

7-2018

High-frequency Internet survey of a probability sample of older Singaporeans: The Singapore Life Panel

Rhema VAITHIANATHAN

Singapore Management University, rhemav@smu.edu.sg

Bryce HOOL

Singapore Management University, BRYCEHOOL@SMU.EDU.SG

Michael D. HURD

RAND Centre for the Study of Aging

Susann ROHWEDDER

RAND Centre for the Study of Aging

DOI: <https://doi.org/10.1142/S0217590818420043>

Follow this and additional works at: https://ink.library.smu.edu.sg/soe_research

 Part of the [Asian Studies Commons](#), [Behavioral Economics Commons](#), [Gerontology Commons](#), and the [Health Economics Commons](#)

Citation

VAITHIANATHAN, Rhema; HOOL, Bryce; HURD, Michael D.; and ROHWEDDER, Susann. High-frequency Internet survey of a probability sample of older Singaporeans: The Singapore Life Panel. (2018). *Singapore Economic Review*. 1-20. Research Collection School Of Economics.

Available at: https://ink.library.smu.edu.sg/soe_research/2243

This Journal Article is brought to you for free and open access by the School of Economics at Institutional Knowledge at Singapore Management University. It has been accepted for inclusion in Research Collection School Of Economics by an authorized administrator of Institutional Knowledge at Singapore Management University. For more information, please email libIR@smu.edu.sg.

HIGH-FREQUENCY INTERNET SURVEY OF A PROBABILITY SAMPLE OF OLDER SINGAPOREANS: THE SINGAPORE LIFE PANEL

RHEMA VAITHIANATHAN§, **, BRYCE HOOL§, MICHAEL D. HURD§, ‡ and
SUSANN ROHWEDDER§, ‡

§ *Centre for Research on the Economics of Ageing, Singapore Management University*

‡ *RAND Center for the Study of Aging*

** *Auckland University of Technology*

May 2017

Facing a rapidly ageing population, Singapore is presented with urgent policy challenges. Yet there is very little economic data on the circumstances of older Singaporeans. In response, the Centre for Research on the Economics of Ageing (CREA) at Singapore Management University has been collecting monthly data on a panel of Singaporeans aged between 50 to 70 years. We detail the methodology by which the Singapore Life Panel® (SLP) was constructed using a population-representative sampling frame from the Singapore Department of Statistics. Contact was made with 25,000 households through postal, phone and in-person canvassing. 15,200 respondents from 11,500 households enrolled in the panel. Comparisons between SLP and official statistics show close matching on age, sex, marital status, ethnicity, education, labour force status, income and expenditure. This suggests that the panel is representative of Singapore's elderly population. Monthly surveys continue to be administered over the internet, supplemented by phone and in-person outreach to ensure the panel remains reliable for use in policy-making, and response rates are remarkably stable at over 8,000 per month. The SLP contains rich data on demographics, health status, socio-economic indicators, contact with government programmes, and subjective perceptions and is likely to be a key resource for economic research into ageing in Singapore.

Keywords: internet survey; probability-based internet panel; survey methodology; sampling techniques, population-representative samples; ageing

JEL Classification: C83 Survey Methods and Sampling Methods

This research was supported by the Singapore Ministry of Education (MOE) Academic Research Fund Tier 3 grant MOE2013-T3-1-009

1. Introduction

Singapore has one of the fastest ageing populations in the world driven by low rates of fertility and rapid increases in life-expectancy. This means that many older Singaporeans are still supporting elderly parents, but with fewer children who can support them in turn. The challenges for Singapore are large and urgent, yet there is almost no unit level data on the socio-economic situation of older Singaporeans.

In 2014, a team of researchers at the Singapore Management University (SMU) along with international collaborators were awarded a Ministry of Education grant to study this issue. As part of this grant the Centre for Research on the Economics of Ageing (CREA) was established at SMU – and a major data collection program commenced.

This is called the Singapore Life Panel® (SLP). The SLP is a high-frequency internet-based survey where respondents answer monthly surveys via a secure internet portal using their respondent details and password to access the survey. Eligible respondents are 50-70 year-old Singaporeans (citizens and permanent residents) and their spouses.

While internet surveys are sometimes criticized, where there is research interest in repeated high-frequency surveys of detailed financial variables such as spending, traditional modes are impractical or prohibitively expensive. Probability-based internet panels with a carefully-executed methodology have a vital role to play in social science research. We begin by examining the literature around internet surveys, and spend the following four sections describing the methodology by which the SLP was established and continues to be operated. We also identify the common pitfalls of internet-based surveys and detail the strategies that we used to ensure that the panel was population representative and also the measures taken to minimise attrition. Comparisons to official statistics are used to suggest that these methods were successful. Finally, we describe the breadth and depth of variables collected by the SLP.

2. Literature Review

Internet surveys of the population are increasing in popularity with improved access to and familiarity with the internet (Hays, Liu and Kapteyn, 2015). The American Association of Public Opinion Research suggests that 85% of studies that would typically utilise traditional methods were instead completed online (Baker et al., 2010).

Web surveys offer many advantages over alternative methods. Data is collected from more respondents, in faster timeframes, at a fraction of the cost of traditional methods such as face-to-face, telephone or postal surveys (Struminskaya, 2014). Panel data can be established much more easily than in the past, and can track changes in complex concepts such as attitudes, expectations and probabilities (Schonlau et al., 2009). Technology enables preloading of prior response, rapid data collection and cleaning, and feedback to and from respondents. Time lags for researchers can be reduced to a few weeks or months. Experiments can be carried out on more diverse groups of respondents than the usual class of undergraduates with spare time between lectures (see Bellemare and Kroeger, 2007). Internet methods have increased in popularity, especially as traditional modes have observed declining response rates in recent years (de Leeuw and de Heer, 2002).

Internet surveys are not without their challenges, and scepticism remains as to their value relative to traditional modes for conducting surveys (Fricker and Schonlau, 2002). Most notably, familiarity with the internet may lead to selection bias and a response group that does not represent the population of interest. This problem can be particularly pronounced among the elderly, among whom internet access is even less common (Schonlau et al., 2009). Web surveys can be prone to low participation rates, leading to bias due to selective non-response (Lozar Manfreda, Bosnjak, Berzelak, Haas and Vehovar, 2008). Respondents using a computer may be careless with

their answers and primacy effects can be significant, introducing errors of observation (Tourangeau et al., 2013). These factors have led some to argue that internet surveys are no different in their quality to convenience surveys (Rivers, 2013).

Proper statistical methods go some way to mitigating these problems. Probability-based internet panels start by selecting respondents randomly from a frame which covers the entire target population (Struminskaya, 2014). Each sample unit thus has a known, non-zero probability of selection. One of the oldest probability-sample internet panels is the CentERpanel, administered by Tilburg University since 1991. Probability-based panels produce data of higher quality than non-probability panels (Callegaro, Villar, Yeager and Krosnick, 2014). Many existing surveys mitigate selection bias by using traditional methods in initial stages, and providing households with tools to access the survey in alternative modes. This ensures non-internet users have the opportunity to become panel members. Examples include Knowledge Networks, RAND American Life Panel (ALP), CentERpanel and Longitudinal Internet Studies for the Social Sciences (LISS) (Schonlau et al., 2009).

3. Sampling Frame

To ensure that the data coming out of the Singapore Life Panel® would be of high quality, it was vital to use probability sampling to construct the panel. The sampling frame was acquired from the Singapore Department of Statistics (DOS) and comprised 50,000 addresses. These addresses were chosen by DOS on the basis that at least one resident met the criteria for eligibility: respondents had to be Singaporean citizens or permanent residents, aged between 50 and 69 years. Spouses of eligible respondents were also entitled to participate. DOS, however, did not reveal the basis upon which this was established. The sample provided to CREA was selected on the following DOS two-stage design:

1. The first stage of selection consisted of sampling divisions (SDs) that were being systematically selected based on probability proportionate to size (in terms of the number of dwelling units in each sampling division)¹.
2. The second stage of selection consisted of the stratification of housing units by broad dwelling types within each selected SD. Thereafter, for every chosen SD, a fixed number of housing units were selected by systematic sampling with a random start (M.S. Chow, personal communication, May 21, 2015).

The sample was an equal-probability and self-weighting sample. The selection probability for each household in the sample was 0.0791.

¹ The primary sampling divisions for the first stage of sample selection were demarcated based on the Urban Redevelopment Authority's planning areas (M.S. Chow, personal communication, May 21st, 2015)

It was agreed that CREA would not invite respondents who were already part of a large Government study on the older population (the Retirement and Health Study) which included a similar age group to our study. Addresses were compared between the two surveys, and 2,053 households were excluded from the sampling frame.²

Next, the remaining 47,947 household addresses were sent to the Yellow Pages Company (Singapore's telephone directory vendor) which claimed to have residential addresses and telephone numbers for all households with a listed residential phone line. Yellow Pages identified 27,551 addresses from the sampling frame for which they could supply a name and telephone number. The remaining 20,396 households from the DOS sample either did not have a landline or had not listed their landline number with Yellow Pages.

Prior to implementing recruitment to the panel, CREA decided to undertake a pilot study. For this, 1,000 households with a Yellow Pages match and 1,000 without were extracted from the sample for this pilot study. During the pilot it was determined that many of the respondents who completed the screener had forgotten that they had agreed to do the baseline survey. Consequently, a lot of effort was invested in ensuring that there were multiple ways to communicate with panel members, particularly for issuing monthly invitations (letter, SMS, email). Lessons from the methodology of the pilot were incorporated into the recruitment process for the full panel – details of which are provided below. The pilot showed a response rate of around 0.4. That is, for every 1,000 houses invited to join the SLP, 400 would be eligible for and enrol in the panel. This suggested that to achieve the target sample in the SLP, CREA would need to invite 25,000 households to participate.

Of the remaining 45,947 available households, 26,551 were Yellow Pages matched and 19,396 were not. Out of these, 25,000 were randomly chosen for recruitment: 14,522 were Yellow Pages matched and 10,478 were unmatched. These households were invited to join the Singapore Life Panel®.

4. Recruitment Methodology

Developing a recruitment methodology presented many challenges; nowhere in the world had there been an attempt to recruit a panel of older people who would be willing to answer questions on a recurring monthly basis, and on the internet. The research team therefore had to develop and test its own recruitment methodology, and recruit and train staff on survey methods. The team also had to develop its own software systems for the field work. The development of the recruitment methodology relied on extensive research on survey methods previously employed—including reaching out to research teams within Singapore and in other parts of the world, including China, the US, the UK and Europe.

The principal challenge was that while initial contact with prospective panelists could be made using traditional means, actual recruitment and sign-up had to take place on the internet platform. The reasons for this were twofold. First, the possibility of interview mode effects was to be minimised to ensure longitudinal comparability of elicited

² This does not invalidate the population-representativeness of the SLP for the target age range.

data (Fowler, 2013). For example, if the recruitment and baseline survey were carried out in a traditional face-to-face interview, then the data collected in this manner may not be comparable with data collected subsequently in self-administered, internet-based monthly modules. Second, while the traditional method would have maximised the initial response rate, subsequent attrition rates would likely have been much higher once the monthly surveys commenced and were available only via the internet. This could have induced bias due to selective non-response (Tourangeau et al., 2013).

It was decided that initial contact would be made by traditional means but that the baseline and informed consent would have to be completed by the respondent via the internet. Internet access and familiarity were asked about in the course of the registration screener and targeted strategies were applied according to these two responses. Corresponding scripts and strategies were developed for student callers to use during follow-up contacts. For example, respondents who had internet access but were not familiar with its use were encouraged to identify family members who might be able to help them. Callers would then try to speak with these household members (often children or grandchildren) and attempt to recruit them as helpers. Those with no internet access were offered the opportunity to meet student helpers at any of several designated public locations (mostly libraries) or at the CREA offices. Using scheduling software developed by the research team, staff were able to immediately schedule respondents for meeting slots. These strategies were tested in a pilot phase and refined for the full recruitment phase.

This special attention given to accommodating people with limited access or familiarity with computers or the internet mirror those used in the RAND ALP, CentERpanel and LISS. Selection bias, which can plague internet surveys, is thus mitigated by ensuring non-internet users have adequate opportunity to become panel members (Schonlau et al., 2009).

5. Recruitment

Recruitment to the main Singapore Life Panel® (SLP) started on 8th May 2015 and continued through to July 2015³. All 25,000 households in the SLP sample were sent an introductory letter. This informed the recipient that the letter was applicable to them if they were between 50 and 70 years of age and a Singapore citizen or permanent resident. If the recipient fell outside these criteria, the letter was to be passed on to someone else in the household falling into this category.

For households where a match had been made with the Yellow Pages, the letter was addressed to the name listed. For unmatched households, letters were addressed more generically to “Head of Household”.

Recruitment to the survey took place in two parts: the screener and the baseline survey.

³ Although in earlier periods we had conducted smaller pilots.

The screener was a series of questions about the age, marital status and citizenship of the respondent and other people in the household. The screener survey was only administered to one person per household. The screener attempted to (i) ascertain whether the respondent was eligible and (ii) obtain the names, birth dates and contact details (telephone numbers, email) of all people living at that address who might be eligible. For every person whom the respondent identified as eligible, the survey system generated an automatic ID and letter of invitation which were sent to these secondary members of the household.

Once eligibility was established, respondents were immediately routed to a baseline survey which consisted of a series of questions about living situation, demographics, health and education. Spouses of eligible respondents were also invited to complete the screener and baseline.

The initial invitation letter provided a web address where these screening and baseline surveys could be taken, username (identification number) and password for potential respondents to complete the survey. It also promised the respondent a \$20 supermarket voucher if they were eligible and completed the survey. All communications (letter and survey) were offered in all four official languages of Singapore – English, Mandarin, Malay and Tamil.

Households that did not respond to this initial introductory letter were then followed up. The follow-up strategy differed between those households for whom there was a Yellow Pages match and for those households for which a match had not been made.

Unmatched households were followed up with personal visits by students employed by SMU. Students visited these households in an attempt to make contact and complete the screener and baseline survey. Each student had a tablet with 3G which had online access to the survey.

They visited the addresses on three separate occasions – choosing the day of the week and time of the day to maximise the chance of the respondents being at home. If someone was at home but was not eligible, canvassers were encouraged to try and ascertain the time that an eligible household member might be home and returned to do the recruitment at that specific time. If it was the third visit and the eligible person was still not home, the canvassers went ahead and completed the screener with the person at the door.

For those households that were listed in the Yellow Pages, follow-up was outsourced via a telephone survey company. Telephone interviewers were only allowed to complete the screener over the telephone. The respondents had to complete the baseline survey themselves using the dedicated online web portal.

Completion of the baseline was the threshold for admission to the panel. In total, 11,500 households and 15,200 respondents entered the panel. Since spouses were also invited to participate, there were 620 people younger than 50 and 200 older than 69 who entered the panel, leaving 14,400 respondents aged 50-70.

6. Operation of the SLP

Every month since the establishment of the panel at the end of July 2015, panel members have been invited to participate in a 15-20 minute internet survey. The survey involves a set of standard questions about spending, income, labour market status, health, and life satisfaction. Quarterly modules ask about health insurance, work expectations, and subjective wellbeing. In the month of January there is a longer survey eliciting the details of the household's assets and income, Central Provident Fund balances, and taxation. Periodically there are one-off modules collecting data on topics relevant to policy makers' interests or to answer other important research questions, such as purchases of lottery tickets and strategic thinking tests. Panel members are paid for their participation, in the form of grocery store vouchers. They were initially paid \$25 for joining the panel, and are paid between \$10 and \$25 for each monthly module depending on the expected length of the monthly survey.

Advice from international research teams suggested that major attrition rates should be expected over time. Non-response in panel surveys results in increased variance and can be particularly problematic when attrition is selective and therefore biasing to variables of interest (Struminskaya, 2014). It was determined that a long-term contact and outreach strategy would be necessary to ensure that the SLP stayed within the consciousness of respondents, so that even if they missed answering one wave, they might remain willing to answer a subsequent wave.

The website where panel members answer the survey is available for respondents at the start of each month and stays open for three weekends, closing on the third Sunday of the month. Panel members are mailed letters at the start of the month inviting them to participate in the current survey, with regular follow-up throughout the month. Respondents who have not completed the survey receive SMS messages on the Friday, and email reminders on the Monday and Wednesday of the month. Respondents without access to a computer or the internet are personally contacted (via telephone) and, if needed, arrangements are made to meet them at local libraries. SMU students are available at the libraries to assist respondents with completing the survey.

Campaigns are run every month to ensure respondents remain engaged with the SLP. There is ongoing personal phone contact between panel members and SMU student assistants to immediately address issues as they arise, re-engage respondents who have missed a few months, and to complete the survey over the phone for respondents with physical disabilities or no internet access at home. SMU also has a hotline call service and a call centre manager. The SLP also provides the opportunity for respondents to leave comments, and around 25-30 comments are received each day that the survey is open. Comments will often clarify answers, give thanks for the vouchers and comprehensive survey, express frustrations with survey length, ask the reason behind certain questions, and enquire about SLP findings. The SLP team addresses these comments within three days of receiving the comments with a follow-up email or phone-call with the respondent and/or their family members. Highly-engaged respondents who miss a month or two are gently encouraged to re-join the panel at their convenience. All respondents are assured of the value of their participation.

Panel surveys can also be subject to errors brought about by panel conditioning – changes in response behaviour brought about by previous participation in the survey (Kalton, Kasprzyk and McMillen, 1989). Periodically, efforts are made to improve the quality of data produced by the SLP. Indicators of poor respondent behaviour include abnormally fast response times, skipping of questions, long sets of repeated responses, and nonsensical answers. Periodically, efforts are made to first warn and then remove respondents who are providing poor quality data. For example, in March of 2017, 72 respondents were removed after having reported zero spending for three consecutive months. The combination of these strategies ensure that the SLP leverages the advantages of an internet-based survey, while maintaining low attrition and good population-representativeness.

7. Response Rates

Internet panel surveys often have low response rates which can be indicative of low respondent engagement, or participation being biased by convenience, both of which can result in poor quality data (Schonlau et al., 2009, Lozar Manfreda et al., 2008). This section shows that the above strategies have paid off: attrition has been acceptable, and response rates have been high and stable.

Table 1 shows the process by which our panel was established.

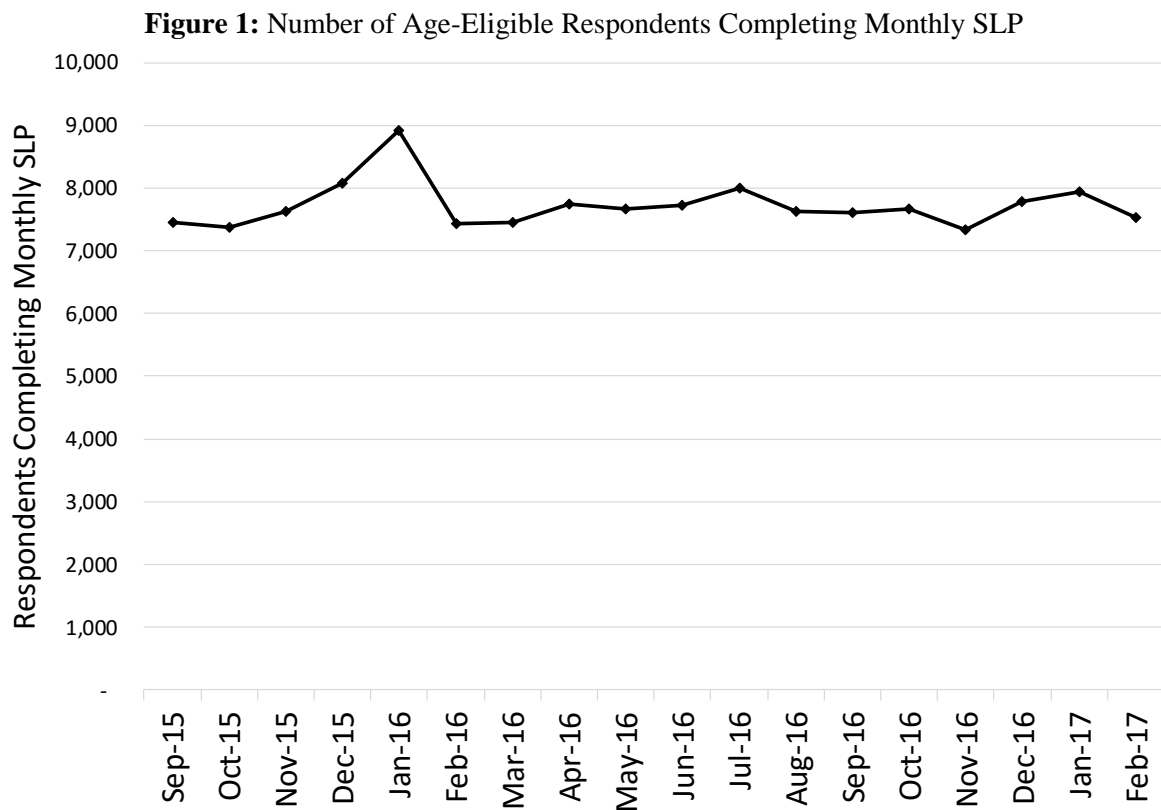
Table 1: Response Rates for the Singapore Life Panel®

Subset	Households
Households Sent Letters of Invitation	25,000
Age-Eligible Households	22,500
Households Enrolled in the Singapore Life Panel®	11,500

Initial invitations were sent to 25,000 households of whom 11% were age ineligible, leaving 22,250 households who were sent a letter and subsequently followed up with door-knocking or telephone contact. 11,500 of these households completed the baseline and were enrolled in the panel, implying a 52% response rate.

Compared to race-to-face recruitment, a 52% response rate is relatively low. However, compared to mail-based recruitment or random-digit dialling, this is a very good response rate. Hays et al. (2015) report that probability-based internet panels typically have much lower response rates. For example, the KnowledgePanel had only 14% of households willing to participate and only three-quarters of those following through – for a net response rate of around 10%. Similarly, only about 15-20% of those contacted for the Understanding America Study have signed up.

Figure 1 shows the number of (age-eligible) people that have completed each wave.



Response rates are remarkably stable over the first 18 months of the survey, consistently eliciting around 7,500 age-eligible responses. Low attrition rates are indicative of high engagement with the SLP. The spike in January 2016 is the annual asset survey for which the respondents were paid more money (\$25 vs. the \$10 paid for the core monthly survey). While January 2017 also offered the same inducement, we did not see such a spike.

We also observe respondents re-entering the survey, even after long periods of absence. For example, in the first six months of 2016, 1,200 respondents completed their first wave. That is, after having completed the baseline, they did not answer any of the first six months' of surveys they were invited to join, and then subsequently responded to their first month. Some of this is due to continued efforts to contact people in the panel, including telephone calls to personally encourage respondents to reply.

Table 2 depicts the distribution of waves completed by respondents.

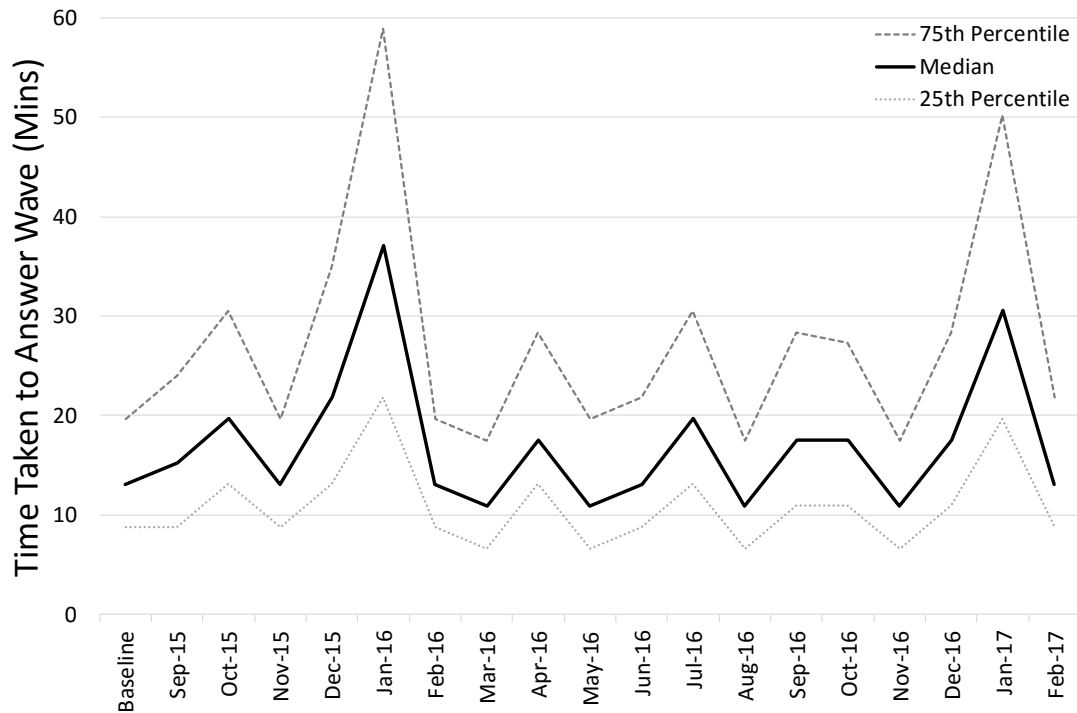
Table 2: Waves Completed by Age-eligible Respondents

Number of Waves Completed	Respondents
All Waves and Baseline	3,197
18	1,239
17	754
16	585
15	369
14	315
13	267
12	246
11	210
10	230
9	205
8	230
7	295
6	369
5	462
4	535
3	743
2	1,287
Baseline Only	2,443
Total	13,981

A core group of 3,200 age-eligible respondents have completed all waves offered to them, with a further 1,200 who have only missed one wave. This combines to over one-third of the active panel. 83% of respondents have answered at least one monthly wave in addition to the baseline.

The overall median time to answer the survey is 15.3 minutes and the 75th percentile is 26.2 minutes. Figure 2 plots the median time taken over the waves for those who completed all waves and although many of the waves are not comparable (due to different lengths), we find little evidence that people are getting faster.

Figure 2: Median Response Time of Age-Eligible Respondents



One of the concerns with using the internet to survey this population is internet access and familiarity. In the screener, we asked whether people had internet at home. Most age-eligible respondents in the SLP (75%) said that they have the internet at home and use it regularly. However, the remaining 25% said they had never used the internet. Singapore Infocomm conducts regular household surveys of computer usage (IDA, 2015). Their 2014 survey finds that 63% of 50 to 59 year olds and 27% of 60 plus residents had used a computer in the last 3 months.

Table 3 shows response frequency by self-reported internet usage for those aged 50-70 in our panel.

Table 3: Self-reported Internet Usage and Participation in Monthly Surveys

Self-reported Frequency of Internet Usage	Share of Panel	Completed at least one monthly wave	Average No. of monthly waves completed
Every day	51%	89%	11.1
Once a week	14%	86%	10.1
Few times a year	11%	83%	9.5
Never	25%	70%	6.9
Total	100%	83%	9.7

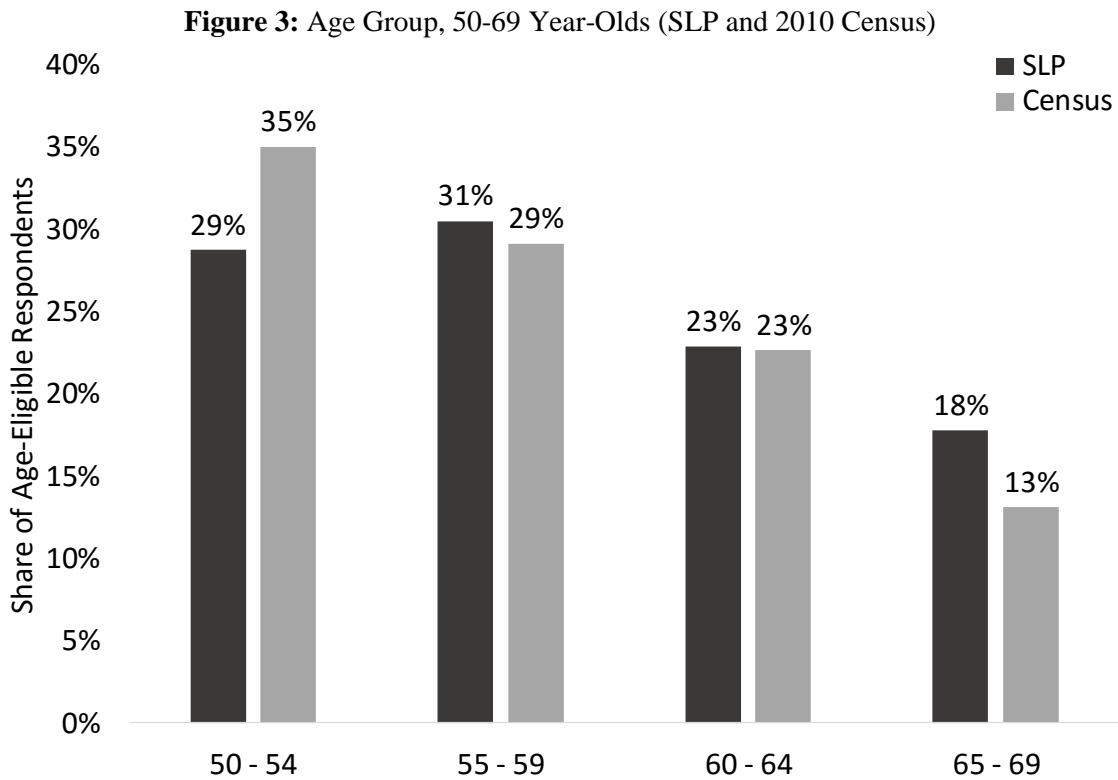
Computer familiarity is correlated with ongoing monthly participation. Of those who have never used the internet, only 70% have completed at least one monthly wave (compared to 83-89% of those who had some familiarity). Moreover, the average number of waves completed by those with no computer familiarity is 6.9, compared with 9.5-11.1 amongst those with some familiarity.

8. SLP Data Compared with Official Statistics

To test the success of the SLP in establishing a population-representative sample, we compare demographic indicators from the baseline to published statistics from Singapore Department of Statistics (DOS).

Our main comparisons come from the 2010 Census of Population and the 2014 edition of the Singapore Labour Force Survey. Note that while results from the Labour Force Survey are weighted, we present raw SLP data. Our matching was restricted only to published tables since DOS does not release any unit level records. Overall, the SLP data appears to match the census population remarkably well.

3 depicts the share of SLP respondents in each 5-year age bracket from 50 to 69. We compare this distribution to the equivalent from the 2010 Census.

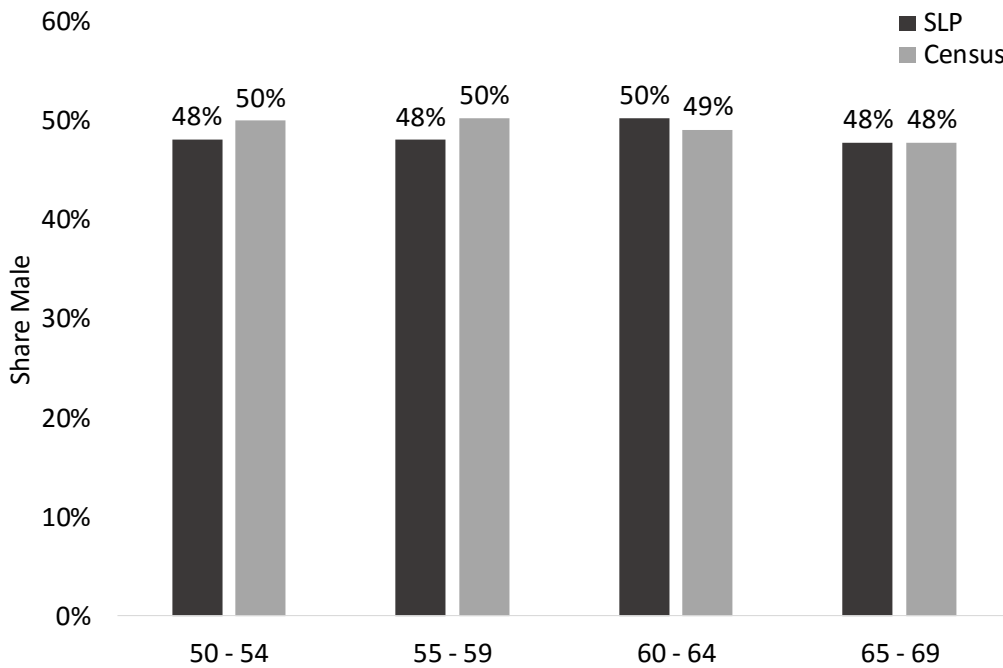


Notes to table: Census data from Census 2010, Table 13.

29% of age-eligible SLP respondents are 50 to 54 years of age (inclusive). The equivalent share from Census data is 35%. This suggests that this youngest age group is slightly under-represented in the SLP. Conversely, 65 to 69 year-olds are slightly over-represented in the SLP. Figures align well for 55 to 64 year-olds.

Figure 4 depicts the share of each age group who are male, for the SLP and Census data. It shows that the SLP is slightly under-representative of young males, and very closely representative of each gender for those in their 60s.

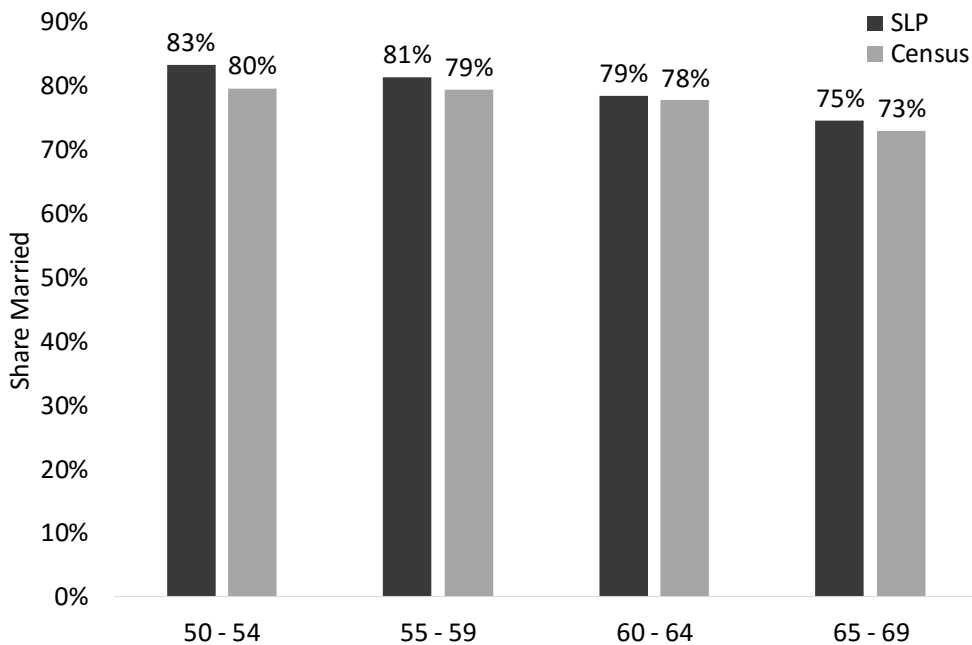
Figure 4: Gender Split in the SLP and Census



Notes to table: Census data from Census 2010, Table 13.

Figure 5 reports marital status for each 5-year age group.

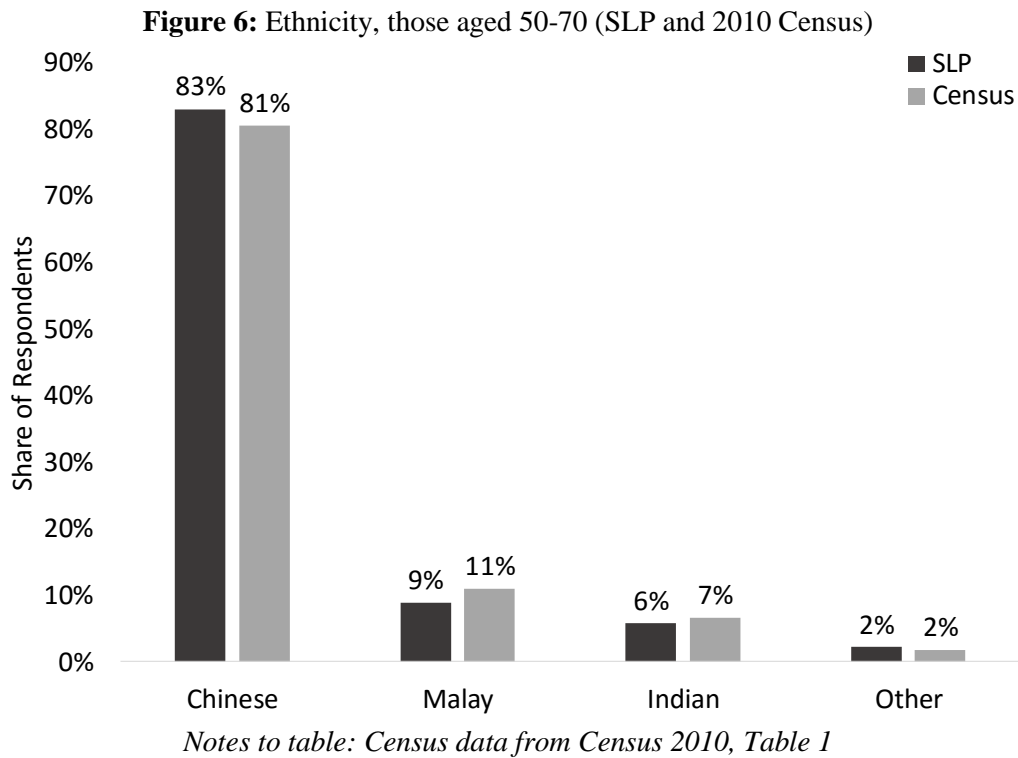
Figure 5: Marital Status and Age Group (SLP and 2010 Census)



Notes to table: Census data from Census 2010, Table 13.

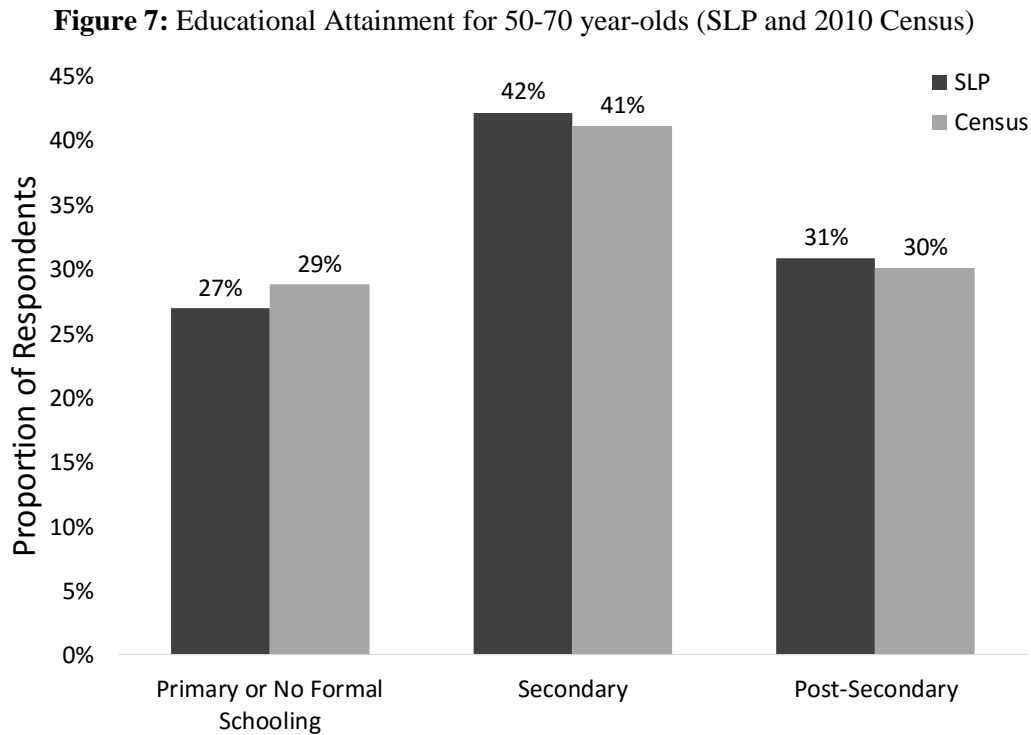
Of the SLP respondents aged 50-54 who completed the baseline survey, 83% were married and 17% were single. This compares to 80% of this age group in the Census who were married and 20% single. The SLP therefore slightly under-represents singles in this age group. The proportions for those in the older age groups are more similar, with 79% of 60-64 year-olds in the SLP being married compared with 78% in the Census.

Figure 6 compares the ethnicity distribution of the SLP respondents aged 50-70 with the 2010 Census data.



83% of age-eligible SLP respondents are Chinese, compared to 81% for the 2010 Census population. The SLP therefore slightly under-represents Malay and Indian Singaporeans.

Figure 7 shows the highest level of formal educational attainment for the SLP and Census.



Notes to Figure: Census data from Census 2010, Table 1.

Whilst we might have expected that in an internet survey, more highly educated individuals would have been more likely to respond, we find a remarkable congruence between the Census education distribution and that of the SLP respondents. In particular, 30% of the Census population had Post-secondary or Tertiary qualifications compared with 31% of the SLP population. Even the proportion of respondents with minimal or no education (i.e. no formal schooling or only primary level) makes up 27% of the SLP respondents compared with 29% of the Census respondents.

In Table 4 to Figure 9 below, we compare the economic characteristics of the SLP data to published economic data from the Singapore Labour Force Survey and the Singapore Household and Expenditure Survey. Note that unlike the census, these published surveys are not comprehensive population data but population-based samples which have been post-stratified to provide population representative sample means. It is also important to note that these economic characteristics change over time and that the survey period of the SLP differs from the survey period of the labour force and expenditure surveys.

Table 4 compares labour force participation rates from the SLP and the 2015 Singapore Labour Force survey, stratifying by gender and age. Rates are very similar across all age and gender combinations, a strong indicator that the SLP is population-representative for employment figures. The largest deviation is for 60 to 64 year-old women, where the LF survey finds that 46% are in the labour force, compared to 49% in the SLP.

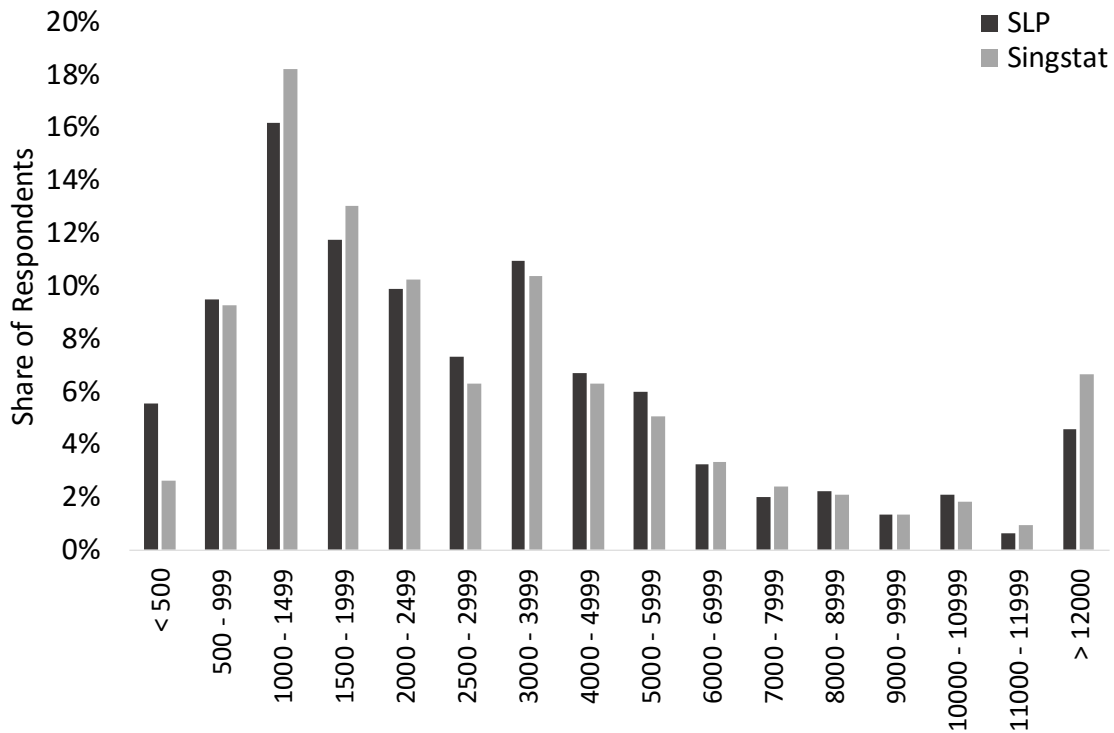
Table 4: Labour Force Participation Rates, (SLP and 2014 Singapore Labour Force Survey)

LF Participation Rate	Men		Women	
	SLP	LF Survey	SLP	LF Survey
50 - 54	95%	94%	71%	70%
55 - 59	89%	88%	63%	61%
60 - 64	75%	77%	49%	46%
65 - 69	52%	54%	29%	30%

Notes to table: LF participation taken from “Labour Force Participation in Singapore, 2014” and is defined as persons aged fifteen years and over who are either employed (i.e. working) or unemployed (i.e. actively looking for a job and available for work) during the reference period. SLP defined as people who answered the question “what is your current status” with working for pay, unemployed and looking for work, temporarily laid off, on sick leave, self-employed.

Monthly income for employed persons is depicted in Figure 8.

Figure 8: Gross Monthly Income (SLP and 2014 Singapore Labour Force Survey)

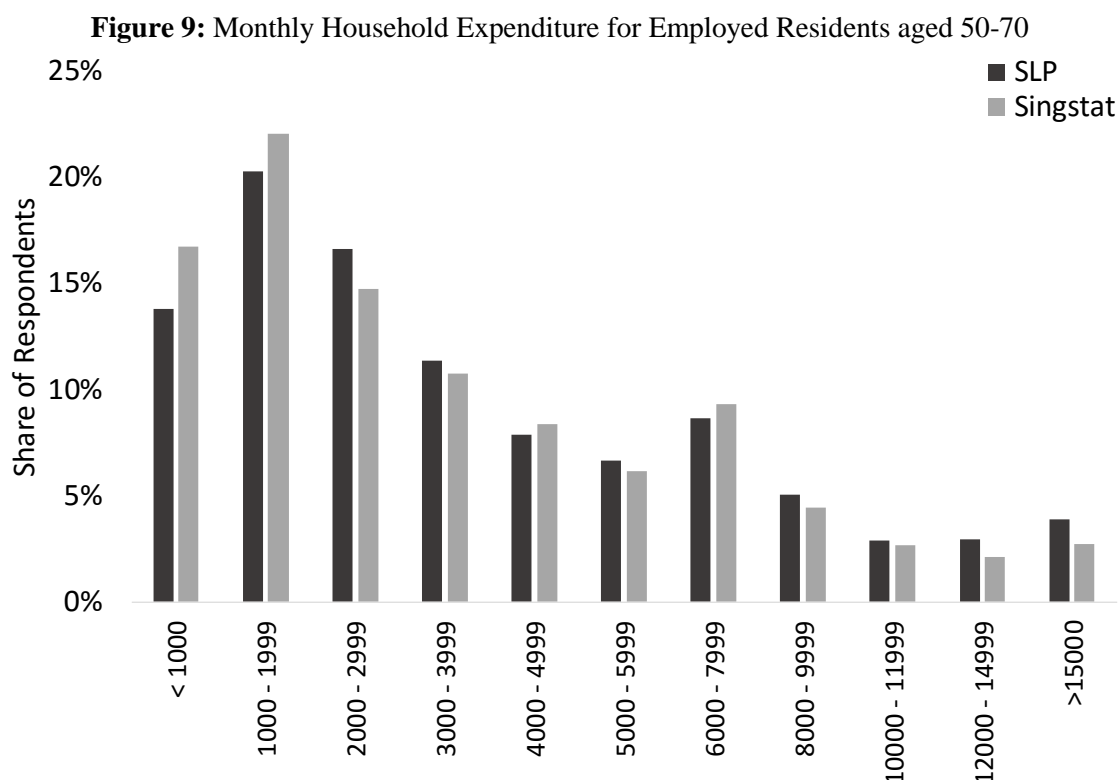


Notes to Figure: Labour Force Survey data from 2015, Table 29 “Employed Residents Aged Fifteen Years and Over by Gross Monthly Income from Work (Excluding Employer CPF), Age and Sex, June 2015”

Figure 8 compares gross monthly income as recorded in the Singapore Labour Force Survey with the SLP data. We have tried to construct comparable samples. The LFS data pertains to employed persons (defined as (i) working for one hour or more either for pay, profit or family gains; or (ii) have a job or business to return to but are temporarily absent because of illness, injury, breakdown of machinery at workplace, labour management dispute or other reasons.) For the SLP, we restricted the data to respondents who answered the question “What is your current employment situation?” with (i) Working for pay, (ii) Temporarily laid off, (iii) On sick or other leave, or (iv) Self-employed. Income is the response to the question “How much was your total income from work in the month of [last month], before taxes and other deductions?”.

The data is very similar in distribution.

Figure 9 shows the distribution of monthly household expenditure for the same two surveys.



Notes: Report on the Household Expenditure Survey from 2012/13, Table 6 “Households by Monthly Household Income and Working Status/ Occupation of Main Income Earner (excluding imputed rental of owner-occupied accommodation)”. Employed persons is defined as work for one hour or more either for pay, profit or family gains; or (ii) have a job or business to return to but are temporarily absent because of illness, injury, breakdown of machinery at workplace, labour management dispute or other reasons.) SLP: Employed defined as answering the question “What is your current employment situation?” with Working for pay or Self-employed. Expenditure taken from waves 1-4 of SLP

Figure 9 compares the monthly household expenditure recorded by the Household Expenditure Survey and those recorded in waves 1 to 4 of the SLP. We have tried to ensure that the samples were comparable. In the Household Expenditure Survey, employed persons are defined as those who (i) work for one hour or more either for pay, profit or family gains; or (ii) have a job or business to return to but are temporarily absent because of illness, injury, breakdown of machinery at workplace, labour management dispute or other reasons.) In the SLP, we defined employed respondents as those answering the question “What is your current employment situation?” with Working for pay or Self-employed.

Again, we see a very similar distribution in household expenditure for the SLP and Household Expenditure Surveys.

One reason for the accuracy of these economic variables is that the SLP uses well-established measurement methods. High-frequency questions on income and spending reduce recall bias, identify changes month-to-month, and also capture low-frequency purchases. Reconciliation screens reduce outliers by providing respondents with a summary screen to fine-tune their spending answers. These techniques are adopted from the ALP (Hurd and

Rohwedder, 2012). The University of Michigan Health and Retirement Study (HRS) uses unfolding brackets to encourage respondents to provide at least an indicative range for economic variables (Hurd, Juster and Smith, 2003). For example, to measure income from work for the past month, the SLP first asks for an integer. Respondents who skip this question are subsequently reminded of the importance of their responses and provided with eight brackets which increase in S\$1,000 intervals and finish with S\$7,000 or more.

9. Domains and Questions Covered by the Singapore Life Panel®

At the time of writing, 22 monthly waves of the SLP have been completed. 16,000 responses were recorded in the baseline, and an average of 8,000 since – adding up to a total of more than 165,000 person-wave observations across more than 700 unique variables.

Demographic data have been collected on respondents' age, gender, race, marital status, level of education and living relatives. Information on their living situation includes dwelling typology, size, number of occupants and mortgage or rent. Movements to and from work and retirement are observed through monthly reports of employment status along with income.

Respondents report visits to the doctor and their health situation every month, allowing us to identify the occurrence of 'health shocks': a new diagnosis of heart disease, cancer, a stroke, hypertension, arthritis, diabetes or psychiatric problems.

Shocks to health, employment and living situation can have a dramatic impact on the trajectory of a person's twilight years. Data collected on a number of socio-economic and subjective indicators will enable voluminous research on the impact of shocks on the life-cycle.

Detailed monthly consumption data records respondents' spending across 8 broad categories and 44 subcategories, along with credit card use and transfers to/from friends and family members. Annual surveys determine household wealth by compiling extensive data on 40 categories of assets and debts. These include CPF balances, property ownership, pension and retirement plans, life insurance policies, vehicles and other durables, bank accounts, shares, bonds, and even gold. The first asset survey was completed in January 2016 and the second in January 2017, enabling research into changes in wealth levels between years and their determinants. Collected in the same interview is a detailed assessment of household income.

Subjective well-being is tracked monthly across several dimensions, including individuals' general life satisfaction as well as satisfaction with social contacts and family life, their job, household income and economic situation. Every three months, experienced measures of well-being are queried: respondents indicate whether they are happy, sad, worn-out, or having trouble sleeping. Periodic data is collected on expectations regarding work, financial struggles, mortality, and the wider economy (SGX and house prices).

By collecting data on various government programmes we can determine whether welfare policy and insurance schemes are having their desired effect. Questions in this area have covered the Workfare Income Supplement (WIS), GST voucher schemes, MediShield, ElderShield, and Service and Conservancy Charge rebates.

We are increasingly learning more about our respondents, with recent questions assessing their skills in areas of health literacy, financial literacy, and probability. Future proposed modules include detailed employment history of the respondents. We are also contemplating additional modules as needed such as cognitive functioning and caregiving roles. The strength of the SLP is that modules can be readily programmed and fielded at relatively low costs.

Impressive in both its scale and scope, this deep pool of data will inform research on ageing in Singapore and beyond for years to come.

10. Conclusion

The Singapore Life Panel® is a challenging survey to field. It is high-frequency, internet-based, focused on a middle-aged to older population, and asks detailed economic questions. It is therefore remarkable for both its high initial response rate and stable participation across its first 18 months.

Key ingredients for the success of the SLP can be broadly split into two categories. First, world-class survey techniques were adopted from the combined experience of similar panels such as the KnowledgePanel, HRS, ALP, CentERpanel and LISS. High-frequency surveys combat recall bias, reconciliation screens reduce outliers, and unfolding brackets prevent nonresponse bias. Second, significant effort was expended in recruiting and maintaining the panel. A population-representative sample frame was obtained, and initial contact made via a combination of invitation letters, phone calls and personal visits. Ongoing campaigns keep respondents engaged with the SLP through letter, SMS and email reminders and rapid response to feedback.

One of the concerns that internet-based surveys tend to over-represent the highly educated has been shown not to be the case in the SLP, with remarkable congruence between the education distribution of the SLP and the education distribution of the Census. Indeed, the SLP also aligns closely with published statistics on age, gender, marital status, ethnicity, labour force participation, income and expenditure.

As the survey continues in the field, we expect to obtain increasingly rich data that will inform economic research for years to come and provide a more detailed picture of the economics of ageing than has been heretofore possible.

11. References

- Baker, R., Blumberg, S. J., Brick, J. M., Couper, M. P., Courtright, M., Dennis, J. M., . . . Zabs, D. (2010). AAPOR Report on Online Panels. Lenexa, Kansas: AAPOR.
- Bellemare, C., and Kröger, S. (2007). On representative social capital. *European Economic Review*, 51(1), 183-202.
- Callegaro, M., Villar, A., Yeager, D., and Krosnick, J. A. (2014). A critical review of studies investigating the quality of data obtained with online panels based on probability and nonprobability samples. In M. Callegaro, R. Baker, J. D. Bethlehem, A. S. Goritz, J. A. Krosnick and P. J. Lavrakas (Eds.), *Online panel research: A data quality perspective* (pp. 23-53). New York: Wiley.
- Hays, R. D., Liu, H., and Kapteyn, A. (2015). Use of Internet panels to conduct surveys. *Behavior research methods*, 47(3), 685-690.
- Hurd, M. D. and Rohwedder, S. (2015). "Measuring Total Household Spending in a Monthly Internet Survey: Evidence from the American Life Panel," in *Improving the Measurement of Consumer Expenditures*, in eds. Christopher Carroll and Thomas Crossley and John Sabelhaus, University of Chicago Press, pp. 365-387.
- Hurd, M. D., Juster, F.T. and Smith, J. P. (2003). "Enhancing the Quality of Data on Income: Recent Innovations from the HRS," *Journal of Human Resources*, 38 (3), Summer, pp. 758-772.
- De Heer, W., and De Leeuw, E. (2002). Trends in household survey nonresponse: A longitudinal and international comparison. *Survey nonresponse*, 41.
- Fowler Jr, F. J. (2013). *Survey research methods*. Sage publications.
- Fricker, R. D. and Schonlau, M. (2002) "Advantages and disadvantages of Internet research surveys: Evidence from the literature." *Field methods* 14.4: 347-367.
- Infocomm Development Authority of Singapore (2015). *Annual Survey on Infocomm Usage in Households and by Individuals for 2014*. Infocomm Development Authority of Singapore, Singapore.
- Kalton, G., Kasprzyk, D. and McMillen, D. B. (1989). Nonsampling errors in panel surveys. In D. Kasprzyk, G. Duncan, G. K. and Singh, M. P. (eds.), *Panel Surveys* (pp. 249-270). New York: Wiley.
- Kapteyn, A., Smith, J. P., and Van Soest, A. (2009). Life satisfaction. For a description of the initial 2003 ALP recruitment and <https://alpdata.rand.org/?page=panel> for a description of how the panel was subsequently supplemented since 2003.

Lozar Manfreda, K., Bosnjak, M., Berzelak, J., Haas, I., and Vehovar, V. (2008). Web surveys versus other survey modes: A meta-analysis comparing response rates. *International Journal of Market Research*, 50(1), 79-104.

Rivers D. Comment. *Journal of Survey Statistics and Methodology*. 2013; 1:111–117.

Schonlau, M., Van Soest, A., Kapteyn, A., and Couper, M. (2009). Selection bias in web surveys and the use of propensity scores. *Sociological Methods and Research*, 37(3), 291-318.

Struminskaya, B. (2014). Data quality in probability-based online panels: Nonresponse, attrition, and panel conditioning (Doctoral dissertation, Utrecht University).

Tourangeau, R., Conrad, F. G., and Couper, M. P. (2013). *The science of web surveys*. Oxford University Press.