Intentional Bequest Motives and the Choice of Annuity

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Abstract

This paper identifies the intentional bequest motive by exploiting the choices between two compulsory partial annuity plans with committed bequest in Singapore: a lower-bequest higher-payout plan, and a higher-bequest lower-payout plan. About 20% of our sample choose the higher-bequest option, supporting the existence of the intentional bequest motive. The bequest motive is driven by altruism and the joy of giving. Structural estimation and simulation show that people with bequest motives leave 8% – 18% more bequests than those without, which implies that the ratio of the annual inheritance flow to national income is about 10%.

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1 Introduction

Intergenerational transfers are widely recognized as a significant contributor to capital accumulation, with bequests being a major form of such transfers (Kotlikoff and Summers, 1981; Gale and Scholz, 1994; Piketty, 2011).[1,2] These bequests are also an important determinant of wealth distribution (De Nardi, 2004; Benhabib et al., 2011; Piketty, 2014).[3] The bequest motive influences the purchases of insurance products, including life insurance, annuities, and long-term care insurance (Ameriks et al., 2011, 2020; Koijen et al., 2016; Lockwood, 2012, 2018).[4] As a result, understanding bequest motives is crucial for policymakers to design effective government policies such as public debt, social security, taxes, and Medicaid (Barro, 1974; Dynan et al., 2004; De Nardi et al., 2016).[5]

The debate over the relative importance of precautionary savings motives and intentional bequest motives in explaining intergenerational transfers remains unresolved in the existing literature. Precautionary savings are typically motivated by health and longevity risks, leading individuals to hold onto wealth at the time of death to avoid low levels of consumption, which may then be passed down to heirs as accidental bequests.[6] However, people can also make intentional bequests to their children as they care for them. It is still an open question whether there are intentional bequest motives. The relative importance between life-cycle savings and intergenerational transfers depends on whether bequests are left accidentally or intentionally. If people leave bequests accidentally, then we underestimate the role of life-cycle wealth and overestimate the role of intentional intergenerational transfers. While some (e.g. Hurd, 1987, 1989; De Nardi et al., 2010) do not find any supporting evidence for the intentional bequest motive, others (e.g. Ameriks et al., 2011; Koijen et al., 2016; De Nardi et al., 2016; Lockwood, 2018)

[1] Kotlikoff and Summers (1981) find that about 80% of the household net worth is due to intergenerational transfers in the United States, while Modigliani (1988) finds that only 20% of capital accumulation can be traced to intergenerational transfers and that 80% of that is due to life-cycle savings. Piketty (2011) predicts that the ratio of the annual inheritance flow to national income in France might reach 20%-25% by the year 2050, which corresponds to a capitalized bequest (inherited wealth) share in total wealth accumulation well above 100%.

[2] The other form of intergenerational transfers is *inter vivos* transfers.

[3] De Nardi (2004) finds that voluntary bequests can explain the emergence of large estates and the upper tail of the wealth distribution, while accidental bequests alone cannot generate the wealth concentration of the data. Benhabib et al. (2011) show that bequest motives and inheritances are critical mechanisms for generating fat tails of wealth distribution in a model with idiosyncratic investment risks.

[4] Ameriks et al. (2011, 2020) and Lockwood (2012) also point out that understanding the bequest motive affects financial product design.

[5] Barro (1974) shows that a sufficient condition for changes in government debts so that they have no impact on agent's consumption plans and, hence, no effect on aggregate demand and interest rates in the economy, is that current generations are connected to future generations through a chain of operative intergenerational transfers. Without bequest motives, the Ricardian equivalence may fail.

[6] Palumbo (1999) and De Nardi et al. (2010) focus on out-of-pocket medical costs as a driver of precautionary savings. Meanwhile, Kopecky and Koreshkova (2014), Lockwood (2018) and Ameriks et al. (2020) highlight the significance of long-term care and nursing home expenses. Long-term care expenditures represented over 8.5% of total health expenditures for all ages, or roughly 1.2% of GDP in the United States in 2004 (Brown and Finkelstein, 2008).

show that intentional bequest motives indeed exist. The difficulty of empirically identifying intentional bequests arises from the fact that an increase in savings increases both precautionary savings and accidental bequests. There is no separate account for committed bequests.

In order to identify intentional bequest motives, we utilize a distinctive institutional setting in Singapore that involves partial annuity plans with committed bequest. The Singaporean government implemented a compulsory life annuity scheme on January 1, 2013, which replaced the existing limited term payment of retirement funds with a partial annuity scheme. This scheme has two exclusive features that allow us to identify bequest motives. Firstly, it is mandatory for all eligible members. Secondly, it offers two annuity options - one with lower-bequest and higher-payout (the default plan) and another with higher-bequest and lower-payout. Since the bequest amounts are explicitly defined at the time of enrolling and members cannot modify their plans once they have made their choices, this mandatory annuity scheme exposes the value of committed bequests.

The unique setting helps us to separate intentional bequest motives from precautionary savings: actively choosing the higher-bequests and lower-payout plan only increases the committed bequest but does not increase precautionary savings to cope with medical or longevity risks. In the absence of intentional bequest motives, all members should choose the default lower-bequest plan. Observing a considerable proportion of people choosing the higher-bequest plan provides strong support for the existence of intentional bequest motives. This strategy has one main advantage over previous studies: we do not rely on strong assumptions to identify intentional bequest motives. The main assumption we need is that people understand the trade-offs between these two plans.

Our identification approach is reminiscent of the method used by Laitner and Juster (1996). They examined whether individuals have intentional bequest motives by analyzing annuity payment selections with and without guarantees among those enrolled in the Teachers Insurance and Annuity Association-College Retirement Equities Fund (TIAA-CREF). With guarantees, the heirs of a retiree receive the remaining payouts from the annuity if the retiree passes away within a set number of years. For instance, a 10-year guarantee would ensure that the beneficiaries receive any remaining annuity payments if the retiree dies within 10 years. Their reduced form analysis found that 73% of families with children chose joint annuities with guarantees, leading them to conclude that individuals do have intentional bequest motives.[7]

To implement the empirical investigation of bequest motives, we combined three different methods. The first approach uses the actual choice of annuity plans, the "revealed preference"

[7]See Brown et al. (2019) for discussions on more recent TIAA plans.

approach.[8] The second uses the hypothetical choice of annuity plans in the survey, the "reported preference" approach. In the third approach, we asked people to allocate real lottery tickets to their children.

We surveyed more than 2,000 households from a representative sample of people aged around 55 at the time of the survey, the age of making their annuity enrollment decisions. Our analyses show that about 20% of our sample individuals choose the higher-bequest plan, suggesting that a significant proportion of people indeed leave bequests intentionally. Since the lower-bequest plan is the default choice, our estimate of the intensity of intentional bequest motives is the lower bound. We also checked their understanding of the difference between those two plans, and found supporting evidence for our assumption that many people know the trade-offs between these two options. We find that having children and higher education are positively correlated with the likelihood of intentionally leaving bequests, which is consistent with Koijen et al. (2016).

After establishing that people leave intentional bequests, we delve into the reasons for doing so. These reasons are altruism, reciprocity, and joy-of-giving. If people leave bequests out of pure altruism, the amount of bequests they leave should depend on income (wealth) differences between their children and themselves. This feature is crucial for dynastic or infinite-horizon models. The testable prediction of altruistic motive is that income differences between the parent and child should have a negative correlation with the likelihood of selecting the higher-bequest plan. Reciprocity suggests that bequests are used to compensate heirs for services rendered, which implies that those who choose the higher-bequest plan should be visited more frequently by their children. Joy-of-giving suggests that people want to distribute their bequests equally among their children. To test the implications of altruism and reciprocity motives, we gathered information on people's beliefs about their children's financial security, their characteristics, and the frequency of their children's visits. We find that the probability of enrolling in the higher-bequest plan is negatively correlated with their children's financial security and their adult children's education levels. This evidence is consistent with the prediction of the altruism motive. We did not find any relationship between the frequency of children's visits, which is inconsistent with the prediction of the reciprocity motive.

We also examined *inter vivos* transfers, which are transfers made during the giver's lifetime and may be motivated by the same factors as bequests. For instance, Altonji et al. (1997) used inter vivos transfer data to test the altruism hypothesis and rejected it. To study inter vivos

[8] We borrow these terminologies from the literature on estimating marginal propensities to consume. In the "revealed preference" approach, preference information is drawn from people's actions in different situations. In the "reported preference" approach, preference information is drawn by asking people to report their choices in different hypothetical situations (Parker and Souleles, 2019; Fuster et al., 2021).

transfers, we used two incentive-compatible survey questions to investigate how individuals allocate potential lottery prizes to their children. We gave each respondent ten identical high-stakes lottery tickets with a minimum guaranteed prize pool amount of S$1 million (approximately US$720,000) before the draw date and asked them to distribute the tickets among themselves and their children. This approach is similar to the strategic survey questions used in Ameriks et al. (2011). Our findings indicate that over 70% of respondents gave at least one ticket to their children, suggesting an intention to make an inter vivos transfer. Furthermore, more than 80% of respondents distributed the tickets equally among their children, which supports the prediction of the joy-of-giving motive but contradicts the reciprocity motive.

To gain deeper insights into intentional bequest motives, we employ the Generalized Method of Moments (GMM) and use variations in people's choices of annuity plans to structurally estimate these motives within a life-cycle model. Our results reveal that households possess strong bequest motives and view bequests as luxury goods. Moreover, our research uncovers heterogeneity in bequest motives between households with and without children. Those with children have a stronger preference for leaving bequests, whereas those without children display a much weaker bequest motives. This result supports the commonly used assumption and childless people have weaker incentive to leave bequests.

To study how bequest motives and policy environments affect intergenerational transfers, we conduct several counterfactual policy simulations based on our structural estimation results. We consider counterfactual policy environments in two dimensions: whether retirement savings and annuity are compulsory, and to what extent retirement savings are annuitized. We find intentional bequest motives play an important role in intergenerational transfers. In our benchmark policy environment, with compulsory savings and partial annuities, similar to that in Singapore, intentional bequest motives increase average bequests by about 17.68%. In the policy environment with no compulsory saving and where the demand for annuity is very low, such as in the United States, intentional bequest motives increase average bequests by about 8.46%. The simulations show that, while intentional bequest motives have a similar impact on average bequests across different gender-education groups, the policy of partial annuities has a larger (negative) impact on males.

This paper related to two strands of literature. First, it contributes to the literature on differentiating between intentional and accidental bequest motives. Previous studies have taken two approaches. The first relies on making assumptions about individual preferences, such as Hurd (1987, 1989) assuming that those without children do not have any incentives to leave bequests, or Inkmann and Michaelides (2012) assuming that those purchasing life insurance plans

have bequest motives.[9] The second approach involves setting up a life-cycle model and using additional information beyond consumption and savings to structurally estimate preference parameters, as done in studies such as Ameriks et al. (2011), Koijen et al. (2016), and Lockwood (2018). We exploit the novel setting in Singapore where people need to choose between two partial annuity plans with different amount of committed bequests. The information revealed by people's choices is similar in nature to the insights gained from the answers to Ameriks et al.'s (2011) lock-box question. Our findings are consistent with a large body of literature that supports the idea that people indeed leave bequests intentionally (e.g., Bernheim, 1991; Inkmann and Michaelides, 2012; Kopczuk and Lupton, 2007; Ameriks et al., 2011; Lockwood, 2012; Koijen et al., 2016) without relying on any assumptions about individuals' preferences.

Second, our paper contributes to the literature on understanding the mechanisms behind intentional bequest motives. Intentional bequest motives may come from three sources: altruism, reciprocity, and joy-of-giving. Laitner and Juster (1996) find that people who plan to leave bequests have altruistic bequest motives. Bernheim et al. (1985) and Perozek (1998) provide evidence for reciprocity and strategic motives.[10] Our results support altruism and joy-of-giving motives, but do not support reciprocity.

2 Institutional background

Singapore's compulsory saving scheme, the Central Provident Fund (CPF), was created by the British colonial authorities in Singapore in 1955. Its modern form is a comprehensive savings plan to fund people's retirement, health care, and housing needs. Both employers and employees need to contribute a proportion of the worker's salary to the scheme. The contribution rate varies over time and age. At the end of 2018, the CPF had 3.91 million members with a total account balance of S$391,117 million (Singapore CPF Board, 2019), or S$100,030 per member, which is 32% of household financial assets and 21% of household net worth.

Before 2013, CPF was a self-funded pension system with no risk pooling. Members started to receive monthly payouts at an age that depended on their birth year. For example, people born in 1943 received payments at 60 while those born after 1954 received them at age 65. The account would be exhausted when a member reached age 80 for the older cohort or 85 for the

[9] Inkmann and Michaelides (2012) find that term insurance demand is positively correlated with measures of bequest motives like being married, having children, and/or subjective measures of strong bequest motives. These findings provide evidence supporting the presence of a bequest motive.

[10] Dynan et al. (2004) find no evidence that the saving behavior of households with children is significantly different from that of households without children. This suggests that the altruistic model cannot explain the saving patterns of households, which shows that high-income households have higher saving rates than low-income ones. Using estate tax return data in the United States, Wilhelm (1996) finds little support for the altruistic theory of bequests.

younger cohort. If a member died before the specified age, the remaining balance would be paid in a lump sum to the member's heirs. The amount of payouts depended on their account balances. As life expectancy grows steadily over time, more and more people will still be alive at 85. For instance, Singapore's life expectancy reached 83.2 at birth and 86.1 at age 65 (Singapore Department of Statistics, 2019) in 2018. More than half of the current 55-year-olds will still be alive at 85, and 15% will still be alive at age 95, 15 years after their CPF savings are depleted.

To address this issue, the Singapore government introduced the CPF Lifelong Income scheme for the Elderly (CPF LIFE) on January 1, 2013, a life annuity that provides a monthly payout until death. It is compulsory for Singapore Citizens or Permanent Residents. CPF members born after January 1, 1958, are automatically enrolled into the scheme when they turn 55 years old if they have at least S$40,000 in their retirement account at age 55, or S$60,000 at the payout eligibility age (65). Other members can opt into the scheme anytime between 55 and 80.

The CPF LIFE scheme consists of two plans: a default plan (Standard Plan), providing relatively higher monthly payouts and lower bequests conditional on death at given ages than the other plan, which will be referred to as the lower-bequest plan hereafter, an alternative plan (Basic Plan), providing relatively lower monthly payouts and higher bequests conditional on death at given ages than the default plan, which will be referred to as the higher-bequest plan hereafter. Between 2013 and 2015, the CPF board mailed invitation letters to its members in the month of their 55th birthday. The letter invited them to choose one of the two annuity plans within the following six months, and informed them that they would be automatically placed on the default low-bequest plan if they did not take any action. Within 30 days of the choice, the member could change the choice only once. Then there was no chance to change the choice.

As of the end of 2014, more than 140,000 people have participated in the scheme, and a total of S$509.5 million has been distributed since September 2009 (Singapore CPF Board, 2014). From January 1, 2016, people only need to choose their annuity plans from ages 65 to 70 at the point when they wish to receive the annuity payouts. The differences in monthly payouts and bequests are considerable (see section A.1). For instance, for a male born in 1958 with a balance of S$180,000 at age 55, his monthly payout is S$1,246 and he can leave a bequest of S$51,779 if he dies at age 75 and chooses the lower-bequest plan. His monthly payout will be reduced to S$1,149 and his bequest will be increased to S$171,006 if he dies at age 75 and chooses the higher-bequest plan.[11]

[11]Chile offers two main options for its pension plan: a programmed withdrawal schedule or a life annuity (Fajnzylber et al., 2016). There are notable distinctions between Chile's and Singapore's pension schemes.

Figure 1 shows the mortality-adjusted net present values (NPVs) for each plan by gender and account balance at age 55. The gender-specific mortality rates from the life table (Singapore Department of Statistics, 2019) is used to calculate the NPVs. Panels (a) and (b) show the mortality-adjusted NPVs of these two plans for males and females, respectively. The horizontal axis represents the retirement account balance at age 55. The vertical axis is the mortality adjusted NPVs. We observe that the two plans have very similar mortality-adjusted NPVs for both males and females. The NPVs of the higher-bequest plan is S$40–S$250 larger than the lower-bequest plan, which is less than 0.5% of the account balance. It suggests that these plans are designed to be equivalent in terms of NPV. Note that the calculation is based on the net present value of future cash flow, regardless of whether it is in the form of monthly payoffs or bequests. It does not reflect utility directly since subjects have different weights on monthly payoffs and bequests.

3 Research design

The compulsory annuity scheme gives us a unique opportunity to identify the existence of the intentional bequest motive: it asks people to choose between accounts with different amounts of committed bequests. Actively selecting the higher-bequest plan implies that an individual is willing to sacrifice their own consumption to commit to more bequests conditional on dying before certain age. We conducted surveys with more than 2,000 households from 2015 to 2016. We drew a random sample of households with at least one member aged 50–64 from the Singapore Department of Statistics. Because it is very difficult to enter private gated residents, we only surveyed households living in apartments built by the Singapore Housing and Development Board (HDB), which accounts for 82% of the Singapore resident population (Singapore Housing and Development Board, 2016). People living in HDB housing tend to be less wealthy than those living in other types of apartments.[12]

The survey consists of four parts. The first part collects socioeconomic information, such as age, gender, education, health status, life expectancy, and labor market status. The second part collects information on financial assets, such as home ownership, retirement account balance, and annuity choice. The third part collects information about the number of children individuals have, and their relationships with their children. The fourth collects information on individual's risk preference, time preference and social preference.

Firstly, unlike Singapore's annuity plan, Chile's does not provide bequests. Secondly, individuals make their selections at the time of retirement and have the flexibility to switch to a different plan later in Chile, whereas in Singapore, people choose their plans 10 years prior to retirement and are unable to change their decisions.

[12] According to the 2010 Singapore census, the monthly household income of 18.5% of HDB residents exceeded S$10,000, the corresponding number is 59% for households living in private apartments.

The last part of the survey consists of some contingent valuation questions that help us to understand the willingness to pay for bequests. We applied the contingent valuation method to elicit individuals' stated preferences under the changing conditions of the two annuity plans. The main tradeoffs between these two plans are the monthly payment before death and the bequest at death. We fixed the bequest amount and increased the monthly payment of the lower-bequest plan to find out how much individuals needed to switch from the higher-bequest plan to the lower-bequest plan. Similarly, we increase the monthly payment of the lower-bequest plan to find out how much individuals needed to switch from the lower to the higher-bequest plan.

To understand the mechanisms of transfer motives, we asked some incentivized strategic survey questions to learn how they allocate *inter vivos* transfers to their children. This idea is similar to questions posed in Ameriks et al. (2011). We explored the feature of TOTO lottery, a popular lottery game by Singapore Pools, to add incentives to these questions. The game is offered by Singapore Pools twice per week. For Ordinary Entry TOTO, a player pays S$1 to select 6 numbers from 1 to 49, and he wins a prize if he picked at least 3 of the Winning Numbers. The prize is S$10 for a Group 7 prize and may be over S$1 million for Group 1 prize. Appendix A.2 provides a detailed description of the lottery.

We gave ten lottery tickets of identical numbers to each subject and ask them two incentivized questions. In the first question, we asked them to distribute these tickets between themselves and their children. The purpose of asking this question was to measure the general bequest motives. In the second question, we asked them to allocate these tickets only to their children. The second question aimed to analyze how children's characteristics and behavior affected the allocation, which helps us understand the mechanisms of bequest motives. After they answered these two questions, we flipped a coin. If heads, we implemented the allocation given in the first question, otherwise we implemented the allocation given in the second question. We divided the lottery tickets into envelopes according to the subject's answer, one for each child. Then we sealed the envelopes and sent them to their children. Since the ten tickets were identical and the winning number would be drawn in the following few days, they allocated a potentially large amount of money to their children and their decisions were incentive–compatible.[13]

[13]Appendix A.3 provides a detailed description of the ticket allocation question.

4 Empirical results

4.1 The existence of intentional bequest motives

Table 1 presents the summary statistics for the key variables of our study. To assess the external validity of our results, we compare these statistics with national-level data. Since our sample consists of individuals within a tight age range, some differences between our sample and the population may be due to differences in age compositions. The average retirement account balance for our respondents is S$55,801, which is lower than the national average of S$102,474 in 2014 according to the Central Provident Fund Board (2022). Additionally, our sample median monthly wage is S$2,500, also lower than the population median of S$3,770 based on data from the Manpower Research & Statistics Department (2015). It is worth noting that lower-income individuals may be less likely to leave bequests, a finding that is supported by our analysis. Therefore, our estimates may underestimate the impact of bequests on wealth accumulation. Our sample is also characterized by a higher percentage of individuals living in a five-room flat than the national average of 27%, as well as a higher proportion of females (56.4% compared to the population mean of 50.3%), slightly more Chinese respondents (81.2% compared to the population mean of 79.6%), and a greater likelihood of having post-secondary education (28.6% compared to the population mean of 22.2%). Overall, the differences between our summary statistics and the national level statistics are in a reasonable range.

Among those who had already enrolled or were in the process of enrolling in one of the two annuity schemes at the time of the survey, 18.4% of them enrolled in the higher-bequest plan. Given the sample size of 746, the statistic is significantly different from 0 at the 1% level. Under the assumption that people understood the trade-offs between these two schemes, this evidence provides direct support for the existence of intentional bequest motives. We also asked our respondents qualitative questions about why they chose the lower or higher-bequest plan. For those who chose the lower-bequest plan, 21.1% answered "higher payout," and 21.5% reported "default plan" as the reason. Both statistics are significantly different from 0 even at the 1% level. For those who chose the higher-bequest plan, 28.4% answered "want to leave more bequest." These results provide qualitative evidence that people leave bequest intentionally.[14]

In addition to gathering data on actual choices made by respondents, we also posed a hypothetical scenario where we asked them to choose between the two retirement plans if they had S$100,000 in their retirement accounts at age 55.[15] This question clearly outlined the

[14] We used the information of the actual choice of the annuity plan ("revealed preference"), which is directly related to the bequest motive. We also employed a "reported preference" approach, when we used the hypothetical question about the choice of the annuity plan.

[15] Fuster et al. (2021) use survey questions about spending in hypothetical scenarios to investigate features

annual payout and bequest amount for each plan at different ages, which help our respondents to make informed decisions.[16] It is also worth noting that the hypothetical retirement account balance is considerably higher that the sample mean of S$55,801. Among the 2,005 respondents who answered this question, about 27% of them chose the higher-bequest plan, which is very close to the value reported in Singapore Parliament (2014), but larger than the proportion of people who actually chose the higher-bequest plan. Since participants were aware of the trade-off between payouts and bequests before making their hypothetical choices, this finding provides further evidence for the presence of intentional bequest motives.

For respondents who were already enrolled, their hypothetical plan choice ("reported references") was largely consistent with their actual enrollment status ("revealed preferences"), with 83% selecting the same plan. Given the fact that the hypothetical choice was made after revealing the trade-off between payouts and bequests, the high level of consistency between hypothetical and actual choices suggests that most individuals made informed decisions. The higher enrollment rate in the hypothetical decision could be due to two factors. First, knowing the tradeoff at the decision-making time encourages people to trade regular payouts for bequests. Second, the hypothetical account balance is higher than the actual balance for most of our respondents, and people with a larger balance in their retirement accounts might more likely to choose the higher-bequests plan as bequests are considered as luxury goods.

To illustrate the tradeoff between monthly payouts and bequests, let's consider a hypothetical male member who has the government suggested amount of S$180,000 in his retirement account at age 55. If he enrolls in the higher-bequest plan, he will receive a monthly payout of S$1,149, while enrollment in the lower-bequest plan would yield a monthly payout of S$1,246, a difference of S$97. However, by enrolling in the higher-bequest plan, he can leave S$171,006 to his heirs if he dies at age 75, compared to only S$51,779 under the lower-bequest plan. It's also worth noting that while the payout remains constant regardless of age, the bequest amount decreases as the policyholder ages and eventually reaching zero for those who pass away at age 90, regardless of the chosen plan. Therefore, even for those with strong bequest motives, the advantage of enrolling in the higher-bequest plan decreases with the number of years they expect to live. If someone is certain they will live past age 90, then enrolling in the higher-bequest plan may not be the best option, even if they have a strong bequest motive. However, for those without any bequest motives, the lower-bequest plan would always be the better choice,

of marginal propensities to consume. Using a hypothetical question in the survey, Shapiro and Slemrod (2003) investigate the agent's specific reasons for saving and spending. Using a hypothetical question in the Italian Survey of Household Income and Wealth, Jappelli and Pistaferri (2020) find a strong negative relationship between cash on hand and the marginal propensity to consume.

[16] See Appendix A.4 for detailed discussion of the question.

regardless of their longevity.

Might people choose the higher bequest plan for other reasons besides leaving more bequests? One explanation could be that tax benefits might affect people's annuity choices. For example, a higher estate tax might discourage people from leaving bequests. However, there are no estate taxes in Singapore and no different tax treatments between the lower and higher bequest plans. Thus, the choice is unlikely to be affected by tax incentives.

Another possible explanation is that they may not fully understand the trade-offs between these two plans even given the values of payout and bequest. To check the validity of our key identification assumption that people know the differences between these two plans, we asked our respondents three questions before asking them the hypothetical question. First, which plan provides a higher monthly payout? Second, which plan offers more bequest? Third, if you did not choose a CPF LIFE plan, which plan would you be placed on? Among those who enrolled, 75% answered at least one question correctly, 60% answered at least two questions correctly, and 73% knew the lower-bequest plan has higher payouts than the higher-bequest plan. Among those who understood the trade-offs, 20% chose the higher-bequest plan. These results suggest that most people knew that they would receive a lower monthly payout if they had chosen the higher-bequest plan and therefore had the intention to leave bequests.

A third possible explanation is that subjects colluded with children, i.e., children would transfer money to parents in return for more bequests. To test this possibility, we asked detailed questions about how they made their annuity choices. We find that 90% of subjects did not discuss it with their children before they made their decisions, and 88% of subjects did not tell their children their choices. We further asked a hypothetical question, "Would you like to tell your children your CPF LIFE choices if we offer you 10 SGD?" 61% of subjects replied "No." These results suggest that parents did not generally discuss their annuity choices with their children. For people who did not discuss it with their children, 18.7% chose the higher-bequest plan, which is almost the same as those who discussed it. These results suggest that collusion with children is an unlikely explanation for our results.

Another possible explanation is trust. People might not trust government pensions and want to withdraw as much money as possible from their compulsory retirement accounts. However, this implies that those who do not trust government pensions should choose the lower-bequest plan and leave a smaller proportion of assets in their government managed retirement account. Hence, the lack of trust cannot explain why people chose the higher-bequest plan. Indeed, one of our respondents stated that she chose the low-bequest plan because of the lack of trust.

4.2 Mechanisms for bequest motives

To understand why people are willing to sacrifice their own consumption for bequests, we further collected information on factors that are potentially related to their incentives to leave bequests, such as having children, health status, wealth, and their children's characteristics. 15% of our sample did not have any children, mostly because they had never married. 12% of our respondents believed their health was very good, and only 12.6% of the respondents believed that they would live longer than the life expectancy of 55-year old Singaporeans (at 81.9 years for males and 85.8 years for females), which suggests many people underestimated their longevity risk. The mean retirement account balance was S$55,801. About 29% of our respondents completed at least nine years of schooling while the mean years of schooling of their adult children were 13.4 (at least 18 years old). Although, on average, children were much better educated than their parents, about 12% of the parents still worried about their children's financial security.

Table 2 examines the relationship between various factors and people's annuity choices jointly. In column (1), we only control for basic personal characteristics and knowledge about these two annuity plans. Knowledge of these plans increases people's probability of enrolling in the higher-bequest plan, suggesting enrolling in it is an informed action, as is the choice of leaving more bequests. We also find that people with children are more likely to enroll in the higher-bequest plan than others even after controlling for other basic personal characteristics. This finding is consistent with that of Ameriks et al. (2011), who find that people with children have higher bequest motives on average than those without children. More years of education also increases people's probability of enrolling in the higher-bequest plan. It could be due to the facts that educated people earn more and are richer than others. We also find that less healthy people are more likely to choose the higher-bequest plan.

Column (2) shows that people are less likely to enroll in the higher-bequest plan if their children have more years of schooling and column (3) shows that people are more likely to enroll in the higher-bequest plan if they think that their children are financially insecure (i.e., with low incomes that are insufficient to maintain a normal lifestyle). These results support the existence of the altruistic bequest motive. The result in column (4) shows that the coefficient on the number of visits of children is positive, but insignificant both economically and statistically. This finding is inconsistent with the reciprocity motive.

Next, we discuss the strength of intentional bequest motives. Since a considerable proportion of people chose the higher-bequest plan, we reject the null hypothesis of no intentional bequest motives and show the existence of the intentional bequest motive. However, choosing the lower-

bequest plan does not imply a weak intentional bequest motive. It is possible that bequests from other assets can substitute bequests from their retirement accounts. For instance, people who have a considerable amount of assets outside their retirement accounts could use other assets as a mean to leave bequests, which might reduce their incentive to enroll in the higher-bequest plan (the substitution effect).[17]

To address this concern, we explore the correlation between other financial assets, housing assets and the choice of the annuity plan. If bequests from other assets can substitute bequests from retirement accounts, we should observe that those with more other assets are less likely to choose the higher-bequest plan since they already leave enough bequests. The top panel of Table 3 shows the results. We find that higher housing value is positively correlated with the choice of the higher-bequest plan. There is no relationship between individuals' annuity choices and whether they live in a large home (equals to 1 if living in a 5-room flat and 0 otherwise), whether they have more non-housing assets than assets in retirement accounts, and whether they intend to leave other bequests in addition to the ones from the partial annuity scheme. Thus, there is no evidence that bequests from other assets substitute those from retirement accounts.

To further study the strength of the intentional bequest motive, we explore the subsample of respondents who have fewer financial assets. In this subsample, because balances in their retirement accounts are likely to be the major source for leaving bequests, choosing the higher bequest plan indeed suggests a stronger intentional bequest motive. We find that among those individuals, 18.6% choose the higher bequest plan, which is almost the same as that of the entire sample. This provides additional evidence that people leave bequests intentionally. The bottom panel of Table 3 shows that the regression results using this subsample have the same sign as in Table 2. Individuals with children and individuals with poorly educated children have stronger intentional bequest motives.

Table 4 reports the results of regressions where the dependent variable is the hypothetical choice. The choice was made under the assumption that the respondents had S$100,000 in their compulsory saving account, regardless of their personal characteristics. This assumption could considerably reduce the impact of wealth on the plan choice. Moreover, all respondents knew the trade-off between these two plans by observing the annualized payout and the bequest amount under two plans given in the question. As a result, we do not control for people's knowledge of these plans in all the regressions. As in Table 2, childless people are less likely to leave bequests. The magnitudes of the estimated impacts are not sensitive to the specification

[17]For the other direction, Bernheim (1991) finds that social security annuity benefits depress private annuity holdings among elderly individuals in the United States.

and are similar to what has been reported in Table 2. A child's schooling and financial status still have significant impacts, suggesting the existence of the altruistic motive. One noticeable difference between these two tables is that the impact of education is significant in Table 2 but insignificant in Table 4. This is likely because the compulsory saving account balance was assumed to be the same when we asked the hypothetical question while the actual account balance of better educated people wes 51% higher than others.

Having documented that a considerable proportion of our sample population was willing to trade a constant stream of payouts for bequests at the current setting, we further analyze how many more additional annual payouts were needed to persuade people to switch their plans. We asked people who chose the lower-bequest plan in the hypothetical question to switch to the higher-bequest plan when we raised the annual payout from S$8,760 to S$9,000, S$9,240, S$9,480, S$9,600, and then to S$9,720, but fixed the amount of bequest in the higher-bequest plan.[18] We stopped asking the question when a person switched from the lower to the higher-bequest plan. Clearly, once the payout increases to S$9,720, which is the annual payout of the lower-bequest plan but with a much lower bequest, an individual should always choose the higher-bequest plan as long as the marginal utility of leaving bequests is positive. The annual payout where a person switches from the lower to higher bequest plan can help us to identify how a person values the difference in the bequest between the higher and lower bequest plan. For instance, if a person still chooses the lower bequest plan even when the annualized payouts are the same, then it is reasonable to assume that the person's valuation of the additional bequests from the higher-bequest plan is 0. If another person chooses the lower bequest plan when the annual payout from the higher-bequest plan is S$9,480 and chooses the higher bequest plan when the annual payout from the higher-bequest increases to S$9,600, it suggests that she would like to sacrifice an at least S$120 annual payout (9720-9600=120) to receive the higher bequest. So, her valuation of the additional bequests from the higher bequest plan is between S$120 and S$240 (=9720-9480). We set her valuation of the bequest at the mid-point S$180. Based on our design, the higher the number, the higher the person's valuation of the bequest.

Table 5 reports the estimation results for people who initially chose the lower-bequest plan. The results show that even among people who chose the lower-bequest plan, those without children, or with better educated children still placed a lower value on bequests, while better educated individuals and individuals with a larger retirement account balance placed a higher value on bequests, which are similar to the results reported in Table 2.

[18] See Appendix A.4 for detailed discussions on the hypothetical choices.

4.3 *Inter vivos* transfers

Apart from leaving bequests, people can transfer their wealth to their children during their lifetime through *inter vivos* transfers. According to Gale and Scholz (1994) estimates, these transfers are approximately half the size of those made through bequests in the United States. By investigating the factors that drive *inter vivos* transfers, we can gain a better understanding of the motivations behind leaving bequests. With this in mind, we analyze how individuals distribute the ten lottery tickets that they are given. We asked our respondents to allocate the ten tickets in two incentive-compatible survey questions. Our first lottery question was to ask people to allocate the potential prizes between themselves and their children. More than 70% of people gave at least one ticket to their children, suggesting that people had the intention of giving *inter vivos* transfers. On average, people gave 39% of the tickets to their children.

Interestingly, the number of lottery tickets given to their children is positively correlated with both the probability of enrolling in the higher bequest plan in both the actual and hypothetical choices. The evidence suggests that people with a stronger incentive to leave bequests are more likely to allocate more lottery tickets to their children.[19] Unfortunately, due to religious reasons, a disproportionate number of Malays refused the lottery tickets. As a result, our results are mostly based on non-Malays. Moreover, a considerable proportion of people from other races refused our lottery offer as well.

Cox and Rank (1992) argue that *inter vivos* transfers are more informative about transfer motives since they are more likely to be intentional. We thus design our second question to ask people to allocate the potential prizes of 10 lottery tickets among their children. A simple calculation shows that more than 80% of people distributed the tickets equally among their children. This contrast with the findings of McGarry (1999), who report uneven distribution of *inter vivos* transfers among children. Table 6 reports the estimation results. The data is organized at the parent-child pair level. The dependent variable is the proportion of lottery tickets allocated to a particular child. The sample consists of respondents who accepted the lottery tickets and have at least one child who was at least 18 years old at the time of the survey. Household fixed effects are added in the regression so that our analysis capture the within-household variation. None of the coefficients reported are statistically significant even at the 10% level. The magnitudes are very small relative to the sample mean of allocating 37% to a child. These results further challenge the reciprocity motive, since it implies that *inter vivos*

[19] Bernheim et al. (1985) argue that altruism or joy-of-giving bequest motives imply *inter vivos* transfers. For example, early transfers may allow the recipient to ease liquidity constraints. But the strategic bequest motive does not have this implication, since promising bequests rather than gifts can influence children's behavior. Our findings support altruism and joy-of-giving motives.

transfers should correlate with the frequencies of children's visits to their parents. Conversely, McGarry's (1999) findings of uneven distribution of *inter vivos* transfers are consistent with both altruistic and strategic motives.

In sum, we find strong evidence supporting the existence of intentional bequest motives and having children is a strong predictor for having intentional bequest motives. Regarding the various mechanisms of the bequest motive, we find supporting evidence for altruism and joy-of-giving but failed to find support for the reciprocity motive.

5 Structural estimation

We then set up a benchmark life-cycle model where people can choose the annuity plan at age 55. We solve the model numerically. Using our unique data, we estimate the crucial parameters of the bequest motive. We find heterogeneity in bequest motives between households with and without children. Comparing the model with bequest motives and that without bequest motives, we isolate the contribution of the intentional bequest motive to bequests and asset accumulation. Besides the aggregate variables, detailed information of the disaggregate level can be investigated in the structural model.

5.1 The structural model

The agents enter the economy at age 25. Their lifespan is uncertain, with a maximum of 100 years. The agent may have a bequest motive. The financial market is incomplete. The agent can access a risk-free savings account with a net interest rate r. The agent faces a borrowing constraint and cannot borrow money from others and banks.

We assume that the agent's utility from consumption c at age t is

$$u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}.$$

Following Lockwood (2018), we assume that the agent's utility from leaving bequests, b, is

$$v(b) = \left(\frac{\phi}{1-\phi}\right)^{\sigma} \frac{\left(\frac{\phi}{1-\phi}c_b + b\right)^{1-\sigma}}{1-\sigma}, \text{ and } \phi \in [0,1),$$

where ϕ represents the bequest motive intensity.[20] The coefficient of relative risk aversion with respect to the bequests σ plays an important role in separating precautionary savings

[20]De Nardi (2004), De Nardi et al. (2010), De Nardi et al. (2016), Ameriks et al. (2011) and Ameriks et al. (2020) use a similar utility function of bequests.

and bequest motives. If $c_b = 0$ and $\gamma = \sigma$, preferences over consumption and bequests are homothetic.[21] If $c_b > 0$ and $\gamma = \sigma$, bequests are luxury goods.[22] The empirical work of Dynan et al. (2004) find a strong positive relationship between savings rates and lifetime income, which indicates that this set-up is a reasonable specification to replicate the saving patterns in different income quintiles.

All agents start working at age 25 with a given asset endowment a_{25}. An agent has uncertainty about lifespan and medical expenditures. Health status h_t takes one of the four states, i.e. very healthy, healthy, unhealthy, very unhealthy. Health expenditure $d(t; h_t)$ is age-dependent. The health expenditure in each period is drawn randomly from a 4-state set $S(t)$. The four states of $S(t)$ depend on age, which reflect $15\%, 45\%, 75\%$, and 95% of the medical expenditure distribution at the corresponding age. The probability distribution is $Pr(d(t; h_t) = s_1) = 0.3$, $Pr(d(t; h_t) = s_2) = 0.3$, $Pr(d(t; h_t) = s_3) = 0.3$, and $Pr(d(t; h_t) = s_4) = 0.1$. The first argument t of health expenditure $d(t; h_t)$ emphasizes this dependence. The health shock h_t causes the agent's precautionary savings.[23]

The government guarantees that the elderly agent has a minimum consumption level c_m, through a subsidy program. The government subsidy is

$$ys_t = \max\{0, c_m + d(t; h_t) - a_t\}. \tag{1}$$

An agent with $c_m + d(t; h_t) > a_t$ receives the government subsidy $ys_t > 0$, which represents the transfer from the means-tested social insurance programs.[24] Nobody dies before age 55, but everybody faces a mortality risk that depends on gender after age 55. We solve the agent's problem recursively.

The agent's problem during ages 25-54 is

$$V_t(i, edu, a_t) = \max_{c_t, a_{t+1}} \{u(c_t) + \beta E_t V_{t+1}(i, edu, a_{t+1})\} \tag{2}$$

[21] Benhabib et al. (2011) use a homothetic set-up to investigate the wealth distribution of a life-cycle model with idiosyncratic investment risks.

[22] Under these assumptions, the optimal bequest by someone maximizing $U = \max\{u(c) + v(b)\}$ subject to $c + b = w$ is $b^*(w) = \max\{0, \phi(w - c_b)\}$. Thus, the ratio $\frac{b^*(w)}{w}$ is an increasing function of w.

[23] The other reason for precautionary savings is longevity risks caused by the uncertainty of lifespans. To prevent themselves from outliving their savings, people save more than they consume in their lifetimes. These extra savings are counted as precautionary savings. Dynan et al. (2002) emphasize that precautionary savings and bequest motives cannot generally be distinguished.

[24] Following Hubbard et al. (1995), Scholz et al. (2006), and Ameriks et al. (2011), we use a consumption floor as the means-tested social insurance programs. Similarly, Lockwood (2018) uses a wealth floor, and De Nardi et al. (2016) use a lower bound on the utility as the means-tested social insurance programs.

$$s.t.\ c_t \begin{cases} = c_m & , \quad \text{if } ys_t > 0 \\ \geq c_m & , \quad \text{if } ys_t = 0 \end{cases}$$

$$sav_t = \begin{cases} 0 & , \quad \text{if } ys_t > 0 \\ a_t - d(t; h_t) - c_t \geq 0 & , \quad \text{if } ys_t = 0 \end{cases}$$

$$a_{t+1} = (1+r)sav_t + (1-\rho_1)y_{t+1}(i, edu),$$

for $25 \leq t \leq 54$, where a_t is the asset at age t and $sav_t \geq 0$ is the saving at age t. If the agent receives the government subsidy $ys_t > 0$, the consumption equals c_m and savings equal 0. The gross rate of return on savings is $R = 1 + r$. $V_t(i, edu, a_t)$ is the value function of the agent at age t, $y_{t+1}(i, edu)$ represents the gross labor earnings of an agent of gender $i \in \{m, f\}$ with edu level of education at age $t+1$, and ρ_1 is the employee's contribution rate to the compulsory saving account of CPF.

The accumulation of the agent's compulsory savings is regulated by the government, indicated as follows,

$$RA_{t+1} = (1+r)RA_t + (\rho_1 + \rho_2)\min\{\kappa, y_{t+1}\}, \tag{3}$$

for $t \geq 25$. RA_t is the agent's compulsory savings account balance at age t. ρ_2 is the employer's contribution rate to the compulsory savings account when the employee's labor income is less than the contribution ceiling κ. For incomes beyond the ceiling, the marginal contribution rate is 0. Although both a_t and RA_t are financial state variables, we omit RA_t in equation (2) since the agent's consumption decision does not influence the compulsory savings account balance RA_t, and the compulsory savings accumulation does not influence the agent's consumption decision directly between the ages of 25 and 54.[25]

Since the agent did not expect the annuity plans before the plans were launched, we assume that the annuity plans were not in the agent's information sets between the ages of 25 and 54. They believed that their pension system would be under the old regime, which would pay back the entire account balance plus accumulated interests in about 20 years.

At age 55 an agent has to decide on which annuity plans to enroll in,

$$V_{55}(i, edu, RA_{55}, a_{55}) = \max\left\{V_{55}^l(i, edu, RA_{55}, a_{55},), V_{55}^h(i, edu, RA_{55}, a_{55})\right\}, \tag{4}$$

where RA_{55} denotes the balance of the compulsory saving account at age 55. $V_t^l(i, edu, RA_{55}, a_t)$ is the value function of the agent who chooses the lower-bequest plan, and $V_t^h(i, edu, RA_{55}, a_t)$ is

[25]The compulsory savings balance influences the agent's consumption indirectly, since the balance at age 55 determines the pension and bequest payments from this account. These payments influence the agent's consumption decision through expectations.

the value function of the agent who chooses the higher-bequest plan. Given the value functions at age 55, $V_{55}^{l}(i, edu, RA_{55}, a_{55})$ and $V_{55}^{h}(i, edu, RA_{55}, a_{55})$, the agent's problem is to compare these two value functions at age 55 and to make her choice.

Recent studies that estimate the bequest motive in the structural model, such as De Nardi et al. (2010), Ameriks et al. (2011), De Nardi et al. (2016), Koijen et al. (2016), Lockwood (2018), and Ameriks et al. (2020), have access household-level wealth data. However, we do not have precise information about wealth in our survey. Thus, We use simulated wealth to estimate the bequest motive parameters.

When an agent is between ages 55 and 64, he/she works and receives an annual income, but does not receive payoffs from the chosen annuity plan. Under annuity plan j, $j = h$ or l, the agent's problem is

$$
\begin{aligned}
&V_t^j(i, edu, RA_{55}, a_t) = \\
&\quad \max_{c_t, a_{t+1}, b_{t+1}} \left\{ u(c_t) + \beta E_t \left[(1 - p_t(i)) V_{t+1}^j(i, edu, RA_{55}, a_{t+1}) + p_t(i) v(b_{t+1}) \right] \right\}
\end{aligned} \tag{5}
$$

$$
s.t.\ c_t \begin{cases} = c_m & , \quad \text{if } ys_t > 0 \\ \geq c_m & , \quad \text{if } ys_t = 0 \end{cases}
$$

$$
sav_t = \begin{cases} 0 & , \quad \text{if } ys_t > 0 \\ a_t - d(t; h_t) - c_t \geq 0 & , \quad \text{if } ys_t = 0 \end{cases}
$$

$$
a_{t+1} = (1 + r) sav_t + (1 - \rho_1) y_{t+1}(i, edu),
$$

$$
b_{t+1} = (1 + r) sav_t + g_{t+1}^j(i, RA_{55}),
$$

for $55 \leq t \leq 64$, where $p_t(i)$ is the agent's probability of death at age t. The bequest at age $t+1$ is b_{t+1}.[26] The bequest payment from the chosen plan is $g_{t+1}^j(i, RA_{55})$. The stochastic medical expenditures causes retiree to have precautionary savings.[27]

After age 65, agents retire and do not have labor earnings. They receive a fixed, gender-balanced specific monthly pension payment when alive and age-sex-balance-specific bequests from the partial annuity plan they chose at age 55. Between ages 65 and 99, the agent's

[26] There are no taxes on estates in Singapore.

[27] The precautionary savings in Ameriks et al. (2011) are caused by "public care aversion," aversion to the prospect of having insufficient wealth for private long-term care and therefore needing public care. Ameriks et al. (2011) show that the precautionary motive is important for savings. They also find that the bequest motive is statistically significant. The strategic survey questions of Ameriks et al. (2011) are all related to bequest motives. The information of these questions greatly improves the estimation of the preference parameters in the structural model of Ameriks et al. (2011).

problem is

$$V_t^j(i, edu, RA_{55}, a_t) = \max_{c_t, sav_t, a_{t+1}, b_{t+1}} \left\{ u(c_t) + \beta E_t \left[(1 - p_t(i)) V_{t+1}^j(i, edu, RA_{55}, a_{t+1}) + p_t(i) v(b_{t+1}) \right] \right\} \tag{6}$$

$$s.t.\ c_t \begin{cases} = c_m & , \quad \text{if } ys_t > 0 \\ \geq c_m & , \quad \text{if } ys_t = 0 \end{cases}$$

$$sav_t = \begin{cases} 0 & , \quad \text{if } ys_t > 0 \\ a_t - d(t; h_t) - c_t \geq 0 & , \quad \text{if } ys_t = 0 \end{cases}$$

$$a_{t+1} = (1 + r) sav_t + f^j(i, RA_{55}),$$

$$b_{t+1} = (1 + r) sav_t + g_{t+1}^j(i, RA_{55}),$$

for $65 \leq t \leq 99$. An agent's monthly payout plan j is $f^j(i, RA_{55})$, which does not change over time. In contrast, the bequest, $g_{t+1}^j(i, RA_{55})$, gradually declines with age.

Different annuity plans deliver different paths of monthly payouts and bequest payments. That is the trade-off when an agent decides to choose the annuity plan. The bequest motive parameters influence the elasticity of plan choices on these payment flows. This choice is our main identification moment when we estimate the parameters regarding bequest motives. Ameriks et al. (2011), Ameriks et al. (2020), De Nardi et al. (2016), Koijen et al. (2016), and Lockwood (2018) estimate the preference parameters using additional information beyond consumption and savings.[28] Our estimation moments are the actual choice of the annuity plan and the choice of the hypothetical annuity plans. Ameriks et al. (2011) and Ameriks et al. (2020) also use answers to hypothetical questions as part of their identification strategy.

An agent's problem at age 100 is

$$V_{100}^j(i, edu, RA_{55}, a_{100}) = \max_{c_{100}, sav_{100}, b_{101}} \{ u(c_{100}) + \beta v(b_{101}) \} \tag{7}$$

$$s.t.\ c_{100} \begin{cases} = c_m & , \quad \text{if } ys_{100} > 0 \\ \geq c_m & , \quad \text{if } ys_{100} = 0 \end{cases}$$

[28] Ameriks et al. (2011) and Ameriks et al. (2020) use the strategic survey questions to find sharper identification of utility parameters. De Nardi et al. (2016) make use of the Medicaid insurance information. Koijen et al. (2016) use the data of life insurance, annuities, and long-term care insurance. Lockwood (2018) uses long-term care insurance information.

$$sav_{100} = \begin{cases} 0 & , \quad \text{if } ys_{100} > 0 \\ a_{100} - d(100; h_{100}) - c_{100} \geq 0 & , \quad \text{if } ys_{100} = 0 \end{cases}$$

$$b_{101} = (1 + r) sav_{100},$$

for $j = h, l$. At age 100, the bequest payments from both plans are zero. Hence, all bequests are from private savings.

5.2 Estimation results of the structural model

Following De Nardi et al. (2016), Lockwood (2018), and Ameriks et al. (2020), we use a two-step estimation strategy. In the first step, we estimate or calibrate the parameters that can be identified outside our structural model. In the second step, we estimate the key parameters of interest in our model, ϕ, and c_b of the bequest utility function. We employ the General Method of Moment (GMM) to estimate these parameters, taking as given the parameters estimated in the first step.

5.2.1 First-step estimation results

Parameters in the first-step estimation are either from the literature or from the statistical estimation without running the structural model. Following Ameriks et al. (2011), we set $\beta = 0.97$ and $\gamma = \sigma = 3$. We set $r = 0.02$ which is in the range of the equilibrium interest rates of the heterogeneous-agents incomplete-market model (Aiyagari, 1994). The government guaranteed consumption floor c_m is set at S$3,000 (about US$2,205 at the current exchange rate) each year, which equals S$250 every month.

Other parameters in the first-step are calculated using our survey or government publications. These parameters are mainly related to the income process, medical risks, and mortality risks. The earnings path is calculated based on the gender-education specific mean monthly wages at age 55 from our survey, the 2018 cross-sectional age earning profile and the mean monthly wage series between 2000 and 2015 published by the Ministry of Manpower. The accumulation of the compulsory savings is calculated based on the estimated gender-education-specific age-earnings profile and the corresponding regulated contribution rates. The payouts of the partial annuity plan are annualized based on information downloaded from the government website, using 1958 birth cohorts with the assumed rate of return of 4.25.[29]

Medical expenditures at a given age are calculated using the administrative individual-level hospital expenditure that one of the authors can access. We first calculate the 15th, 45th,

[29]We calculated the gender-asset specific monthly payouts and bequests using https://www.cpf.gov.sg/eSvc/Web/Schemes/LifeEstimator/LifeEstimator in November 2019.

75th, and 95th percentile of the hospital expenditure distributions in 2013 and 2014 by age and gender. Since less than 50% of the population went to a hospital in any given year, we interpolate these expenditures by age-specific hospitalization rate. Mortality rates between age 55 and 100 are calculated based on our survey question "In Singapore, the life expectancy at age 55 is 81.9 years for males and 85.8 years for females. What is the percent chance that you will live to be 65 or more, 70 or more, 75 or more, 80 or more, 85 or more, 90 or more." The mortality rate is set to 0 between ages 25 and 55 and to 1 at age 100.

5.2.2 Second-step estimation results and model fit

To estimate the parameters ϕ and c_b, we use the information on agents' choices of their annuity plans and of the hypothetical plans. Our sample consists of 279 females and 285 males who enrolled in one of the plans. We separate the sample into four gender-education groups, which gives us eight moments. Four of them are from the actual enrollment: the fraction of people choosing the higher-bequest lower-payout plan. The other four are from the choices of the hypothetical plan.

Table 7 reports the estimation results. In Panel A, the preference for men and women are restricted to be the same. The estimated value of ϕ is 0.924 and significant at the 1% level, which shows that people indeed have the intention to leave bequests. The estimated value of c_b is 3.984 and significant at the 1% level, which suggests that bequests are luxury goods. In panel B, we allow men and women to have different ϕ. For identification purposes, we assume c_b does not depend on gender. Hence, the differences in their choices are driven by the differences in their preferences for bequests, mortality rate, and earnings. We find that both men and women have a similar preference for leaving bequests, 0.938 and 0.916.

Our findings are consistent with recent literature that finds bequest motives are important for interpreting the observed savings, insurance behavior, and wealth inequality. Lockwood (2018) shows that bequest motives are crucial in reconciling the slow drawdown of wealth and low long-term care insurance coverage among retirees in the top half of the wealth distribution. This is because bequest motives reduce the opportunity cost of precautionary savings. De Nardi et al. (2016) find that bequest motives are necessary for a life-cycle model to match Medicaid recipient rates across the income distribution. Benhabib et al. (2019) show that bequest motives play an important role in generating the fat tail of the wealth distribution. The estimates of De Nardi et al. (2021) show that bequest motives are statistically significant, after they take into both retired couples and singles. Lee and Tan (2019) also use a structural model to find that bequest motives are statistically significant. Our estimation results show that households

have strong bequest motives and that bequests are luxury goods.

Panel C of Table 7 reports the estimation results where we allow the preference for bequests (ϕ) to vary across people with and without children. We still assume that c_b is the same for everyone. The estimated value of ϕ for those with children is 0.909, which is similar to the value of the full sample. The estimated value of ϕ for those without children is 0.654 and is also statistically significant. These results suggest that people with children have a stronger preference for leaving bequests than childless people as the former have a larger ϕ. Nevertheless, even people in the latter category also have bequest motives.

Hurd (1987) assumes that people without children have no bequest motive. Models predict that retirees with and without intentional bequest motives should have different dissaving patterns. Observing that retirees with and without children follow quite similar patterns of asset accumulation, he concludes that people only leave bequests accidentally.[30] Kopczuk and Lupton (2007) find that the existence of children is a marginally significant indicator of having a bequest motive. But the hypothesis that people without children have no intentional bequest motives and people with children have intentional bequest motives, is statistically rejected by the likelihood ratio test.[31]

The results from recent literature are presented in the bottom panel of Table 7 for comparison purposes. Our results suggest that the bequest motive becomes operative when consumption exceeds S$3,984 per year and the marginal propensity to leave bequests is 0.924. Our estimated propensity to leave bequests is at the top of the previous estimates, which is close to Ameriks et al. (2011), Lockwood (2018), and De Nardi et al. (2021), slightly higher than De Nardi (2004), and considerably higher than De Nardi et al. (2016) and Ameriks et al. (2020). Our estimated c_b is at the bottom range of the previous estimates. De Nardi (2004) finds that the bequest motive becomes operative when consumption exceeds US$1,810 per year and the marginal propensity to leave bequests is 0.86. De Nardi et al. (2016) estimate that the bequest motive becomes operative when consumption exceeds US$3,540 per year and the marginal propensity to leave bequests is 0.79. De Nardi et al. (2021) find that, for singles, the bequest motive becomes operative when consumption exceeds US$377,400 and the marginal propensity to leave bequests is 0.96. Ameriks et al. (2011) show that the bequest motive becomes operative when consumption exceeds US$7,280 and the marginal propensity to leave bequests is 0.98.[32]

[30] Barczyk et al. (2022) give an alternative explanation of the similar savings and bequests behavior between households with and without children: childless cannot count on informal care or financial transfers from their children, and they face larger risks and thus accumulate higher precautionary savings.

[31] Hurd (1989) uses a structural model to estimate that the bequest motive is small, and thus that most bequests are accidental. Kopczuk and Lupton (2007) find that this result relies on Hurd's assumption that households without children have no bequest motives. Using a switching equation determining who has bequest motives, Kopczuk and Lupton (2007) estimate that 75% of the elderly population has a bequest motive.

[32] Ameriks et al. (2011) find that, without the strategic survey questions, the bequest motive becomes operative

Ameriks et al. (2020) find that the bequest motive becomes operative when consumption exceeds US$8,530 and the marginal propensity to leave bequests is 0.48. Lockwood (2018) estimates that the bequest motive becomes operative when consumption exceeds US$17,100 and the marginal propensity to leave bequests is 0.96. Our estimated value of ϕ is smaller than those of De Nardi et al. (2021), Ameriks et al. (2011), and Lockwood (2018).

To check the fit of our model, we plot the fitted moments against the sample moments in Figure 2. In all panels, the horizontal axis represents the sample moments while the vertical axis represent the predicted moments. Each dot is one of the 8 moments used in the estimation in panels (a) and (b) and one of the 16 moments in panel (c). The preference is assumed to be homogenous in panel (a). We allow ϕ to depend on gender in panel (b), and on both gender and childless status. Panel (a) shows that except for less educated women's choice of the hypothetical plan, the predicted moments are close to the 45 degree line, suggesting that our estimation fits the actual data reasonably well. Allowing ϕ to differ between genders improves the fit.

To check whether our results are sensitive to the choices of parameters that are not estimated inside the model, we also implement a series sensitivity analysis by varying the time discount factor β, risk aversion γ, and the consumption floor c_m. We test seven different combinations of these three parameters and present the estimation results in Table A.1. The estimated ϕ varies from 0.867 to 0.927, and the estimated c_b varies from S$1,975 to 5,227. Overall, our sensitivity analysis suggests that our estimates are not sensitive to the choice of these parameters in a wide range.

Even among those who accept the existence of intentional bequest motives, there is disagreement about the impacts of bequest motives on the savings behavior of retirees. De Nardi (2010) finds that the bequest parameters are not statistically significant and do not help improve the fit of the model. Ameriks et al. (2011) and Ameriks et al. (2020) find that precautionary savings for long-term care are much more important than intentional bequest motives, while Lockwood (2018) finds that models without intentional bequest motives cannot match retirees' choices of savings and long-term care insurance. De Nardi et al. (2021) find that intentional bequest motives play an important role in the saving decisions of retirees in a model which takes into account both singles and couples. We exploit the unique setting of partial annuities in Singapore and provide supporting evidence for intentional bequest motives. Our paper complements this literature and finds that intentional bequest motives do exist.

only when consumption exceeds US$12,060. Thus, the prevalence of bequest motives is larger after they use the strategic survey questions.

5.3 Counterfactual simulation

In the counterfactual analysis, we employ compulsory savings with partial annuities - our research setting - as the benchmark. Simulation based on the structural model shows that the ratio of the annual inheritance flow to national income is approximately 10%, which is comparable to the finding of Piketty (2011). We simulate the bequest flow left by different cohorts and find the aggregate bequest flow using the cohort size distribution which is implied by the agents' death rates. We use the aggregate labor earnings in the economy to proxy the national income. Then we calculate the ratio between them. Piketty (2011) documents that the ratio of the annual inheritance flow to national income in France declined from 20%-25% between 1820 and 1910 to less than 5% in 1950, and climbed back to 15% in 2010. Under plausible assumptions, he predicts that the figure might rise back to 20%-25% by the year 2050.

Based on our structural estimation, we conduct several counterfactual policy simulations to study how bequest motives and policy environments affect intergenerational transfers. We consider counterfactual policy environments in two dimensions: whether retirement savings and annuity are compulsory, and to what extent retirement savings are annuitized. We include five policy environments: compulsory savings with partial annuities, compulsory savings with no annuity, no compulsory savings with no annuity, no compulsory savings with full annuities, and no compulsory savings with partial annuities. In each policy environment, we simulate two scenarios, one without intentional bequests ($\phi = 0, c_b = 3.984$) and the other with intentional bequests ($\phi = 0.924, c_b = 3.984$). Comparing the model with bequest motives and that without bequest motives, we isolate the contribution of the intentional bequest motive to bequests and asset accumulation.

We report assets at age 65 and the average bequests, which are calculated as the weighted sum of the bequests left by households aged 65 and older, with the weight derived from mortality rates, in each policy environment under two levels of bequest motives in Table 8. In the top panel, we present the simulation results for average bequests. In our benchmark policy environment with compulsory savings and partial annuities, the simulated average bequest is about S$94,110 if individuals have no bequest motive and about S$110,750 if individuals have bequest motives, with $\phi = 0.924$ as the estimate in Table 7. Our simulations show that intentional bequest motives increase the average bequests, i.e. intergenerational capital transfers, by about S$16,640, or 17.68% in our benchmark policy environment. Kopczuk and Lupton (2007) find that households with a bequest motive spend about 25% less on consumption on average and thus have more savings.

Even if people do not have a bequest motive, annuitizing retirement wealth still reduces their

longevity risk. Hence, introducing life annuity into the economy might still affect people's saving decisions. In the policy environment with compulsory savings and no annuity, the simulated average bequests are larger than those in the partial annuity case. Partial annuities reduce accidental bequests and thus increase consumption. Annuities play a role in risk sharing and reduce intergenerational transfers. This is consistent with Yaari (1965). Without annuities, intentional bequests increase the average bequest by about S$11,950 or 9.56%, which is smaller than that in the partial annuity case.

Under the policy environment with no compulsory savings, we show that the intentional bequest motives also increase the average bequest. Many other countries, such as the United States, resemble this case since they have a policy environment with no compulsory savings and the demand for annuity is very low. Without annuities, intentional bequests increase the average bequest by about S$10,320 or 8.46%. The increase is largest when there are partial annuities: the bequest motive increases the average bequest by about S$11,520, a 14.44% increase. In the bottom panel of Table 8, we show the simulation results for average assets at age 65. Its pattern is similar to that of the top panel, but the impacts are smaller when measured in relative terms.

We further analyze the heterogeneous effects of our counterfactual policy simulation. We study the heterogeneity in two dimensions: gender and education. Based on these two dimensions, we split our sample into four subgroups: better-educated females, less-educated females, better-educated males, and less-educated males. Figure 3 shows the heterogeneous impacts of the intentional bequest motives on average bequests and assets at age 65. Our simulation suggests that the impact of the bequest motive on average bequests is similar across all four groups. Figure 4 shows the heterogeneous impacts of a partial annuity on average bequests and assets at age 65. We find that the impact on bequests is larger for males. The possible explanation is that males have a lower life expectancy and are likely to die earlier than females. Thus, males have more bequests to leave compared with females. When males buy a partial annuity, the impact on bequests is larger. We also find that the impact on bequests is larger for high-income (better-educated) groups. This is likely because better-educated groups have higher earnings, and thus the partial annuity has a larger effect on them.

In sum, our counterfactual policy simulations show two key results. First, intentional bequest motives play an important role in intergenerational transfers. Our calibration implies that the ratio of the annual inheritance flow to national income is about 10%. Under our benchmark policy environment with compulsory savings and partial annuity, which resemble Singapore, the intentional bequest motive increases average bequest by about 17.68%. Second, while the intentional bequest motive has a similar impact on average bequests among different genders

and income levels, the policy of partial annuities has a larger (negative) impact on males due to different life expectancies.

6 Conclusion

Bequests are a major contributing factor to intergenerational transfers and constitute a large proportion of net wealth. There exists a debate between bequest motives and precautionary savings motives. In this paper, we exploit the introduction of a compulsory life annuity scheme by the Singapore government in 2013 to identify the intentional bequest motive. The scheme has two options, one offers a higher monthly payout but a lower bequest (the default), while the other offers a lower monthly payout but a higher bequest. This unique setting helps us to separate intentional bequest motives from precautionary savings: actively choosing the higher-bequests and lower-payout plan only increases the committed bequest but does not increase precautionary savings to cope with medical or longevity risks.

We conducted about 2,000 face-to-face household surveys from a representative sample who are eligible for the scheme. Our analysis shows that about 20% of people chose the lower payout but higher bequest plan, suggesting that people indeed leave bequests intentionally. We find that households with children and more educated households are more likely to leave bequests intentionally. Less healthy people are more likely to leave bequests intentionally, which is consistent with adverse selection in the annuity market.

Having identified the existence of intentional bequests, we further explore the potential reasons for people to leave bequests. In the literature, bequest motives may come from three sources: altruism, reciprocity, and joy of giving. To investigate the mechanisms, we collected information on children's educational attainment, the respondents' view of their children's financial security, and how frequently their children visit or call them. We find that people are more likely to leave bequests if their children are poorly educated or worry about their children's financial security. This evidence supports the altruism motive. The frequency of children's visits does not affect the probability of leaving bequests, which is inconsistent with reciprocity. We also ask each individual to allocate real high stake lotteries to their children and study the correlation between the allocation and children's behavior. We find that more than 80% of people distribute the tickets equally among their children, implying the motive of joy of giving.

To analyze the impact of the existence of intentional bequest motives on bequests and savings, we estimate a structural model and conduct a series of counterfactual analyses. Our calibration implies that the ratio of the annual inheritance flow to national income is about 10%. Our counterfactual experiment results show that intentional bequest motives increase bequests

by 17.68% when there is compulsory saving and compulsory annuity, and by about 8.47% when there is neither compulsory saving nor compulsory annuity. In other policy environments, the impact varies from 9.56% to 14.44%. These results suggest that the intention to leave bequests indeed plays an important role in intergenerational wealth transfer.

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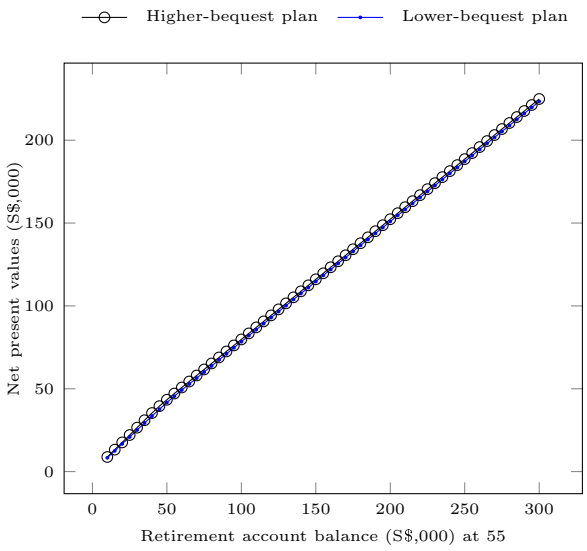
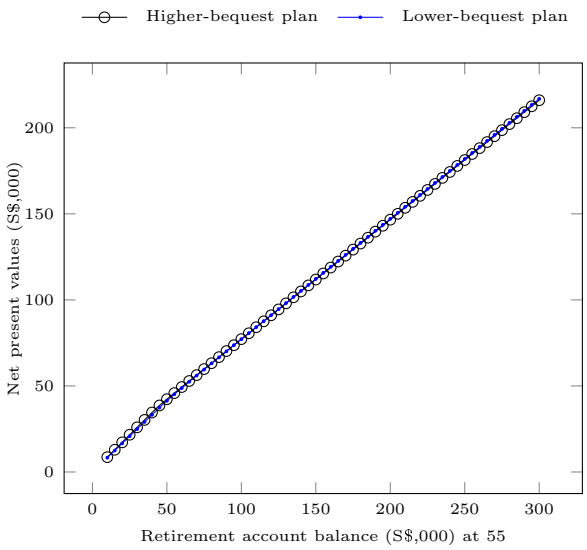
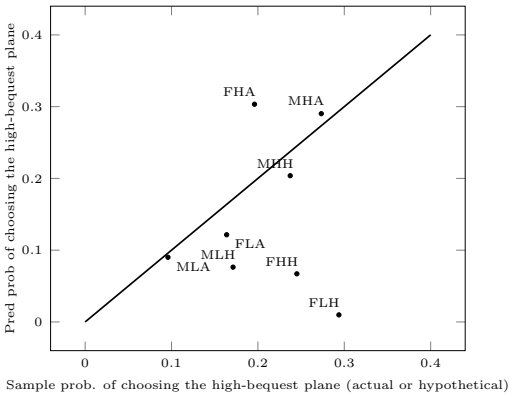


(a) Males

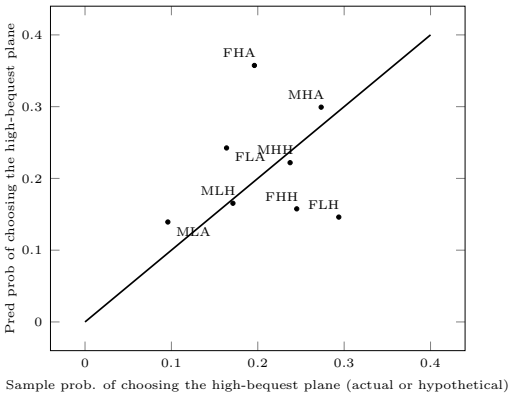


(b) Females

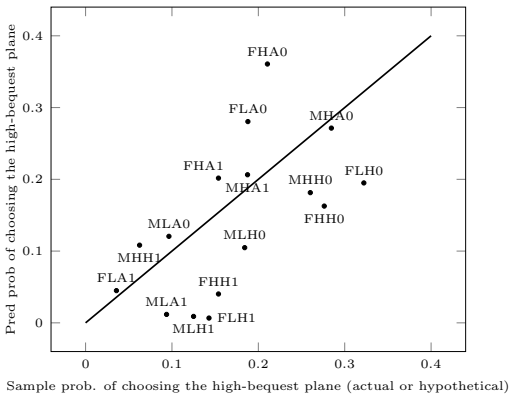
Figure 1: Mortality adjusted net present values at age 55. Gender-specific mortality rates are used to calculate the NPV.



(a) Homogenous agent



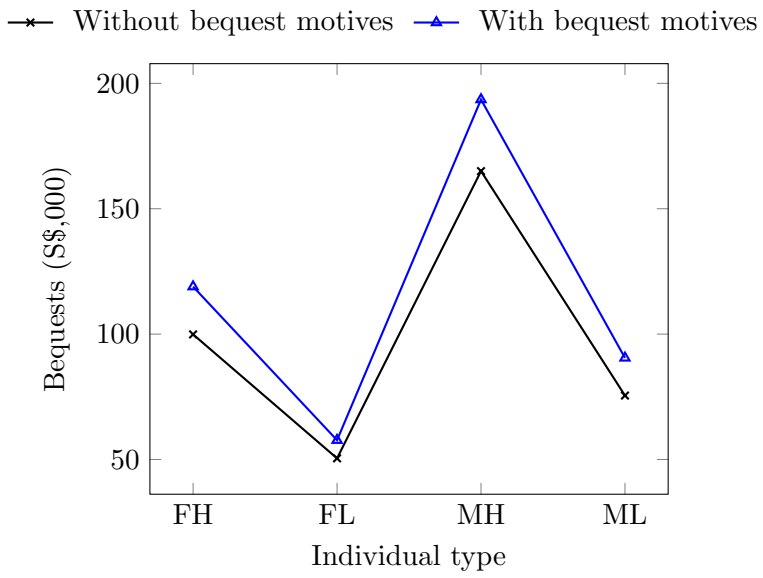
(b) Gender specific ϕ



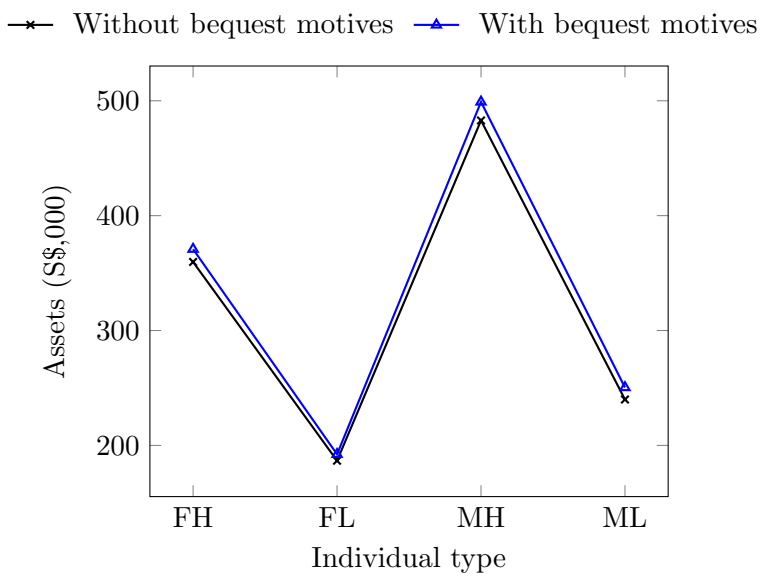
(c) Gender-childless specific ϕ

Figure 2: Predicted and actual moments.

The horizontal axis represents the sample probability of choosing the high-bequest plan (actual or hypothetical) while the vertical axis is the corresponding predicted probability. An observation is a gender-education-plan in panels (a) and (b), and gender-education-childless-plan group in panel (c). The first, second, and third characters of the data label refer to gender (Female or Male), education (High or Low), and plan choice (enrolled in the Actual high-bequest plan or enrolled in the Hypothetical high-bequest plan). The last digit 0 indicates childless groups and 1 the group with children.



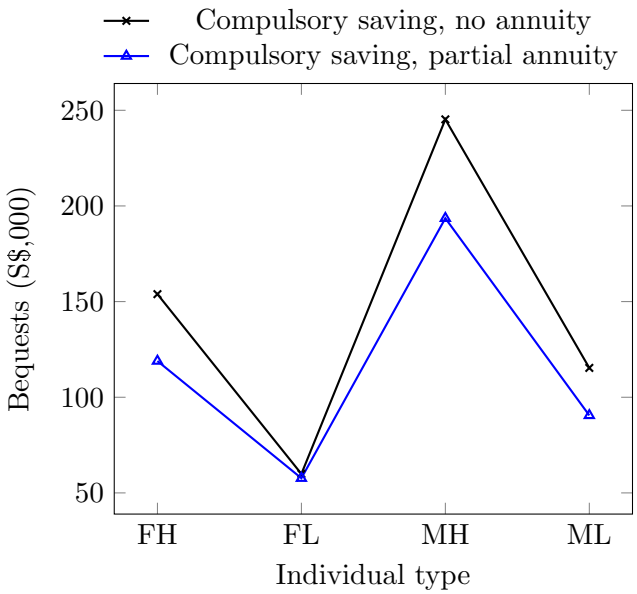
(a) Bequest amounts (S$,000)



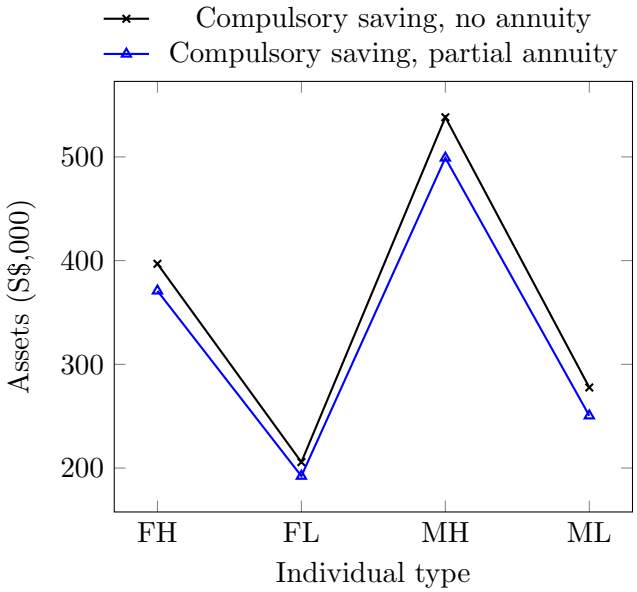
(b) Assets amounts (S$,000)

Figure 3: The impact of the intentional bequests motive

In the no bequest motive case, $\phi = 0$. With a bequest motive, $\phi = 0.924$. $c_b = 0$ for both cases. Bequest is the simulated average individual bequest from ages 65 to 100. Asset is the simulated asset level at age 65.



(a) Bequest amounts (S$,000)



(b) Assets amounts (S$,000)

Figure 4: The impact of partial annuity

Under the compulsory saving without annuity scheme, the government pays a constant amount of monthly payouts to survival policy holders up to age 85. The present value of the payout equals the compulsory saving balance at age 65. If a policy holder dies before 85, the compulsory saving balance at the time of death will be paid to the policy holder's heirs.

Table 1: Summary statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) max	(5) min
Eligible for enrolling in the annuity plans	2,011	0.736	0.441	1	0
Would choose higher-bequest plan (hypothetical)	1,890	0.271	0.445	1	0
Knowledgeable about the annuity plans	2,005	0.777	0.937	2	0
CPF account balance (S$)	1,448	55,801	52,867	200,000	0
Have other bequests in addition to CPF	1,906	0.352	0.478	1	0
Non-housing asset > CPF	1,897	0.346	0.476	1	0
Living in a 5-room flat	1,906	0.313	0.464	1	0
Age	2,010	58.86	3.149	75.73	50.55
Very good health	2,011	0.127	0.333	1	0
Do not have any children	2,011	0.159	0.366	1	0
Chinese	1,956	0.812	0.391	1	0
Female	2,011	0.564	0.496	1	0
Years of schooling > 9	2,011	0.286	0.452	1	0
Monthly earnings	780	3,034	2,162	10,000	130
Percentage of lottery tickets given to others	1,241	38.99	30.54	100	0
Ave. years of schooling of all adult children	1,478	13.42	1.975	18	0
Average financial security	1,535	3.436	0.798	5	1
Financial insecurity of all children	1,535	0.123	0.329	1	0
Mean number of visits (per month)	516	3.075	1.321	5	0
Values of the difference in bequests between the two Plans (in term of annual payout)[a]	1,839	1,261	2,042	5,440	0

Notes: Enrollment in the annuity plans is compulsory for Singaporeans and Singapore permanent residents born between 1/1/1959 and 31/7/1960 if their retirement account balance is S$40,000 or more at age 55, or S$60,000 at age 65. Those born before 1/8/1960 are eligible to join the annuity plans.

[a] For those who chose the lower-bequest plan initially, the value is the additional annual payout when they switch to the higher-bequest plan. For those who choose the higher-bequest plan initially, the value is negative one times the additional annual payout when they switch to the lower-bequest plan.

Table 2: The probability of enrolling in the higher-bequest plan

VARIABLES	(1)	(2)	(3)	(4)
Have some knowledge about the two plans	0.087***	0.134***	0.095***	0.169***
	(0.029)	(0.033)	(0.035)	(0.057)
Childless (yes=1)	-0.079**			
	(0.033)			
Very good health (yes=1)	-0.127***	-0.106***	-0.127***	-0.103
	(0.032)	(0.038)	(0.037)	(0.068)
Years of schooling > 9	0.092***	0.100***	0.104***	0.069
	(0.030)	(0.035)	(0.035)	(0.073)
Chinese	0.049	0.062*	0.061	-0.036
	(0.035)	(0.037)	(0.038)	(0.069)
Female	-0.002	0.034	0.015	0.083
	(0.028)	(0.033)	(0.033)	(0.058)
Ave. years of schooling of all adult children		-0.018**		
		(0.008)		
Financial insecurity of all children			0.126**	
			(0.063)	
Mean number of visits (per month)				0.001
				(0.022)
Observations	743	550	567	177
R-squared	0.046	0.061	0.054	0.067
Mean of the dependent variable	0.184	0.189	0.198	0.192

Notes: The dependent variable equals 1 if the respondent enrolled or planned to enroll in the higher-bequest plan and 0 otherwise. The sample consists of respondents who have already enrolled or were in the process of enrolling in an annuity plan. Huber-White robust standard errors are reported in parentheses. (* p<0.1; ** p<0.05; *** p<0.01).

Table 3: The impacts of other assets and children's characteristics on annuity choice

VARIABLES	(1)	(2)	(3)	(4)
ln (Housing Value)	0.148**			
	(0.071)			
Living in a 5-room flat		0.039		
		(0.034)		
Non-housing asset > retirement account			0.003	
			(0.031)	
Have other bequests				0.014
				(0.029)
Other controls	Yes	Yes	Yes	Yes
Observations	449	722	729	725
R-square	0.075	0.051	0.041	0.043
Mean of the dependent variable	0.200	0.184	0.185	0.185
	(5)	(6)	(7)	(8)
Living in a 5-room flat	0.011			
	(0.046)			
Log of retirement account balance		0.048**		
		(0.020)		
Ave. schooling of all adult children			-0.017*	
			(0.010)	
Financial insecurity of all children				0.106
				(0.078)
Other controls	Yes	Yes	Yes	Yes
Observations	447	345	340	346
R-square	0.042	0.063	0.052	0.044
Mean of the dependent variable	0.190	0.200	0.185	0.194

Notes: The dependent variable equals 1 if the respondent enrolled or planned to enroll in the higher-bequest plan and 0 otherwise. The sample consists of respondents who have already enrolled or were in the process of enrolling in an annuity plan. We further restricted the sample to those whose non-housing asset is smaller than their retirement account balance in columns (5) to (8). We controlled for a series of dummy variables indicate whether the respondent knows the difference between the two schemes, and is in good health, graduated from secondary school, is an ethnic Chinese, and is a female in all regressions. We further also include childless dummy variable in columns (1) to (6). Huber-White robust standard errors are reported in parentheses. (* p<0.1; ** p<0.05; *** p<0.01).

Table 4: The probability of preferring the hypothetical higher-bequest plan

VARIABLES	(1)	(2)	(3)	(4)
Do not have any children	-0.111***			
	(0.037)			
Very good health	-0.089**	-0.051	-0.081*	-0.118
	(0.040)	(0.047)	(0.046)	(0.081)
Years of schooling > 9	0.002	0.019	0.009	0.061
	(0.032)	(0.039)	(0.038)	(0.072)
Chinese	0.004	0.021	-0.004	-0.060
	(0.043)	(0.047)	(0.047)	(0.079)
Female	0.049	0.094**	0.085**	0.178***
	(0.032)	(0.038)	(0.038)	(0.065)
Ave. schooling of all adult children		-0.033***		
		(0.009)		
Financial insecurity of all children			0.143**	
			(0.069)	
Mean number of visits (per month)				-0.027
				(0.025)
Constant	0.249***	0.645***	0.220***	0.279**
	(0.043)	(0.131)	(0.047)	(0.107)
Observations	718	530	551	172
R-squared	0.019	0.038	0.024	0.067
Mean of the dependent variable	0.244	0.255	0.263	0.256

Notes: The dependent variable equals 1 if a respondent preferred the hypothetical higher-bequest plan and 0 otherwise. The sample consists of respondents who had already enrolled or were in the process of enrolling in an annuity plan. Huber-White robust standard errors are reported in parentheses. (* p<0.1; ** p<0.05; *** p<0.01).

Table 5: The value of the difference in bequests between the high- and low-bequest plans

VARIABLES	(1)	(2)	(3)	(4)
Do not have any children	-35.580*			
	(18.795)			
Very good health	0.361	18.748	22.533	83.671
	(23.100)	(26.368)	(26.451)	(52.371)
Years of schooling > 9	76.813***	67.643***	65.568***	88.493**
	(18.498)	(21.389)	(21.153)	(39.169)
Chinese	-7.618	16.555	-10.043	-19.567
	(20.513)	(22.929)	(23.238)	(36.781)
Female	6.640	7.027	10.188	-22.879
	(15.921)	(18.211)	(18.033)	(29.848)
Ave. schooling of all adult children		-18.200****		
		(4.785)		
Financial insecurity of all children			37.836	
			(29.951)	
Mean number of visits (per month)				-12.489
				(12.032)
Observations	1,342	1,012	1,043	357
R-squared	0.017	0.025	0.013	0.041
Mean of the dependent variable	162	158	163	144

Notes: The sample consists of all respondents who preferred the hypothetical high-payout low-bequest plan. The dependent variable is the difference in the annualized payout between the two plans when a person switched from the hypothetical low- to high-bequest plan. The value is set at 0 for those who still took the low-bequest plan even when the two hypothetical plans provided the same annualized payout. Huber-White robust standard errors are reported in parentheses. (* p<0.1; ** p<0.05; *** p<0.01).

Table 6: The distribution of lottery tickets among children

VARIABLES	(1)	(2)	(3)	(4)
Child is a male	0.451	0.380	0.375	0.882
	(0.612)	(0.632)	(0.624)	(0.806)
Birth order	-0.079	-0.120	-0.127	-0.719
	(0.320)	(0.344)	(0.328)	(0.713)
Child's schooling		0.059		
		(0.311)		
Financial insecurity (child)			-0.989	
			(1.478)	
No. of visits (per month)				1.264
				(0.914)
Family fixed-effects	YES	YES	YES	YES
Observations	1,420	1,383	1,380	489
R-square	0.001	0.001	0.002	0.064
Number of families	588	583	576	303
Mean of the dependent variable	36.672	36.63	36.654	35.139

Notes: The data is organized at the parent-child pair level. The dependent variable is the proportion of lotteries allocated to a particular child. The sample consists of respondents who accepted the lottery tickets and had at least one child who was at least 18 years old at the time of the survey. No. of visits includes both physical visits and phone calls. Household fixed effects are added in the regression. Standard errors are clustered at the household level. (* p<0.1; ** p<0.05; *** p<0.01).

Table 7: Estimates of parameters

Our estimates	ϕ	c_b (S$1,000)	over-identification test
A: Homogenous agents	0.924***	3.984***	χ^2=1861.353
	(0.003)	(0.367)	p=0
B: By gender			
Men	0.938***		
	(0.009)	3.334***	χ^2=333.928
Women	0.916***	(0.003)	p=0
	(0.009)		
C: By children			
With children	0.909***		
	(0.002)	1.118***	χ^2= 6794.728
Without children	0.654***	(0.433)	p=0
	(0.006)		

Estimates from previous studies	σ	ϕ	c_b (US$1,000)	c_m (US$1,000)	β
De Nardi (2004)	1.5	0.86	1.81	NA.	0.95-0.97
De Nardi et al. (2016)	2.83	0.79	3.54	4.6	0.994
De Nardi et al. (2021)	3.698	0.96	377.4	4.108	0.97
Ameriks et al. (2011)	3	0.98	7.28	2.8	0.97
Ameriks et al. (2020)	5.27	0.48	8.53	77.43	0.97
Lockwood (2018)	4.5	0.96	17.1	19.1	0.84

Notes: Standard errors are reported in parentheses. (*** p<0.01). The sample consists of respondents who had already enrolled or were in the process of enrolling in the partial annuity plan. We fitted eight moments: four gender-education specific choices for actual enrollment and hypothetical enrollment, respectively in panels A and B. We fitted 16 moments: eight gender-education-childless specific choices for actual enrollment and hypothetical enrollment, respectively in panel C. In our structural estimation, we set $\sigma = 3$, $c_m = S\$3,000$, and $\beta = 0.97$. We transformed estimates from previous studies based on their utility functions to make the estimates comparable with our results. The authors provide the Python code of the transformation conducted on these estimates.

Table 8: The impacts of bequest motives on bequests and assets at age 65, (S$1,000)

	$\phi = 0$ (1)	$\phi_0 = 0.924$ (2)	(2)/(1)-1 in % (3)
	Bequests		
Compulsory saving			
With partial annuity	94.11	110.75	17.68
Without annuity	124.99	136.94	9.56
No compulsory saving			
No annuity	121.97	132.29	8.46
Full Annuity, load factor = 0	69.99	79.05	12.94
Partial Annuity, load factor = 0	79.79	91.31	14.44
	Assets at age 65		
Compulsory saving			
With partial annuity	304.76	315.22	3.43
Without annuity	331.86	340.88	2.72
No compulsory saving			
No annuity	342.40	352.28	2.88
Full Annuity, load factor = 0	325.76	336.11	3.18
Partial Annuity, load factor = 0	352.93	360.11	2.03

Notes: Under the compulsory saving regime, the partial annuity results are the weighted average of the two prevailing government annuity schemes. Under the no compulsory saving regime, the present value of the payout from the annuity adjusted for group specific mortality is restricted to be the same as the premium. Under the partial annuity regime, the present value of the payout plus the present value of bequests adjusted for group specific mortality is restricted to be the same as the premium. We further assume that 20% of the premium is used to pay for bequests and 80% for monthly payouts. Similar to the prevailing government annuity schemes, we also reduce the amount of bequests as people age. In particular, the relationship between age and bequest follows a spline function $b_x = b_{65}(0.232 + 0.764 * (75 - x)/10)\ if\ x \leq 75$; $= b_{65}(0.232 * (85 - x)/10)\ if\ 75 < x \leq 85$; and $= 0\ if\ x > 85$, where b_x and b_{65} are the bequests at age x and 65, respectively.

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Intentional Bequest Motives and the Choice of Annuity

Haoming Liu, Changcheng Song, and Shenghao Zhu

A Institutional background

A.1 CPF and CPF LIFE plans

The Central Provident Fund (CPF), created by the British colonial government in 1955, is the predominant pillar of Singapore's pension system. It is a self-funded pension system with no risk pooling before the introduction of the CPF Lifelong Income scheme for the Elderly (CPF LIFE). Both employers and employees need to contribute. The contribution rate is regulated at 5% for both the employer and the employee at the beginning. Both the employer and employee contribution rates have progressively increased along with the growth of Singapore's economy. Between 1 January 2016 and 31 December 2016, the employer contributes 17% of its employee's wage while the employee contributes 20% of his/her wage to the fund for workers who are at most 55 years old. Total contributions are capped at S$2,220 per month. The contribution rates reduce to 13% for both the employer and the employee once the employee reaches age 56, and to 7.5% for the employer and 9% for the employee once the employee reaches age 61. The contributions are divided into three accounts: the Ordinary Account (OA), the Special Account (SA), and the Medisave Account (MA). The contribution rate to each account varies across age and year as well. For an 55-year old employee, the joint employer-employee contribution rate is 15% for the OA, 11.5% for the SA, and 10.5% for the MA.[33] CPF members can either manage their own accounts or leave the management to the CPF board. If they choose the latter, these accounts will yield risk-free interests, guaranteed by the government. The interest rate is 3.5% for the OA, and 5% for the SA and MA in between 1 April 2016 to 30 June 2016.[34]

The SA is designated for retirement needs and CPF members cannot withdraw any money from it before they are 55. The MA can only be used to pay for their own or immediate family member's health expenditures or approved medical insurances. CPF members can use some of their OA to purchase homes. The CPF board creates a Retirement Account (RA) when its members turn 55. Savings from the OA and SA will be transferred to this account and form the Retirement Sum. Before the transfer, members have the option to withdraw some of their

[33] See `http://solutionsatwork.com.sg/wp-content/uploads/CPF-Contribution-Rates-2016.pdf` for a detailed description of the CPF contribution rate and allocation in 2016.

[34] The information is downloaded from `https://www.cpf.gov.sg/member/infohub/news/news-releases/cpf-interest-rates-from-1-april-2016-to-30-june-2016\#:~:text=Central\%20Provident\%20Fund\%20(CPF)\%20members,the\%20second\%20quarter\%20of\%202016.` Last accessed on 24 October 2022.

CPF savings. The amount of withdrawal depends on account balance and home ownership. Members can withdraw all savings in their OA and SA if the combined balance is S$5,000 or less. If the balance exceeds S$5,000, CPF members can withdraw up to S$5,000 if the balance is less than S$171,000 (referred to as the Full Retirement Sum) or more if the balance is above S$171,000. If members own homes, they can pledge to refund their CPF account if they sell their homes. For them, they can withdraw the balance above S$80,500 (referred to as the Basic Retirement Sum).

The initial CPF LIFE scheme consists of four planes: Basic Plan, Balanced Plan (the default), Plus Plan, and Income Plan. These plans differ in monthly payouts and bequest. The Basic Plan offers the lowest monthly payout, but highest bequest, while the Income Plan offers the highest monthly payout, but lowest bequest. The scheme was further simplified to only two plans on January 1, 2013: Basic Plan and Standard Plan (the default). For individuals who opted in before 2013, they can choose either to stay with their original choice or to switch to the new plans or to opt out. As of the end of 2014, more than 140,000 CPF members participated in the scheme and a total of S$509.5 million had been distributed since September 2009 (Singapore CPF Board, 2014). From January 1, 2016, CPF members only needed to choose their CPF LIFE plans from age 65 to 70 at the point when they wish to receive the CPF LIFE payouts. The differences in monthly payouts and bequests are considerable. For instance, for a male CPF member born in 1958 with a Retirement Sum of S$180,000 at age 55, his monthly payout is S$1,246 and he can leave a bequest of S$51,779 at age 75 if he chooses the Standard Plan. His monthly payout will be reduced to S$1,149 and his bequest will be increased to S$171,006. The CPF LIFE scheme presents two choices: the Standard Plan (the default) and the Basic Plan. The month payout and bequests depend on the policy holder's gender, account balance, and birth year. For a member with an account balance of S$180,000 at 55, the following table shows that the government suggested monthly payout and bequests by gender and age of death.

					Bequests after death at age		
Balance	Birth year	Gender	Plan	Monthly payouts	65	75	85
180,000	1958	Male	Standard	1,246	208,651	51,779	0
180,000	1958	Male	Basic	1,149	235,259	171,006	78,604
180,000	1958	Female	Standard	1,137	208,760	63,239	0
180,000	1958	Female	Basic	1,097	233,104	171,920	83,930

A.2 TOTO lottery

TOTO has the biggest prize and is the second most popular lottery game in Singapore.[35] The size of the prize pool is about 54% of the net amount of the total stake collection of that draw, less the Goods and Services Tax. It is similar to the Lotto offered in New York State. It is operated by "Singapore Pools" and the tickets can be purchased from any of the 300 Singapore Pools outlets across Singapore. Draws are conducted every Monday and Thursday. The operator draws six numbers ("Winning Numbers") and then one more number ("Additional Number") from 1 to 49. If there are no winners in one of the groups (1 to 4), the respective group's prize will be snowballed to the next draw. Group 1 prizes can only be snowballed up to 4 draws, thereafter, the prize will be cascaded to Group 2. If there is more than 1 winner in a Group (1 to 4), they share the winnings equally. The payout and odds ratio for various prizes are as given in the following table.

Prize Group	Matches	Prize	Odds of winning
1 (Jackpot)	6 numbers	38% of prize pool	1 in 13,983,816
2	5 numbers + the additional number	8% of prize pool	1 in 2,330,636
3	5 numbers	5.5% of prize pool	1 in 55,491
4	4 numbers + the additional number	3% of prize pool	1 in 22,197
5	4 numbers	S$50 per winning combination	1 in 1,083
6	3 numbers + the additional number	$25 per winning combination	1 in 812
7	3 numbers	S$10 per winning combination	1 in 61

A.3 Lottery Allocation Questions

For the next two questions, we will give you S$10 TOTO lottery tickets for you to allocate. One of the questions will be implemented by a coin flip after you make your choices.

We will give you ten S$1 tickets with identical ticket numbers for the TOTO lottery from Singapore pool. Group 1 prize for S$10 tickets will be over S$380,000. Suppose you win S$250,000 with these tickets, how would you like to allocate the winnings? What percentage do you want to allocate to your children, and to yourself (including your spouse)? We will allocate the lottery tickets in several envelopes according to your choices and mail the envelops to your children. Please write your children's names and mailing addresses on the envelopes.

	Yourself	Child 1	Child 2	Child 3	Child 4	Child 5	Child 6
Lottery allocation (%)							
Name							
Mailing address or contact information							
Number of tickets							

	Child 1	Child 2	Child 3	Child 4	Child 5	Child 6
Lottery allocation (%)						
Name						
Mailing address or contact information						
Number of tickets						

[35]The most popular lottery in Singapore is 4-D with a highest prize of S$3,000.

A.4 Hypothetical CPF LIFE plan question

Mr Tan is a Singaporean who will be 55 in Jan. 2014. He has $100,000 in his RA and will be placed on CPF LIFE. He can choose between the two existing plans (the LIFE Standard Plan or the LIFE Basic Plan). The table below is based on the CPF LIFE payout calculator. The bequest amount is rounded to the nearest 1000.

Suppose you have $100,000 in your RA, which plan will you choose? i. The LIFE Standard Plan (the lower-bequest plan); ii. The LIFE Basic Plan (the higher-bequest plan).

Plan	**Option 1: LIFE Standard**	**Option 2: LIFE Basic**
Annualized payout from 65	9,720	8,760
Bequest left for your beneficiaries at selected ages		
Bequest at age 65	$108,000	$140,000
Bequest at age 75	$14,000	$102,000
Bequest at age 85	$0	$47,000
Bequest at age 95	$0	$0

If respondents chose option 1, then they were asked whether they would switch to option 2 if the monthly payout increases from $8,760 to $9,000, to $9,240 etc.

Plan	Option 1: LIFE Standard	Option 2: Plan X	Choice 1 or 2
Bequest at age 65	$108,000	$140,000	
Bequest at age 75	$14,000	$102,000	
Bequest at age 85	$0	$47,000	
Bequest at age 95	$0	$0	
Annualized payout from 65	9,720	9,000	
Annualized payout from 65	9,720	9,240	
Annualized payout from 65	9,720	9,480	
Annualized payout from 65	9,720	9,600	
Annualized payout from 65	9,720	9,720	

B Technical notes for structural estimation

B.1 Expectation in the structural model

Before the government announced the new pension system, the agents in the model had the expectation that they would be under the old regime after retirement. We formalize the agent's expectation under the old regime in this section. We use the recursive method of dynamic programming to describe the agent's expectation. Under the old regime, the agent's problem during ages 55-64 is

$$V_t^j(i, edu, RA_{55}, a_t, h_t) =$$
$$\max_{c_t, a_{t+1}, b_{t+1}} \left\{ u(c_t) + \beta E_t \left[(1 - p_t(i)) V_{t+1}^j(i, edu, RA_{55}, a_{t+1}, h_{t+1}) + p_t(i) v(b_{t+1}) \right] \right\}$$

$$s.t.\ c_t \begin{cases} = c_m & , \text{ if } ys_t > 0 \\ \geq c_m & , \text{ if } ys_t = 0 \end{cases}$$

$$sav_t = \begin{cases} 0 & , \text{ if } ys_t > 0 \\ a_t - d(h_t) - c_t \geq 0 & , \text{ if } ys_t = 0 \end{cases}$$

$$a_{t+1} = (1+r)sav_t + (1-\rho_1)y_{t+1}(i, edu),$$

$$b_{t+1} = (1+r)sav_t + g_{t+1}^{mins}(i, RA_{55}),$$

for $55 \leq t \leq 64$, where $g_{t+1}^{mins}(i, RA_{55})$ is the bequest received from the CPF under the old regime.

Under the old regime, the agent's problem after age 65 is

$$V_t^j(i, edu, RA_{55}, a_t, h_t) =$$
$$\max_{c_t, sav_t, a_{t+1}, b_{t+1}} \left\{ u(c_t) + \beta E_t \left[(1 - p_t(i)) V_{t+1}^j(i, edu, RA_{55}, a_{t+1}, h_{t+1}) + p_t(i) v(b_{t+1}) \right] \right\}$$

$$s.t.\ c_t \begin{cases} = c_m & , \text{ if } ys_t > 0 \\ \geq c_m & , \text{ if } ys_t = 0 \end{cases}$$

$$sav_t = \begin{cases} 0 & , \text{ if } ys_t > 0 \\ a_t - d(h_t) - c_t \geq 0 & , \text{ if } ys_t = 0 \end{cases}$$

$$a_{t+1} = (1+r)sav_t + f_{t+1}^{mins}(i, RA_{55}),$$

$$b_{t+1} = (1+r)sav_t + g_{t+1}^{mins}(i, RA_{55}),$$

for $65 \leq t \leq 99$, where $f_{t+1}^{mins}(i, RA_{55})$ is the monthly payout from the CPF under the old regime. Both $f_{t+1}^{mins}(i, RA_{55})$ and $g_{t+1}^{mins}(i, RA_{55})$ equal zero after age 85.

B.2 Numerical solution

We use dynamic programming to solve the household's problem. We discretize the state space of assets on an interval. One period in the household's problem represents one year. We use backward induction to solve dynamic programming. To solve the maximization problem in each period, we apply the piece-wise linear interpolation to the value function. For different gender-education groups, we solve different dynamic programming problems.

B.3 Estimation

We use the Generalized Method of Moments to estimate the structural parameters of the model. To solve the minimum distance problem, we use grid search on the parameter space.

Let $\theta = [\phi, c_b]$. $m(\theta)$ is the moment vector generated from the model,

$$m(\theta) = \begin{bmatrix} m_1(\theta) \\ m_2(\theta) \\ m_3(\theta) \\ \vdots \\ m_H(\theta) \end{bmatrix},$$

where H is the total number of moments used in the estimation. Each moment $m_i(\theta)$ is constructed by

$$m_i(\theta) = \frac{1}{n_i} \sum_{j=1}^{n_i} m_{i,j}(\theta),$$

for $i = 1, 2, \ldots, H$, where n_i is the number of individuals used to calculate moment i. $m_{i,j}$ represents the choice probability of individual j.

Since the annuity choice is a discrete option, we use the logit formula to calculate the choice probability. In the model, the probability of choosing the higher-bequest plan is

$$m_{i,j}(\theta) = \frac{\exp[V_{55}^h(\cdots;\theta)]}{\exp[V_{55}^l(\cdots;\theta)] + \exp[V_{55}^h(\cdots;\theta)]},$$

where $V_{55}^h(\cdots;\theta)$ is the value function of the agent who chooses the higher-bequest plan at age 55, and $V_{55}^l(\cdots;\theta)$ is the value function of the agent who chooses the lower-bequest plan at age 55.

In the benchmark estimation, we use $H = 8$ moments to estimate the parameters, including the hypothetical questions. m^d is the moment vector from the data. m_i^d, $i = 1, 2, 3, 4$, is the fraction of people who choose the higher-bequest plan in different gender-education groups. m_i^d, $i = 5, 6, \ldots, H$, is the fraction of people who choose the higher-bequest plan in the hypothetical scenario in different gender-education groups. We have the individual level information in the survey. For individual j, let

$$I_{i,j} = \begin{cases} 1 & , \text{ if } j \text{ chooses the higher-bequest plan} \\ 0 & , \text{ if } j \text{ chooses the lower-bequest plan} \end{cases}$$

represent $j's$ annuity choice. Then, we have

$$m_i^d = \frac{1}{n_i} \sum_{j=1}^{n_i} I_{i,j},$$

for $i = 1, 2, \ldots, H$, where n_i is the number of observations used to calculate moment i.

We use a two-step procedure to estimate the parameter θ. Let

$$b(\theta) = m(\theta) - m^d.$$

In the first step, we use the identity matrix as the weighting matrix,

$$W_1 = \begin{bmatrix} 1 & 0 & 0 & \ldots & 0 \\ 0 & 1 & 0 & \ldots & 0 \\ 0 & 0 & 1 & \ldots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \ldots & 1 \end{bmatrix}_{H \times H}$$

We find

$$\hat{\theta} = arg\min_{\theta} b(\theta)' W_1 b(\theta).$$

In the second step, we use the optimal weighing matrix estimated from the first step,

$$W_2 = \left[\frac{\partial b(\hat{\theta})}{\partial \theta} \frac{\partial b(\hat{\theta})'}{\partial \theta} \right]^{-1},$$

where $\frac{\partial b(\hat{\theta})}{\partial \theta}$ is calculated as the numerical derivative by perturbing θ at $\hat{\theta}$. We then find

$$\theta^* = arg\min_{\theta} b(\theta)' W_2 b(\theta).$$

Table A.1: Sensitivity analysis

$(\beta, \sigma, c_m\ )$	ϕ	c_b (S$1,000)
0.97, 3, 3	0.924	3.984
	(0.003)	(0.367)
0.98, 3, 3	0.888	4.119
	(0.004)	(0.921)
0.96, 3, 3	0.902	3.494
	(0.005)	(0.483)
0.95, 3, 3	0.867	1.975
	(0.005)	(1.113)
0.97, 2.5, 3	0.887	5.227
	(0.004)	(0.536)
0.97, 3.5, 3	0.927	3.183
	(0.006)	(0.522)
0.97, 3, 2	0.909	3.889
	(0.004)	(0.488)
0.97, 3, 4	0.906	3.787
	(0.003)	(0.722)

Notes: β is the discount factor, σ is the coefficient of relative risk aversion with respect to the bequests, and c_m is the minimum consumption. Numbers in the parenthesis are standard errors.

This is the result that we report in the first line of Table 7.

To find the global minimizer of θ, we first use grid search on the parameter space of $31(\phi) * 62(c_b) = 1922$ initial points . Then we use the minimizer in the grid search as the initial value to start a Nelder-Mead algorithm to implement a new search. For each gender-education group, we use 500 individuals to simulate the wealth distribution within the group. At age 25 each individual is assigned an initial asset of S$4,000.

The health expenditure $d(t; h_t)$ is age-dependent. The health expenditure in each period is drawn randomly from a 4-state set $S(t)$. The four states of $S(t)$ depend on age, which reflect 15%, 45%, 75%, and 95% of the medical expenditure distribution at the corresponding age. The probability distribution is $Pr(d(t; h_t) = s_1) = 0.3$, $Pr(d(t; h_t) = s_2) = 0.3$, $Pr(d(t; h_t) = s_3) = 0.3$, and $Pr(d(t; h_t) = s_4) = 0.1$.

To speed up the calculation, we use parallel computing. We assign m_i of each i for different cores to implement the calculation.

B.4 Standard errors

We use a two-step procedure to estimate the standard errors of parameter estimates. The variance-covariance matrix for estimated parameters is

$$Q_2 = \left[\frac{\partial b(\theta^*)'}{\partial \theta} W_2 \frac{\partial b(\theta^*)}{\partial \theta} \right]^{-1}.$$

This is the result that we report in the first line of Table 7.

Table A.2: The impacts of bequest motives on bequests and assets at age 65, (S$1,000)

	$\phi = 0$ (1)	$\phi_0 = 0.924$ (2)	(2)/(1)-1 in % (3)
	Bequests		
Compulsory saving			
With partial annuity	94.11	110.75	17.68
Without annuity	124.99	136.94	9.56
No compulsory saving			
No annuity	121.97	132.29	8.46
Full Annuity, load factor = 0.10	63.84	73.79	15.58
Partial Annuity, load factor = 0.10	77.65	88.18	13.57
	Assets at age 65		
Compulsory saving			
With partial annuity	304.76	315.22	3.43
Without annuity	331.86	340.88	2.72
No compulsory saving			
No annuity	342.40	352.28	2.88
Full Annuity, load factor = 0.10	336.64	347.10	3.11
Partial Annuity, load factor = 0.10	354.88	362.23	2.07

Notes: Under the compulsory saving regime, the partial annuity results are the weighted average of the two prevailing government annuity schemes. Under the no compulsory saving regime, the present value of the payout from the annuity adjusted for group specific mortality is restricted to be the same as the premium. Under the partial annuity regime, the present value of the payout plus the present value of bequests adjusted for group specific mortality is restricted to be the same as the premium. We further assume that 20% of the premium is used to pay for bequests and 80% for monthly payouts. Similar to the prevailing government annuity schemes, we also reduce the amount of bequests as people age. In particular, the relationship between age and bequest follows a spline function $b_x = b_{65}(0.232 + 0.764 * (75 - x)/10)\ if\ x \leq 75$; $= b_{65}(0.232 * (85 - x)/10)\ if\ 75 < x \leq 85$; and $= 0\ if\ x > 85$, where b_x and b_{65} are the bequests at age x and 65, respectively.