely credit card debt repayment, stock market participation, and age-based investment risk diversification. Most older respondents understand interest compounding and inflation, but fewer than half know about risk diversification. Almost all older credit card holders pay off their balances in a timely manner, but only 40% hold stocks; fewer than 18% with \$1000+ in assets hold portfolios consistent with age-appropriate investment glide paths. We further show that a one-unit higher financial literacy score is associated with a greater propensity to timely pay off credit card balances (1.5 ppts), to hold stock (8.3 ppts), and to follow an age-appropriate investment glide path (1.7 ppts).

1. Introduction

Successful management of financial matters is important at every stage of the life-cycle, but sound financial decision-making can grow more challenging as people grow older (Hammond et al., 2017). This is important, inasmuch as older people tend to have more wealth and resources to manage than during their working lives. Additionally, financial liberalization has led to a proliferation of new financial products and services, many of which are unfamiliar to retirees. This increased complexity may also be exacerbated by declining cognitive abilities in later life. Nevertheless, older individuals may have also learned from experience after years of making financial decisions and observing those of others. In sum, learning more about the factors shaping financial behaviors in later life is important as the world ages.

A large literature has examined how financial literacy shapes financial decisions. Some of these studies did not employ direct measures of financial literacy, relying instead on proxies (or imputations) of financial sophistication to draw a link between the proxies and outcomes. For instance, Scholnick et al. (2013) studied the relationship between wealth/income and credit card repayment in Canada, and they concluded that poorer individuals made non-payment mistakes because of their lower wealth, education, and, presumably, financial sophistication. Moreover, their subjects were unaware of the unnecessary costs they incurred for failing to pay

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on time. Agarwal et al. (2009) found that many American households paid too-high interest rates on credit card debt, home equity loans, and mortgages; moreover, such behaviors were most prevalent among the young and the old, presumably those with the lowest levels of financial knowledge. Calvet et al. (2007) showed that many Swedish households held under-diversified portfolios or did not participate in financial markets, with non-negligible welfare costs. Christelis et al. (2010) concluded that more cognitively able adults were more likely to participate in the stock market. Stolper (2018) reported that German households with characteristics believed to be correlated with financial literacy were less likely to follow conventional financial advice.

Other studies have used direct measures of financial literacy, often relying on surveys that included the “Big Three” financial literacy questions developed by Lusardi and Mitchell (2014). Consequently, these allow researchers to more cleanly trace out the links between better-measured financial literacy and a variety of financial behaviors. For example, Bucher-Koenen and Ziegelmeyer (2014) showed that Germans with low levels of financial literacy were less likely to have invested in the stock market and reacted to financial crises by selling assets that lost value. Using a sample of about 2000 Dutch households, Van Rooij et al. (2011) reported that financial illiteracy reduced households’ propensity to buy stock. Guiso and Jappelli (2008) used Italian data on investors’ portfolio choices and answers to two questions about inflation and interest rates. They concluded that being able to answer these two questions correctly was strongly associated with more diversified portfolios, controlling for other respondent characteristics and measures of risk aversion. Recent evidence from China suggests that financial literacy boosted younger households’ risky investments, but lowered returns for older, less educated households based on a sample of 3882 households (Li et al., 2020). Grohmann (2018) showed that higher financial literacy led to improved savings and borrowing decisions among 491 urban middle-class persons in Thailand.

With few exceptions, however, most of these studies have focused on only one economic outcome of interest (e.g., stock market participation). It is thus unclear how financial literacy may shape a range of financial decisions simultaneously in the same population. For instance, it is possible that older adults perform better in some aspects of economic decision-making, but worse in other regards. In addition, it is unclear whether the determinants of poor decision-making are common across the various types of financial decisions. For instance, if higher levels of education and financial knowledge are associated with stock market participation, are the same factors also associated with good credit card repayment behavior? Our study aims to fill this gap in the literature.

In particular, this paper examines how financial literacy is associated with three types of financial decisions pertinent to older individuals: adherence to timely credit card repayment, stock market participation, and risk diversification of household assets. Each of these constitutes a central element of common financial advice. For instance, many analysts have highlighted the benefits of timely credit card repayment. For instance, Keys et al. (2020) reported that 27–33% of Americans held credit card debt that had been sent to collection, meaning the holder was in arrears. Those with late payments also incurred costly fees and interest charges (Agarwal et al., 2009; Jørring, 2018; Scholnick et al., 2013; Stango and Zinman, 2009). Stock market participation is also widely deemed to be important for risk diversification and exposure to the equity premium (Lincoln, 2019). Financial advisors also encourage clients to use “rules of thumb” to guide investment patterns, in particular the widely-followed age-based glide path implied by the “100-minus-your-age” rule (Powell, 2018). Therefore the usual recommendation has been for investors to hold a higher equity fraction when young, and to reduce the equity allocation as they age.

Our investigation of financial behaviors at older ages relies on a module we fielded in the Singapore Life Panel (SLP®) survey, an unusually rich panel dataset covering a representative sample of adults age 50–70 in Singapore. The survey provides background on older respondents’ socio-demographic, health, and economic characteristics, as well as family network and retirement expectations (Vaithianathan et al., 2018).

A key strength of our dataset is its large sample size. Our analysis focuses on a total of 6573 older respondents age 50+. This large sample of older adults allows an in-depth examination of their various financial decisions. Another advantage of the dataset, and one that is particularly important for our study, is that the SLP® 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. The high-frequency panel nature of the SLP® allows us to observe household credit card repayment behavior on a monthly basis over the course of two years. We also have information on respondents’ net home equity and share ownership both inside and outside their pension accounts. This provides a uniquely complete picture of older peoples’ asset and financial behaviors.

Singapore is an interesting setting for our 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. Its financial system is highly integrated into international financial markets and serves as an important regional financial hub. Financial markets in Singapore are well-established and the main financial services industries include banking, insurance, and capital market services. Additionally, Singaporeans have one of the highest life expectancies in the world, requiring households to finance their additional years of spending in a setting with limited annuitized retirement income. The United Nations (2018) estimates that the share of Singapore’s population age 60+ will rise from 19.5% today to 42.7% by 2060. 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). Accordingly, it is of interest to learn whether and how financial literacy may be associated with financial behaviors in the older population.

To preview results, we document a reasonably high degree of adherence to common financial advice with respect to the three financial behaviors we examined. Almost all (92%) of the older Singaporean credit card holders in this study repay their credit card balances in a timely manner over a 24-month period. Among those with late credit card repayments, half had insufficient liquidity,

while the other half did not repay on time despite having sufficient liquidity. Avoidable annual interest costs for those with late repayments average S\$2900¹ (median S\$511). About two in five (or 42%) of older adults with at least \$1000 in net worth held stocks. This is slightly higher than comparable statistics from other industrialized countries. For instance, only about 30% of older adults in the Netherlands participate in the stock market (van Rooij et al., 2011).² On a more negative note, only 18% of sampled respondents had an asset mix consistent with the “100 minus age” investment rule of thumb.

We find that the more financially literate were more likely to exhibit each of the recommended financial behaviors: specifically, a one-unit higher financial literacy score is associated with a 1.5 percentage point higher likelihood of timely credit card repayment; 8.3 percentage point greater propensity to hold stocks; and a 1.7 percentage point higher likelihood of following an age-appropriate investment glide path, other factors held constant. These estimates are all statistically significant at the 1% level. Interestingly also, we find a low correlation among the three financial behaviors considered. This implies that the behavioral measures we use are picking up different aspects of financial decision-making. Considering the three behaviors jointly, we find that higher education and financial literacy levels are predictive of greater adherence to recommended behaviors. Those who are older, with lower income, married, and less wealthy tend to follow fewer of the recommended behaviors.

In what follows, we first briefly review prior studies linking financial literacy and the three financial behaviors we examine. Next, we describe our dataset and the construction of the three measures of financial behaviors. Subsequently, we report the results of our empirical analysis, followed by discussion and robustness checks. A final section concludes.

2. Prior studies on financial literacy and specific aspects of financial behavior

Previous studies examining financial literacy among older individuals in the U.S. and elsewhere generally find important gaps in basic financial knowledge (Bernheim, 1998; Lusardi and Mitchell, 2008, 2011a, 2011b). For example, Bernheim (1998) was among the first to show that many U.S. households could not perform simple financial calculations. Using the Health and Retirement Study, Lusardi and Mitchell (2011b) found that only half of Americans age 50+ could correctly answer two simple questions about compound interest and inflation, and only one-third could correctly answer those two questions plus another on risk diversification. The same “Big Three” questions were subsequently fielded in several other developed countries including Germany, the Netherlands, Italy, Sweden, Russia, Japan, and New Zealand. Results showed not only that financial literacy is low in many countries, but also that older individuals tend to have a lower level of financial knowledge relative to younger groups (Lusardi and Mitchell, 2011a).

There is also literature on how improving financial literacy influences downstream financial behaviors. For instance, Gibson et al. (2014) documented that financial literacy training was associated with information-seeking behavior on remittance services among migrants in Australia and New Zealand, at least in the short term. In the U.S. context, Bernheim and Garrett (2003) showed that financial education in the workplace was associated with higher retirement accumulation, while Xiao and O’Neill (2016) reported that financial education at school or in the workplace were associated with positive financial behaviors.

Our analytical strategy in selecting outcome variables of interest took into consideration prior studies and data availability. Two financial behaviors that are frequently studied in relation to financial literacy and that are well recorded in the SLP are credit card repayment and stock market participation. Most studies on credit card repayment behavior focus on the benefits of timely credit card repayment. Yet little is known about this potential cause of financial distress in the older population.

Research on stock market participation (or lack thereof) has burgeoned of late: for instance Klapper et al. (2013) and van Rooij et al. (2011) showed that, in developed nations, substantial portions of the population do not participate in the stock market. The 2016 U.S. Survey of Consumer Finance found that only half of U.S. households of all ages held equity in any form (SCF, 2017). A key reason for many people not holding equity might be that they do not understand the workings of the stock market and hence shy away from what they see as an ambiguous proposition (Dimmock et al., 2016). Nevertheless, relatively little research has focused on the older population, which we examine here.

Our third measure of financial behavior is inspired by the observation that financial advisors often encourage clients to use “rules of thumb” to guide investment patterns. One popular rule is the widely-followed age-based glide path implied by the “100-minus-your-age” allocation path. That is, the recommendation has been for investors to hold a higher equity fraction when young, and to reduce the equity allocation as they age.³ Yet in the population as a whole, there is little evidence of such diversification (Guiso et al., 2003; Campbell, 2006; and Bhamra and Uppal, 2019), and even less evidence on what these patterns look like among the elderly.

¹ As of this writing, S\$2900 was equal to about US\$2100.

² The van Rooij et al. (2011) study offers the closest comparison to this present study because it also focused on a sample of older adults above age 50. The authors used data from the 2005–2006 De Nederlandsche Bank Household Survey. See also Campbell (2006) for other statistics on levels of stock ownership among U.S. households.

³ In view of longer lifespans, some analysts now favor a 125 minus age rule instead; see Marsh (2015).

3. Methodology

3.1. Data and sample

In this study we use data from the 2015–2017 Singapore Life Panel (SLP®), a high-frequency internet-based survey conducted by the Centre for Research on the Economics of Aging at the Singapore Management University.⁴ It is a longitudinal survey of Singaporean citizens and permanent residents initially age 50–70 as well as their spouses. About 15,000 individuals have participated in the monthly surveys since August 2015, and about 8000 interviews are completed on average every month. Thus far, over 63 waves have been completed and response rates have remained remarkably stable. The interviews are 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. Respondents receive modest compensation for the effort of participating in the surveys, and the survey team conducts various outreach efforts to keep respondents engaged. 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. The monthly observations on credit card debt rollover behavior allows us to assess the number of months in a year that credit card balances were not paid off resulting in penalty interest charges. Our full analytic sample is composed of respondents aged 50–70 in the SLP® Dec 2015 wave who answered all three financial literacy questions and who responded to the annual asset and income modules ($N = 6573$). Further sample restrictions are applied as called for in each of the three specific analyses (these are detailed in the next section and summarized in Table A1). Our analyses are conducted at the respondent level, assuming resource sharing in married households. Most asset information, including on credit card ownership, is elicited at the household level (i.e. respondent and spouse for married persons). Financial literacy is assessed at the individual level using the Big Three questions now standard in the literature.

3.2. Measurement of financial behaviors

3.2.1. Timely credit card repayment

The SLP asks respondents every month if they own a credit card and, if so, whether all credit card debt was paid off that month, or if there was an unpaid debt carried over to the next month on which the respondent had to pay interest. With this information, we constructed an indicator that takes the value 1 if the respondent paid off the credit card balance every month in a timely manner for calendar years 2016 and 2017, and 0 otherwise. For the analyses of timely credit card repayment, we restricted the sample to respondents who owned at least one credit card and who participated in at least nine monthly surveys in a given calendar year ($n = 4321$, or 66% of the full sample). The latter selection criterion ensures that we extract sufficient information on credit card repayment habits on an annual basis, while minimizing the number of observations dropped from the analysis (see Online Appendix A for details).⁵

Among those who reported carrying over balances from one month to the next, we counted the number of late payments over the assessed period and added up the accrued interest charges. In some cases, households may face liquidity constraints due to unexpected spending shocks, so that the carrying over of the credit card balance does not necessarily constitute poor financial behavior. The SLP collects information on household balances in checking and savings accounts annually, so we cannot determine liquidity constraints every month. Accordingly, we used the nearest available asset information before and after the late credit card payment, to approximate for each rollover transaction whether it likely constituted a poor financial decision. That is, we checked whether the

⁴ 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. The Center has recently been renamed the Centre for Research on Successful Aging.

⁵ The SLP question is phrased as: “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 Online Appendix B for the wording of the relevant survey sequence.

dollar amount of the rolled over credit card debt in a given month was less than the respondent's total deposits in checking and saving accounts.^{6,7} Note that even when a household lacked liquidity, it could still be that the late repayment of credit card debt resulted from poor financial decision-making, if the household had the opportunity to set aside buffer stock saving but failed to do so. We present descriptive evidence of the cost associated with late credit card repayment, but our main outcome of interest in this context is timely credit card repayment.⁸

3.2.2. Stock market participation

Stock market participation allows households to access the equity risk premium. For this reason, many financial advisors recommend that households hold some equity, even at older ages. 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 contribution rates ranging from 37% of wages (17% by employers and 20% by employees) for young working adults age 35 and below, to 12.5% of wages for those age 65 + .⁹ Investment in stocks or mutual funds using CPF savings is allowed via the CPF Investment Scheme, subject to the CPF member meeting certain saving balance thresholds.¹⁰

We assessed stock market participation through both direct holdings of stocks and indirect holdings via participation in mutual funds; the latter included 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 thus defined stock market participation as an individual holding stocks or mutual funds sometime over the two-year period (indicator variable = 1, else 0). Given that accessing the stock market requires some fixed costs and a minimal level of wealth, we excluded respondents living in households with extremely low net worth (\leq \$S1000). The subsample used for this analysis is $n = 6177$, or 94% of the full sample.

3.2.3. Age-related asset diversification

The third financial behavior we examine concerns age-related investment diversification. 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 an optimal assessment at the individual level is quite complicated, the age-based glide path implied by the "100-minus-age" rule (defined as 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. Arshanapalli and Nelson, 2012; Bodie and Crane, 1997; and Mayer et al., 2011). 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 "100-minus-your-age" investment rule would suggest 40% of the portfolio be held in stocks (or risky assets, overall), and the remaining 60% in relatively safe assets like bonds.

To assess whether older respondents' investment patterns were similar to this rule, we categorized investments in stocks and mutual funds as risky assets, using either non-pension and/or pension money. The net value of a respondent's primary residence, and where applicable, the net value of a secondary residence, were also counted as risky assets. This approach is broadly consistent with numerous studies in the literature on household life cycle models (e.g. Cardak and Wilkins, 2009; Chang et al., 2018; to name just a few). Fig. 1, which plots the residential house price index in Singapore, documents the evolution of house values over the last four decades. It indicates that during the 2008 financial meltdown, residential property prices fell by over one quarter in real terms.

We defined the household's risky investment share as the net value of stocks, mutual funds, and real estate, all divided by total net

⁶ Previous work has defined the incurrence of an avoidable credit card late fee and/or penalty interest charges as a suboptimal financial behavior (Scholnick et al., 2013; Stango and Zinman, 2009). 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. Thus, for our purpose, a late credit card repayment is deemed to have occurred in a given month if the respondent rolled over credit card debt despite having sufficient checking and saving balances, leading to the imposition of an interest charge for that month.

⁷ 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. For the very small number of missing values for checking and saving balances (<10 cases) in 2016, 2017, or 2018, we impute using the observed balances in the adjacent year.

⁸ Specifically, we computed at the respondent-level the average number of late repayments per year (continuous variable, range 0–12). The average number of late repayments per year 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. For persons who committed late repayments, we then extract the corresponding penalty interest charges for each rollover transaction from the data. This information was employed to compute the annualized costs associated with the observed late repayments by respondent across the two years of observation (see Online Appendix B for details).

⁹ 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>.)

¹⁰ 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 eligible savings, after meeting the set-aside requirements.

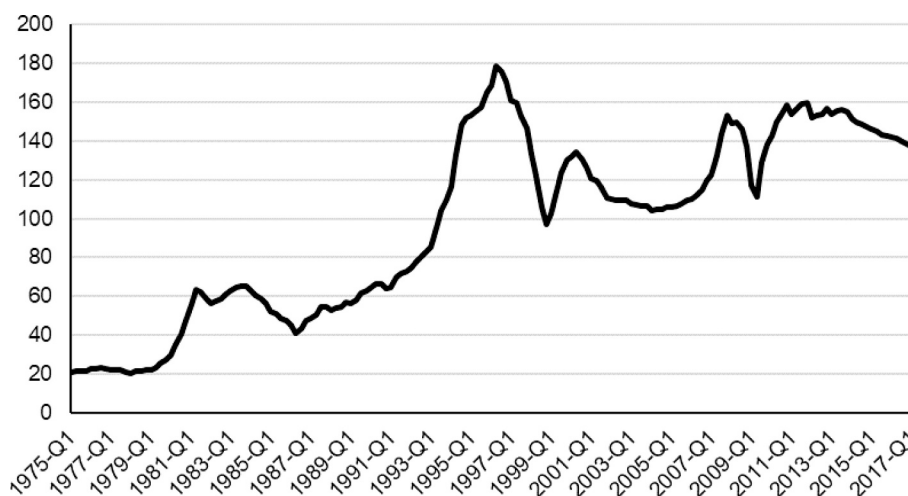


Fig. 1. Real residential house price index in Singapore over time.

The figure displays the time series of the private residential house price index in Singapore from January 1975 through June 2017. The nominal house price index is then adjusted to real terms using the annual consumer price index with base year 2014. Data are from the [Singapore Department of Statistics \(2019a, 2019b\)](#).

wealth in 2017.¹¹ Our dependent variable therefore measures adherence to the age-based glide path within a $\pm 10\%$ 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 = 1). Conversely, if the respondent's risky share did not fall within $\pm 10\%$ of the 100 minus his age percent, his financial behavior would not follow this rule (indicator variable = 0). Consistent with our sample selection criteria for stock market participation, we excluded respondents living in households with extremely low net worth ($\leq \$1000$), and those with incomplete information on portfolio allocation. We retain $n = 6318$, or 96% of the full sample, for this part of the analysis.

It is important to keep in mind the institutional framework for saving and investment in Singapore, and how its evolution over time has influenced older Singaporeans' portfolios. First, 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 invested in equity. Second, the government has provided financial incentives to purchase housing with CPF funds. In fact, the CPF explicitly permits borrowing for buying a primary residence, allowing young workers to contribute to their CPF accounts and then take out a mortgage repaid from their CPF contributions.¹² As a result, equity holdings are relatively low among many older Singaporean households, while housing makes up a large share of portfolios and the possibilities to diversify may be constrained. For example, a “house-rich” homeowner in old age 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.¹³ Nevertheless, even if these institutional factors provided a reasonable explanation for observed portfolio structures that do not conform to the age-based glide path, households will still be exposed to the associated imbalanced portfolio risk. Hence, we posit that it is useful to examine older Singaporean's adherence to the glide path and compare it to household investment behavior in other countries.

3.3. 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, 2011a, 2011b). 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:

- (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 \$102**, exactly \$102, less than \$102?

¹¹ We used asset information from 2017 instead of 2016 for this analysis because additional detail on asset allocation was included in the Jan/Feb 2017 module.

¹² 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.

¹³ 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, but take-up has been limited.

- (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 used 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,” 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.¹⁴

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. The average FinLit score in our sample is 2.02 (SD = 0.97). In Koh et al. (2018), using the same data from the SLP, we compared the findings on older Singaporeans’ financial literacy to that of older U.S. respondents in the 2011 RAND American Life Panel. In the same age group of 50–70 year-olds, 87% of U.S. respondents answered the interest rate question correctly, 86% answered the inflation question correctly, 43% responded to the risk diversification question correctly, and the average FinLit score was 2.16. Hence, we note that the average FinLit score among older Singaporeans is generally comparable to – but slightly lower than – that of similar-aged persons in the United States. Nonetheless, financial literacy in Singapore is probably higher compared to other countries in the Asia-Pacific region.¹⁵

3.4. 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 further control for home ownership and whether the respondent is working for pay. We also included an indicator for whether the respondent managed the household’s finances to account for individuals with experience in managing household finances and who therefore might be more likely to make financial decisions that are consistent with common financial advice. An indicator for high risk tolerance concerning financial decisions was also included. Finally, we controlled on total household income and total household net worth in logs (van Rooij et al., 2011), and indicators for missing values in key control variables.¹⁶

Table 1 presents descriptive statistics for the full sample ($N = 6573$). Respondents’ average age was 58.8; slightly over half (52%) were female; and over one-third (38%) had a post-secondary education (10+ years of schooling).¹⁷ The mean of the FinLit index score is 2.02 with a standard deviation of 0.97, implying that older Singaporeans averaged two of three correct answers to the “Big Three” questions. 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 were married (81%) and owned their homes (88%). Respondents’ self-assessed risk tolerance with respect to financial decisions was low: only 15% scored above 5 on a 0–10 scale, where 10 represents highest risk tolerance. Slightly more than half of the sample reported that they were currently employed and working for pay.¹⁸ Average annual household income was S\$60,554 (US\$42,388) and median income was S\$27,700 (US\$19,390). Mean total net worth was S\$1.16 M (US\$0.81 M), the median was S\$0.66 M (US\$0.46 M). Most of the respondents were in good health, while about one-third (34%) reported fair or poor health.

4. Results

We begin by presenting descriptive statistics on the three financial behaviors that are the focus of this study.

4.1. Timely credit card repayment

Of the 6573 older SLP respondents, about two-thirds (66%) held at least one credit card. This is consistent with recent evidence suggesting that credit card use is relatively lower among older Singaporeans compared to their younger counterparts, because the former exhibit a greater reliance on debit card spending (Agarwal et al., 2015).¹⁹ Among older cardholders, 91.9% (or 3969) paid off

¹⁴ 7766 out of 7882 persons (or 98%) aged 50–70 in December 2015 responded to all three questions (see Table A1).

¹⁵ For example, using data from the 2014 China Family Panel Studies which covered persons of all ages, Niu et al. (2020) found that 50.5% of respondents answered the interest rate question correctly, 58.8% answered the inflation question correctly, and 34.3% answered the risk diversification question correctly. See also Lee (2016) and Karekar (2015).

¹⁶ For further details on question wording and variable definitions, see Online Appendix B.

¹⁷ 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.

¹⁸ 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.

¹⁹ This could be because credit card firms require a minimum income for card application, or due to older Singaporeans’ preference to carry and use cash for daily transactions.

Table 1
Summary statistics for the full sample.

Variable	Means (SD)
Female	52%
Married	81%
FinLit Score	2.02 (0.97)
Age in Dec'15	58.8 (5.46)
<i>Age bands</i>	
50–54	27%
55–59	31%
60–64	23%
65–70	20%
<i>Education</i>	
Less than secondary	21%
Secondary	41%
Post-secondary	38%
Manage household finances	84%
Homeowner	88%
Risk tolerance (0–1 scale)	0.15
Work for pay	54%
Fair/poor health	34%
Annual income (S\$)	60,554 (145,422)
Median annual income (S\$)	27,700
Total net wealth (S\$'000 s)	1161 (1725)
Median total net wealth (S\$'000 s)	662
Financial wealth (S\$'000 s)	196 (421)
Median financial wealth (S\$'000 s)	50
N	6573

This table reports sample statistics for the sample, which includes respondents age 50–70 in the SLP® Dec 2015 wave. Percentages are shown for categorical variables. Means (and standard deviations in parenthesis) are shown for continuous variables. Approximately S\$1 = US\$0.7. For variable definitions and construction, see the Online Appendix.

any accrued balances every month over the 24-month period; 3.9% (168) rolled over their credit card debt despite having sufficient balances in their checking and saving accounts, and 4.3% (184) rolled over credit card debt when not having sufficient saving balances.

Failure to repay credit card balances in a timely manner is costly, and some respondents incur such charges more than once in a year. Fig. 2 shows the 352 respondents with late repayments sorted by the annualized frequency of failing to pay on time. The primary vertical axis of the Figure depicts the frequency (in percent) of the annualized number of late repayments per year in this subsample; the secondary vertical axis shows the corresponding median annualized penalty interest charges. About half of these individuals (47%) had three or fewer late repayments per year (first two bins) with a relatively modest median annual cost. However, the other half accrued substantial interest charges. The 10% of the sample with >3 to 6 late payments annually accrued median interest charges of S\$815 (mean S\$1894); and 16% of the sample had >6 to 10 late payments with a median annual cost of S\$1551 (mean S\$3153). Most notably, just over one quarter of this subsample had more than 10 late payments with a median annualized cost of S\$3640 and a much higher mean (S\$7777), indicating a skewed distribution that includes many higher values.

Table 2 reports the demographic and financial characteristics of respondents living in households with at least one credit card, sorted by repayment behavior. The first column represents people who always paid off their credit card balance on time in the 24-month period, while the next two columns focus on those with late repayments, differentiating whether the household probably had sufficient balances for timely payments or faced liquidity constraints. The 92% of credit card holders who always repaid on time tended to be slightly older, had higher FinLit scores, and were somewhat more likely to manage the household's finances. There were also large wealth differences across the three groups: mean and median total net wealth of respondents who always repaid on time (S\$1.56 M and S\$952 thousand respectively) was substantially higher than for those with at least one late payment who had sufficient liquidity (S\$1.414 M and S\$717 thousand); this, in turn, was substantially higher than mean and median total net wealth of those with late payments who lacked liquidity. The patterns for financial net wealth are similar. The incomes of those always paying on time and those with late payments with sufficient liquidity were not that different, but those with insufficient liquidity had much lower incomes. The patterns are consistent with Jørring (2018) who showed that U.S. consumers who paid avoidable late fees were less wealthy than those who rarely exhibited this costly financial behavior. As such, credit card debt rollover behavior can exacerbate wealth inequality over the life-cycle.

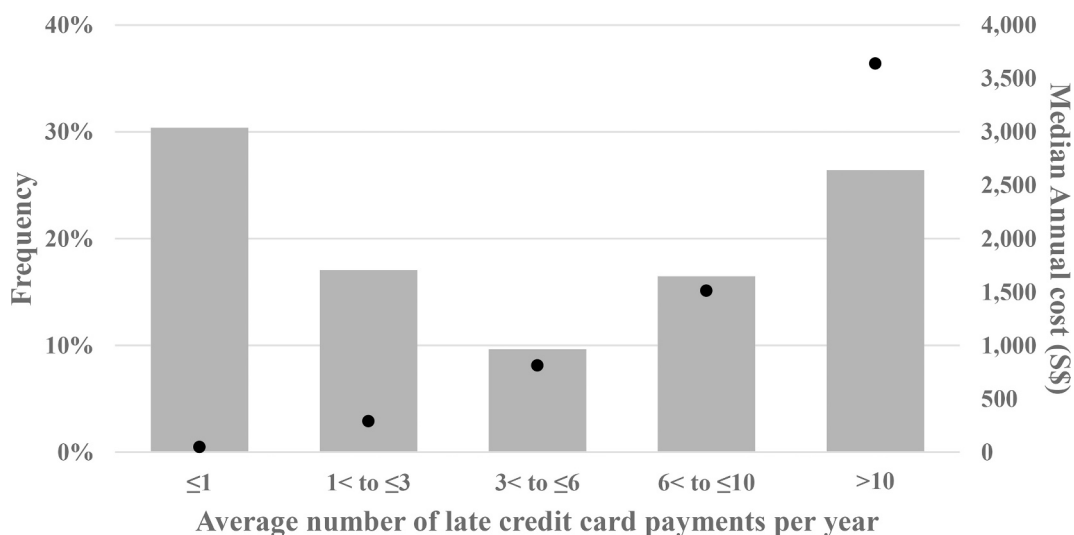


Fig. 2. Frequency of late credit card repayments and median annualized costs.

The figure displays the distribution of credit card holders who rolled over debt at least once during the 24-month period. The 352 persons with late repayments are sorted into bins based on their average number of errors committed per year. The black dots show the median of annual penalty interest charges incurred by individuals in the respective bin.

Table 2

Characteristics of respondents by credit card repayment behavior.

	Timeliness of Credit Card Payments		
	Always on time	Late, sufficient liquidity	Late, but insufficient liquidity
Baseline age	58.3	57.4	56.3
FinLit score	2.2	2.0	1.8
Post-secondary education	51%	51%	35%
Manage household finances	87%	84%	83%
Total net wealth (S\$'000 s)	1558	1142	638
Median total net wealth (S\$'000 s)	952	717	458
Financial wealth (S\$'000 s)	291	160	10
Median financial wealth (S\$'000 s)	117	32	0
Annual income (S\$)	82,174	72,242	47,743
Median annual income (S\$)	46,804	50,333	25,773
N	3969	168	184
%	92%	4%	4%

This table provides the summary statistics of 4321 credit card holders based on their credit card repayment behavior assessed monthly over a two-year period (2016 and 2017). Mean values of the characteristics are shown unless otherwise stated.

4.2. Stock market participation

Next, we analyze investment in stocks and mutual funds for respondents with total net wealth exceeding S\$1000. Table 3 shows that 42% of the older respondents invested in stocks or mutual funds: 26% (or 1596 persons) invested in both years, and 16% (or 1012 persons) in a single year, while 58% held no stocks or mutual funds over the two-year survey period. Among older Singaporeans who invested, shares (or stocks) were the preferred asset class. For example, 88% 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 money, rather than pension assets. Among respondents who invested both years, 74% used private savings only, 7% used CPF savings only, and 19% used both channels (among respondents who invested in a single year, 84% used private monies only, 11% used CPF savings only, and 4% used both).

Table 3 reports the demographic and financial characteristics of respondents by stock market participation. Those who participated were more educated, scored higher on the financial literacy index, and had higher wealth holdings: specifically, among older adults who held stocks, 48–63% had a post-secondary education compared to 25% of those holding no stocks. The average FinLit index score of those holding stocks was 2.3–2.5, while it was lower among non-stock holders (1.8). Net worth of those who consistently held stocks averaged S\$2.21 M, almost three times that of those owning no stocks (S\$0.73 M). The median of financial net wealth among those not participating in the stock market was S\$14,000. The fraction always paying off credit cards in a timely manner was lower among non-stockholders (88% vs 96%).

Table 3
Characteristics of respondents with and without stock market participation.

	Participate		Did not participate
	both years	one year only	
Baseline age	58.8	58.5	58.8
FinLit score	2.5	2.3	1.8
Post-secondary education	63%	48%	25%
Manage household finances	89%	86%	82%
Total net wealth (S\$'000 s)	2211	1362	726
Median total net wealth (S\$'000 s)	1495	874	509
Financial wealth (S\$'000 s)	517	201	68
Median financial wealth (S\$'000 s)	287	99	14
Annual income (S\$)	108,532	75,697	39,535
Median annual income (S\$)	61,567	43,020	19,957
% always paying credit card balance on time	96%	92%	88%
<i>N</i>	1596	1012	3569
%	26%	16%	58%

This table provides the summary statistics of 6177 respondents based on their stock market participation assessed annually over a two-year period (Jan/Feb 2016 and Jan/Feb 2017). Only respondents with non-missing information on total net wealth and asset allocation, and total net wealth >S \$1000, are included in this tabulation. The 'Did not participate' column comprises respondents who held no stocks or mutual funds over the entire two-year period. Mean values of the characteristics are shown unless otherwise stated. The statistics shown for "% always paying credit card balance on time" are computed only over the subsample of credit card holders.

4.3. Age-linked glide paths for risky assets

We next focus on respondents with total net wealth exceeding \$1000 and who provided complete information on how their assets were allocated. For this subset, we determine whether their share of risky assets declined with age according to the age-related glide path. Interestingly, only 18% ($N = 1116$) did so within $\pm 10\%$ bounds. Almost two-thirds of the total sample "over-invested" in risky assets, while 17% "under-invested" (see Table 4). Of the three risky asset classes we considered (stocks, mutual funds, and real estate), the largest component was typically real estate held in the form of the primary residence. Thus 79% (3259 of 4138) of those holding risky portfolios for their age had home values exceeding 50% of their net wealth, while 52% (2171 of 4138) had home values exceeding 70% of their net wealth. Such large holdings in risky home equity substantially surpasses the risky asset bounds prescribed by the 100-minus-age rule, which based on the sample's mean age of around 60 works out to only 40%. Conversely, persons who under-invested either did not own a home or had relatively low home equity.²⁰

The policy of encouraging homeownership espoused over the past five decades renders it unsurprising that so many older Singaporeans hold so much of their assets in a single property. Nevertheless, housing has proved to be a rather risky investment, inasmuch as those inhabiting older flats are now learning that these are depreciating assets (Silvam, 2018). Of course, having a home provides a stream of housing services protected from price fluctuations (while living in the same home), and as an investment, a home can provide old-age resources. But it is also important to note that older peoples' home values are uncertain in the current environment.

4.4. Financial behaviors across multiple dimensions

Thus far, we have examined the financial behaviors separately. Since we have three distinct measures of efficacy in relation to several domains of financial decision-making (i.e. timely credit card repayment, stock market participation, and balancing risk in one's investment portfolio), it is also worth *jointly* examining these financial decisions at the individual level. Inasmuch as those without credit cards could not make late repayments, the analysis uses only the subset of 4321 credit card holders (or 66% of the full sample).²¹ We find that 35% adhered to one of the three financial behaviors, 47% adhered to two, and 13% adhered to all three (see Table 5). Thus on the positive side, 60% of the respondents adhered to at least two of the recommended financial behaviors. Nevertheless, almost 5% of the sample failed to adhere to any of them. The more financially literate, better-educated, healthier, wealthier, and higher income respondents were also more likely to practice the three behaviors of interest.

To determine whether people were consistent across financial behaviors, we compute the correlations across the three behaviors. Table 6 shows that the correlations are all positive but fairly small. For example, the correlation between timely credit card repayments and stock market participation was 0.12, while it was 0.15 for stock market participation and following the age-based investment glide path. The correlation between timely credit card repayments and following the 100-age glide path was 0.06. These low correlations may be attributable to different factors driving each behavior. For instance, those who do not repay their credit cards on time, despite having sufficient liquidity, most probably lack self-discipline or have poor financial habits (see, e.g., Thaler, 2000). Stock non-participation may be the result of ambiguity aversion (Dimmock et al., 2016), while not following the age-based glide path may

²⁰ 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.

²¹ This is the same subsample identified in Table 2.

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	56.7	58.0	59.6
FinLit score	2.3	1.9	2.0
Post-secondary education	52%	35%	35%
Manage household finances	88%	81%	85%
Home owner	95%	60%	94%
Total net wealth (S\$'000 s)	1350	816	1238
Median total net wealth (S\$'000 s)	1039	455	637
Financial wealth (S\$'000 s)	291	167	185
Median financial wealth (S\$'000 s)	160	25	35
Annual income (S\$)	86,672	65,992	54,282
Median annual income (S\$)	58,833	18,435	25,679
% always paying credit card balance on time	95%	89%	91%
N	1116	1064	4138
%	18%	17%	65%

This table provides the summary statistics of 6318 respondents based on whether they follow the investment age-rule assessed at a single time point over a two-year period (Jan/Feb 2017). Only respondents with non-missing information on total net wealth and asset allocation, and total net wealth >S\$1000, are included in this tabulation. The 'follow age-rule' column comprise respondents who have allocations in risky assets within $\pm 10\%$ of 100 minus their individual age. Mean values of the characteristics are shown unless otherwise stated. The statistics shown for "% always paying credit card balance on time" are only computed over the subsample of credit card holders.

Table 5
Characteristics of respondents by degree of adherence to recommended financial behavior.

	Number of recommended financial behaviors adhered to (out of 3 assessed)			
	Zero	One	Two	All Three
Baseline age	56.8	58.3	58.7	56.7
FinLit score	1.7	2.0	2.4	2.5
Female	44%	51%	50%	45%
Married	84%	84%	84%	86%
Post-secondary education	31%	38%	58%	62%
Manage household finances	82%	85%	88%	88%
Home owner	84%	88%	92%	96%
Risk tolerance	20%	12%	22%	21%
Work for pay	59%	58%	56%	63%
Fair/poor health	37%	32%	30%	29%
Annual income (S\$)	39,973	54,548	97,527	102,809
Median annual income (S\$)	25,500	30,500	57,000	76,500
Total net wealth (S\$'000 s)	610	949	1952	1716
Median total net wealth (S\$'000 s)	447	635	1186	1392
Financial wealth (S\$'000 s)	9	99	389	430
Median financial wealth (S\$'000 s)	0.5	25	186	271
N	201	1531	2016	573
%	5%	35%	47%	13%

The three indicators of adherence to common financial advice that are assessed include: timely credit card repayment, stock market participation, and age-appropriate wealth holdings in risky assets. The subsample of 4321 respondents who are credit card holders are included in this analysis; respondents with no credit cards are excluded.

Table 6
Correlation matrix.

	Always timely credit card repayment	Stock participation	Follow investment age-rule
Always timely credit card repayment	1.00		
Stock participation	0.12	1.00	
Follow investment age-rule	0.06	0.15	1.00

This table shows the correlations across the three financial behaviors assessed (Always timely credit card repayment: =1 if always paid credit card debt on time over the 24-month period. Stock market participation: = 1 if held stocks or mutual funds sometime over the 24-month period. Follow investment age-rule: =1 if % total net wealth in risky assets within $\pm 10\%$ of 100-minus-age investing rule, 0 otherwise). The subsample of 4321 respondents who are credit card holders are included in this analysis; respondents with no credit cards are excluded.

reflect individuals' lack of awareness of the riskiness of holding much wealth in a single home or lack of knowledge how to diversify their portfolio while holding on to their primary residence. They could, for example, take advantage of the Lease Buyback Scheme that was introduced in Singapore in 2009.

4.5. Regression results: Three financial behaviors

Table 7 presents our estimates from three separate multivariate Probit regressions corresponding to the three financial behaviors of interest. Marginal effects are reported in all columns of the Table. The first column shows credit card holders' propensity to always repay credit card balances in a timely fashion. We find a statistically significant association between the outcome variable and the main covariate of interest, although the effect size is small: a one unit higher FinLit score was associated with a 1.5 percentage points ($p < 0.01$) higher propensity to always repay the credit card on time. Higher wealth, lower risk tolerance, age, and not currently working were predictive of a higher probability of timely credit card repayment. One possible explanation for why Singaporeans who work for pay are less likely to always pay off credit card balances on time might be that they are more likely to be pressed for time.

The results in the second column of Table 7 confirm that financial literacy was significantly and positively associated with stock market participation, holding other factors constant: a one-point higher FinLit score was associated with 8.3 percentage points higher propensity of investing in stocks ($p < 0.01$). In other words, those who were more financially savvy were also more likely to own stocks and/or mutual funds. Similar results in other countries have been reported by van Rooij et al. (2011), Calvet et al. (2007), and Guiso et al. (2003).

While some people may avoid the stock market due to lack of knowledge, other individuals do so because they lack the means. Our results show that higher income and wealthier older adults were more likely to participate in the stock market, indicating support for the entry cost hypothesis discussed earlier. Investing in stocks and mutual funds requires learning and setup costs which are worthwhile only if deployable assets are sufficiently large. Better-educated individuals were also more likely to participate in the equity market. Conversely, those who were married, currently working, and owned a house, were less likely to invest in stocks.

In contrast with studies focusing on Western populations, stock market participation in Singapore is higher at older ages: the positive statistically significant coefficients for age groups 60–64 and 65–70 imply that older people were more likely to own stocks compared to their relatively younger peers. In fact, respondents age 60+ were about 5 percentage points more likely to participate in equity markets 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 held substantial shares and unit trust investments. This may be a unique cultural phenomenon, where retired Singaporeans demonstrate a general preference for stock investing and taste for risk when they have more time to devote to investments.

The results in the last column of Table 7 show that more financially savvy respondents tended to follow the age-based investment rule, although the estimated effects are smaller than for stock market participation. On average, a one-point higher the FinLit score was associated with a 1.7 percentage point ($p < 0.01$) higher probability of following the age-based rule, holding other factors constant. We also find that the probability of following the age-based glide path was lower among relatively older groups. For instance, respondents age 60–64 were 7.5 percentage points less likely to do so, compared to their younger counterparts, while those age 65–70 were 12.5 percentage points less likely to do so. This may be because, for individuals at advanced ages, large investment holdings in (risky) home equity surpasses the rather narrow risky asset bounds prescribed by the 100-minus-age rule.²² Similar to the regression results for stock market participation, both income and total net wealth are positively associated with following the investment age-rule at the 1% significance level.

4.6. Regression results: Financial behaviors across multiple domains

Recalling that correlations across the three financial behaviors were relatively low, Table 8 explores the multivariate relationships, using the number of financial behaviors that each respondent complied with as the dependent variable. Here we see that a one-unit higher FinLit score was associated with an estimated 0.115 unit ($p < 0.01$) higher number of adhered to financial behaviors. The effect of education was also notable: having secondary and post-secondary education were associated with greater adherence, that is, a 0.198 unit ($p < 0.01$) and 0.269 unit ($p < 0.01$) higher number of recommended financial behaviors, respectively. Additionally, wealthier persons, as well as those with higher income were also more likely to exhibit higher adherence. By contrast, those who were older (aged 65–70) and married individuals tended to follow fewer of the recommended financial behaviors.

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, 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 (Delavande et al., 2008; 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

²² 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%.

Table 7
Association between financial literacy and various recommended financial behaviors.

Variable	Always timely credit card repayment		Stock participation		Follow investment age-rule	
	Probit		Probit		Probit	
FinLit Score	0.015	**	0.083	**	0.017	**
	(0.005)		(0.009)		(0.006)	
Female	0.015	*	0.028	*	-0.015	
	(0.006)		(0.012)		(0.008)	
Married	-0.007		-0.120	**	0.016	
	(0.010)		(0.021)		(0.013)	
Age (Ref. group: 50–54)						
55–59	0.021	*	0.012		-0.040	**
	(0.009)		(0.019)		(0.011)	
60–64	0.037	**	0.050	*	-0.075	**
	(0.009)		(0.022)		(0.011)	
65–70	0.030	**	0.050	*	-0.125	**
	(0.010)		(0.025)		(0.010)	
Education (Ref. group: Less than secondary)						
Secondary	-0.025		0.215	**	0.087	**
	(0.015)		(0.022)		(0.017)	
Post-secondary	-0.016		0.301	**	0.097	**
	(0.015)		(0.025)		(0.019)	
Manage HH finances	0.019		0.003		0.007	
	(0.012)		(0.020)		(0.013)	
Home owner	-0.009		-0.195	**	0.054	**
	(0.013)		(0.032)		(0.015)	
Risk tolerance	-0.046	**	0.113	**	-0.014	
	(0.012)		(0.021)		(0.013)	
Ln total net wealth	0.029	**	0.182	**	0.017	**
	(0.005)		(0.013)		(0.005)	
Ln annual income	0.002		0.031	**	0.014	**
	(0.003)		(0.005)		(0.004)	
Work for pay	-0.021	*	-0.051	**	0.028	**
	(0.008)		(0.016)		(0.010)	
Fair/poor health	-0.007		0.014		0.000	
	(0.009)		(0.016)		(0.010)	
<i>N</i>	4321		6177		6318	
<i>Pseudo R-sq</i>	0.10		0.25		0.09	
<i>BIC</i>	2407.8		6520.5		5578.3	
<i>Mean of dep. var.</i>	0.92		0.42		0.18	
<i>Std.dev of dep. var.</i>	0.27		0.49		0.38	

This table shows the effect of financial literacy on timely credit card repayment, stock market participation, and portfolio risk exposure (shown in bold for emphasis). Marginal effects and robust standard errors (clustered at the household level) from separate Probit regressions are reported. The first column reports estimates of financial literacy on timely credit card repayments (=1 if always timely, 0 otherwise; mean = 0.92). The second column reports the estimates of financial literacy on stock market participation (=1 if stocks or mutual funds held over entire 24-month period, 0 otherwise; mean = 0.42). The last column reports the estimates of financial literacy on whether follow investment age-rule (=1 if % total net wealth in risky assets within $\pm 10\%$ of 100-minus-age investing rule, 0 otherwise; mean = 0.18). Other controls not shown include indicator variables for race and for missing values of controls. ** and * indicate statistical significance at the 1%, and 5% level, respectively. BIC refers to Bayesian information criterion.

diversification, requiring care to identify and, especially, to quantify the causal relationships.

5. Robustness analysis

We conducted sensitivity analyses along two dimensions. First, we explored whether the main results are robust when using 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 individuals have to repay their credit card debts or with which to buy stocks.²³ The estimated effects of the FinLit index, our main explanatory variable of interest, are largely robust to this empirical variation (see Online Appendix A), although the point estimates are a little smaller. In the Probit regression of timely credit card repayments, a one unit higher FinLit score is associated with a 0.8% ($p < 0.10$) higher likelihood of always repaying on time, which is about half the size of the earlier point estimate in the regression when controlling for total net wealth. With respect to stock market participation, we find a one-point higher FinLit score is associated with a 6.8

²³ We did not include in this set of reported robustness checks the model for the investment age-rule, because the investment rule derives a recommendation for the fraction of *total* wealth that should be invested in risky assets. While the recommendation is independent of the wealth level, to the extent that there are fixed costs and returns to scale, total wealth may nevertheless have predictive power in these descriptive regressions for whether or not someone adheres to the age-glide path.

Table 8
Association between financial literacy and adherence to recommended financial behaviors.

Variable	Coefficients (SE)	
FinLit Score	0.115 (0.014)	**
Female	0.016 (0.018)	
Married	-0.076 (0.031)	*
Age (Ref. group: 50–54)		
55–59	-0.003 (0.030)	
60–64	-0.002 (0.033)	
65–70	-0.078 (0.035)	*
Education (Ref. group: Less than secondary)		
Secondary	0.198 (0.036)	**
Post-secondary	0.269 (0.038)	**
Manage HH finances	0.046 (0.032)	
Home owner	-0.056 (0.040)	
Risk tolerance	0.023 (0.029)	
Ln total net wealth	0.172 (0.016)	**
Ln annual income	0.033 (0.008)	**
Work for pay	-0.036 (0.024)	
Fair/poor health	0.003 (0.025)	
<i>N</i>	4321	
<i>R-squared</i>	0.18	
<i>BIC</i>	9175.3	
<i>Mean of dep. var.</i>	1.69	
<i>Std.dev of dep. var.</i>	0.76	

This table reports the association between financial literacy and the number of financial behaviors adhered to (range 0–3; mean = 1.69). Coefficients and robust standard errors (clustered at the household level) from an ordinary least squares regression are reported. The three financial behaviors are timely credit card repayment, stock market participation and following the investment age-rule. Other controls not shown include indicator variables for race and for missing values of controls. ** and * indicate statistical significance at the 1%, and 5% level, respectively. BIC refers to Bayesian information criterion.

percentage point ($p < 0.01$) greater probability of stock market participation, controlling for financial net wealth, and holding other factors constant (compared to the previous estimate of 8.3 percentage points).

Second, we assessed how the proportion following the age-based glide path changes when we use wider risky asset bounds. Previously we showed 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 allow for this investment practice, for instance using $\pm 20\%$ (instead of $\pm 10\%$) 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 classified as contravening the conventional age-based glide path. Using this wider bound increases the fraction of respondents who we can characterize as adhering to the glide path, from 18% to 34%. Results provided in Online Appendix A show that 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 3.7% higher probability of following the age-related investment glide path ($p < 0.01$), holding other factors constant. Accordingly, this analysis confirms that financial literacy plays a substantive role in guiding financial behaviors at older ages.

6. Conclusions

This paper explored older persons' financial behaviors in later life and examined the role of financial literacy as a predictor of practices generally recommended as protective against financial distress. Using the Singapore Life Panel®, we examined three financial behaviors exhibited by older adults, aged 50–70. We found that 92% of older Singaporean credit card holders always paid off their credit card balances on time over a 24-month period, and 42% participated in the stock market. Yet only 18% followed an age-based glide path for their risky investments. Taken together, about 60% of older Singaporeans adhered to at least two of the three

recommended financial behaviors; moreover, 13% adhered to all three while 5% violated all three. Our multivariate analysis shows that financially savvy individuals were more likely to make better financial decisions, controlling for other factors. A one-unit higher literacy score was associated with a 1.5 percentage point ($p < 0.01$) higher likelihood of consistently repaying credit card balances on time; an 8.3 percentage points ($p < 0.01$) greater chance of stock market participation, and a 1.7 percentage points ($p < 0.01$) higher chance of adhering to an age-appropriate investing guideline. Higher wealth also consistently predicted better financial decisions. Among the age group we studied, relatively older respondents, that is, those in their 60s compared to those in their early 50s, were more conscientious about repaying credit card balances and more likely to invest in stocks, but they were less likely to have risk adjusted their investment portfolios, mainly due to the value of the owned primary residence dominating their portfolios. Government policies in Singapore have encouraged home ownership by providing access to pension savings for servicing of mortgages. For many older households this has resulted in asset portfolios that are disproportionately invested in housing.

Our findings are generally consistent with the literature on adults in Western countries which document a positive relationship between financial literacy and investment skill (Calvet et al., 2007; Klapper et al., 2013; Scholnick et al., 2013; Stango and Zinman, 2009; van Rooij et al., 2011). It is worth recalling that – similar to their Western counterparts – older Singaporeans we studied here 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.

We further verified that the strong association observed between financial literacy and each of the three potentially costly financial behaviors was 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 financial decision-making. For example, we found that education was an important predictor of diversified household investment portfolios, but not for timely credit card repayments, when also controlling for financial literacy.²⁴ One interpretation is that investment-related decisions are linked to the capacity to acquire knowledge and learn concepts (e.g., the 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.'s (2013) observation that education can have a significant impact when the decisions are made rarely and are difficult to understand (e.g., investment-related decisions), but education may have a smaller impact when decisions are made frequently and are easy to understand (e.g., monthly credit card repayments).

Our findings are also relevant to broader policy considerations. The fact that costly credit card rollovers are concentrated among a small group of older individuals, while lack of diversification is widespread, suggests that policy interventions might be differentially targeted. Financial literacy programs on investment and saving can aim for broad reach through platforms such as school-based programs and training for the elderly.²⁵ By contrast, financial education on debt and credit card management will likely be more effective if targeted at specific subgroups of the older population. Regulators and industry could explore financial products that help “nudge” older consumers’ behaviors: for example, automatic bill payment systems may help reduce credit card fees.²⁶ Additionally, financial products permitting homeowners to extract equity from their properties like the Lease Buyback Scheme in Singapore could be beneficial in terms of helping older individuals better diversify their property holdings, though few Singaporean households have taken advantage of this program since its introduction in 2009. Target-date investment funds could also be introduced to encourage older individuals to hold portfolios that rebalance along age-linked glide paths (Mitchell and Utkus, 2020). Some effort has been made towards this direction in recent years; for instance, the Singapore 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.²⁷ Future research on household financial decision-making covering longer follow-up periods and with finer-grained transaction data will be required to investigate further how credit card repayment, borrowing behavior, and age-linked risk diversification varies with financial literacy.

Declaration of Competing Interest

This is to confirm that all authors have no competing interests. Moreover all authors had full access to the data analyzed in this study and take complete responsibility for the integrity of the data and the accuracy of the data analysis.

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²⁴ 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.

²⁵ 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 + .

²⁶ 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.

²⁷ This program, known as the CPF Lifetime Retirement Investment Scheme, is still under discussion (see Fong and Koh, 2018).

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pacfin.2020.101481>.

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