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DISCUSSION PAPER SERIES

IZA DP No. 15250

Gender, Financial Literacy and Pension Savings

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APRIL 2022

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ABSTRACT

Gender, Financial Literacy and Pension Savings[*]

Using micro-data from the *Household, Income and Labour Dynamics in Australia (HILDA) Survey* this paper examines the relationship between the gender gap in financial literacy and the gender gap in pension savings amongst non-retired adults aged 18-64 in 2018. A simple theoretical model is presented. It implies two empirical specifications: a reduced-form specification where the focus is on pension savings and a more structural specification where the focus is on the "pension return" (the ratio of pension savings to cumulative earnings). Oaxaca-Blinder decomposition analysis suggests that around 8.5 per cent of the gender gap in pension savings may be attributed to the gender gap in financial literacy. This finding holds even in the presence of controls for financial risk tolerance. Policy implications and directions for future research are discussed in the paper.

JEL Classification:	H53, J16, J32
Keywords:	pension savings, superannuation, financial literacy, gender gap, decomposition

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I. Introduction

In high-income countries, population ageing and rising dependency ratios have brought into question the sustainability of public pension systems and private-sector defined-benefit pension schemes (European Commission, 2018; Feng, 2018). One partial response to this has been the introduction of, and shift to, defined-contribution pension plans, where individuals are responsible for ensuring they have sufficient pension savings for their retirement. In countries such as the UK, the US and Australia most pension savings are now held in defined-contribution plans. In such plans savings are predominantly driven by employee and employer contributions as well as investment returns and investment shocks.

The consensus is that the growth in the coverage of defined-contribution pension plans has the potential to improve income adequacy in retirement. The growth in such arrangements may, however, exacerbate gender differences in retirement incomes as, relative to men, women (on average) have lower life-time earnings and, therefore, make lower contributions over their working life (Feng *et al.*, 2019; Dobrescu *et al.,* 2018; Austen & Mavisakalyan, 2018; Bardasi & Jenkins, 2010; Jefferson & Preston, 2005). Of particular concern is the size of the gender gap in pension savings amongst non-retired adults. In Australia, for example, the latter was 62 per cent in 2018 (see Table 1). Large gender gaps in pension savings and retirement benefits are observed in most "rich" countries (OECD, 2019). There is, accordingly, growing interest in the extent and cause of such gaps (Feng *et al.,* 2019; Dobrescu *et al.,* 2018; Fernández-López *et al.,* 2015; Bardasi & Jenkins, 2010). Understanding their source is important for the design of policy aimed at addressing gender inequality and improving women's economic and financial well-being in retirement.

There are various reasons why women (on average) accumulate less pension savings during their working lives. The main reason is that women typically have lower life-time earnings than men and, therefore, have less capacity to contribute to their pension savings. This

largely reflects gendered differences in employment participation, hours worked and wages and is the product of normative and social factors such as gendered norms surrounding work and family care. Gender differences in pension savings may also result from structural factors such as default setting arrangements within the pension plan (Dobrescu *et al.,* 2018) and eligibility rules. In Australia, for example, employers are exempt from making mandatory pension contributions to employees in receipt of government funded paid parental leave payments. Other factors known to correlate with savings and thus, possibly, the gender gap in pension savings, include behavioural responses to how pension plans are designed (Card & Ransom, 2011), locus of control (Cobb-Clark *et al.*, 2016), risk preferences (Dobrescu *et al.,* 2018, Fernández-López *et al.,* 2015; Best & Saba, 2021), planning and decision-making ability (Choi, *et al.,* 2014; Bateman *et al.,* 2012) and financial literacy (Lusardi *et al.,* 2017; Behrman *et al.*, 2012; Hastings & Mitchell, 2020; Lusardi & Mitchell, 2011; Lusardi & Mitchell, 2008).

In this paper we explore the potential role that financial literacy plays in understanding the gender gap in pension savings. Financial literacy may affect pension savings through decisions such as choice of fund, portfolio allocations, the purchase of health and life insurance products, contribution rates and drawdown decisions. As a mechanism, financial literacy is of particular interest since, in most countries, there is a sizeable gender gap in financial literacy with women (on average) less financially literate than men (Hasler & Lusardi, 2017). Given this background it is reasonable to hypothesise that the gender gap in financial literacy may be a potential determinant of the gender gap in pension savings, with empirical analysis needed to establish its importance.

To empirically examine the relationship between the gender gap in financial literacy and the gender gap in pension savings we use individual-level data collected in the *Household, Income and Labour Dynamics in Australia* (HILDA) survey for a sample of adults aged 18-64 in 2018. As a case study Australia is of considerable international interest for several reasons.

The first is that, within Australia, around 90 per cent of adults aged 18-64 years have some pension (superannuation) savings (mostly in defined-contribution accounts), largely because of a system that mandates that employers contribute to pension accounts on behalf of employees. The second is that, compared to pension systems elsewhere, there are a multitude of decisions that individuals may make within Australia's pension (superannuation) system that may affect their pension savings and total accumulation (savings) at retirement. The third is that there is a large gender gap in the pension savings of non-retirees in Australia. The fourth reason is that, in international comparisons, Australia has a high level of financial literacy. However, it also has a large gender gap in financial literacy (Preston & Wright, 2019). The fifth is that HILDA is a large sample, nationally representative, individual-level dataset that contains detailed information relating to pension savings, financial literacy and socio-economic/demographic characteristics.

The remainder of this paper is organised as follows. Section 2 is a review of studies concerned with the relationship between financial literacy and pension savings. Much of this research has been concerned with financial literacy and pension planning, with few studies focusing on financial literacy and actual pension savings. Section 3 gives an overview of the Australian pension system. The aim of this section it to provide the reader with the necessary details of the system, particularly the way in which individuals may manage their pension savings. Section 4 presents a theoretical model aimed at guiding the empirical analysis. The model implies two empirical specifications that may be estimated as regression equations with individual-level data. The first is a reduced-form specification where financial literacy is included as an explanatory factor. The second is a more structural specification, where financial literacy is related to the "pension return", measured as the ratio of pension savings to cumulative earnings. Section 5 describes the data and research method. The results are presented in Section 6. The analysis suggests that there is a positive, statistically significant

and robust relationship between financial literacy and pension savings for both males and females. In addition, a positive relationship is found between financial literacy and the pension return for both males and females. We interpret this as support for the mechanism that more financially literate individuals (regardless of sex) make more profitable decisions relating to the management of their pensions. Most importantly, an Oaxaca-Blinder decomposition indicates that a sizable share (around 8.5 per cent) of the gender gap in pension savings may be attributed to the gender gap in financial literacy. Conclusions follow in Section 7. The analysis suggests that policies that close the gender gap in financial literacy, by improving the financial literacy of women, will likely close the gender gap in pension savings, and subsequently improve the income and living standard of women in retirement.

II.   Previous Research

A key characteristic of pension reforms around the world is the shifting of responsibility for retirement saving from the state to the individual. Globally this has seen a growth in defined-contribution plans and, in some countries, an extension of pension coverage through legal mandates whereby employees (employers) are required to contribute a portion of wages received (paid) into a pension account. While the growth in defined-contribution arrangements may improve income adequacy in retirement, a particular concern with such developments is that those with discontinuous work histories, atypical employment (e.g., part-time, casual, self-employed) and low earnings power may be unable to accumulate sufficient funds for their retirement, and thus face poverty and income inequities in retirement. Given these concerns, there is a growing body of research examining the pension outcomes of at-risk groups. Considerations include the design of pension systems, coverage, taxation arrangements, replacement rates, relative pension benefits, well-being etc. Examples of recent papers and

reports include OECD (2019), PC (2018), Australian Government (2020), Della Giusta and Longhi (2021) and Evans and Pienknagura (2021).

Studies of the gender gap in the incomes of retirees suggest sizeable male-female differences in retirement benefits. In the EU, for example, the average pension income gap is around 25 per cent amongst 65-year-olds; in countries such as the Netherlands and Germany it is closer to 40 per cent (OECD, 2019). A number of studies attribute the gap to part-time work (linked to gendered division of market and care work), with mothers, in particular, facing a steep 'pension penalty' (Mohring, 2015, Bettio *et al.,* 2013). However, the source of the gap extends beyond motherhood and part-time work. Kuivalainen *et al.* (2020) using Finnish administrative data from 2011 shows that much of the gender gap in the pensions of retirees' relates to earnings differences arising from occupational segregation during the accumulation phase. In Finland career breaks do not lead to breaks in pension accumulation rights and thus have less of an effect on gender gaps in retirement benefits. As with Kuivalainen *et al.,* Bonnet *et al.* (2022) using French administrative data (for 2012) also show that gender differences in wage levels and contribution periods predominantly drive the gender gap in retirees' pensions. Their distributional analysis by sector (private and public) points to particularly pronounced gender gaps in pensions at the bottom of the distribution of private sector pensions. In Ireland the situation is different with gender gaps in retiree pension income largest at the top of the distribution (this study does not disaggregate by sector) (Nolan *et al.,* 2019). The main factor explaining the latter appears to be gender differences in years of work experience. At the bottom of the Irish distribution the gender gap is also affected by factors such as living arrangements and migrant status (*ibid.*).

While much of the discussion thus far has focused on the gender gap in the income of retirees, analysis based on younger cohorts suggests that the drivers of pension gaps during the accumulation phase are similar. Feng *et al.* (2019), for example, use administrative data from

a pension fund in Australia to track age cohorts over time and examine the cumulative effects of labour market status on retirement savings. They show that substantial gender gaps in pension savings occur in the early phase of paid working life (due to career breaks, part-time work and gaps in contribution records) and that this affects future income in an adverse way. They also show that while a return to full-time paid work in later life may have a positive effect on savings, the "…damage in terms of foregone wages and associated retirement savings in their own account has already been done, and women's balances are much lower" (*ibid.,* p.166). Best and Saba (2021) also emphasise the enduring effect of the gender gap in pension savings over the accumulation phase.

The extensive literature on savings behaviour also suggests that decisions about pension savings may be affected by factors such as framing effects, the design of the pension system and default settings (Card & Ransom, 2011; Clark & Pelletier, 2022; Dobrescu *et al.,* 2018; Hastings & Mitchell, 2020), interest in pension affairs (Bateman *et al.,* 2014; Debets *et al.,* 2022), risk, time preferences and patience (Charness & Gneezy, 2012; Arrondel *et al.,* 2013; Choi *et al.,* 2014; Hastings & Mitchell, 2020; Best & Saba, 2021), confidence levels (Angrisani & Casanova, 2021); household decision making roles (Bucher-Koenen *et al.,* 2017), cognitive and decision-making abilities (Bateman *et al.,* 2012; Choi *et al.,* 2014), financial literacy (Lusardi & Mitchell, 2007; Lusardi & Mitchell, 2011; Behrman et al., 2012; Agnew *et al.,* 2013; Brown & Graf, 2013; Boisclair *et al.,* 2017; Dahlquist *et al.* 2017; Hastings & Mitchell, 2020) and trust (e.g. in financial institutions) (Burke & Hung, 2019). Gender differences in pension savings may, therefore, stem from gender differences in one or more of these characteristics.

A consistent finding in the literature is that women, on average, are less financially literate than men (Fonseca *et al.,* 2012; Lusardi & Mitchell, 2014; Hasler & Lusardi 2017; Cupák, *et al.,* 2018; Preston & Wright, 2019). In most countries financial literacy is shown to

have an inverse U-shape, suggesting that it is lower amongst the young and the old than it is amongst prime aged adults. Gender gaps in financial literacy prevail across the life-course and have been shown to be particularly large amongst young adults (Preston & Wright, 2019). Gender differences in pension savings may, therefore, stem from gender differences in financial literacy. During the accumulation phase of a defined-contribution pension plan, financial literacy may affect the gender gap in pension savings through several channels, including decisions relating to: the choice of pension fund; choice of investment strategy (e.g. balanced, high growth etc.) within the pension fund (assuming choice permitted); contributions; life-insurance etc. Moreover, if gender gaps in financial literacy contribute to gender differences in choice of fund, investment strategy, contributions etc. when young, it could be that these decisions serve to magnify gender gaps in pension savings in later years. Empirical research is required to examine these considerations.

III. **Australian Retirement Income System**

The Australian retirement income system is comprised of three pillars: (1) a means tested, universal, public pension (Age Pension) safety-net; (2) a system of mandatory employer pension contributions (known as Superannuation Guarantee (SG) contributions); and (3) pre and post-tax voluntary contributions into pension funds and other private savings. Most contributions within the system are under the second pillar and most are into defined-contribution accumulation funds. Pillar (2) is underpinned by the 1992 *Superannuation Guarantee Act* which mandates that employers contribute a portion of each employee's ordinary time earnings into a pension account. In 1992 the SG contribution rate was 3 per cent (4 per cent if the payroll exceeded A$1m). It increased to 9 per cent in 2002, 9.25 per cent in 2013, 9.5 per cent in 2014 and 10 per cent in 2021 and is legislated to incrementally increase to 12 per cent by 2025. Those not covered by the mandatory provisions include workers on

government funded paid parental leave payments, those under 18 years of age and those not classified as employees (e.g., independent contractors and the self-employed). Prior to 1 July 2022, those earning less than $450 per month were also not entitled to mandatory SG contributions. The preservation age in most pension plans is 60 years if born after 1 July 1964 (and between 55 and 60 years for those born earlier). On reaching the preservation age an employee may choose to enter into a 'transition to retirement' agreement (where they work fewer hours and may supplement their income by drawing down on their pension savings) or they may opt to retire and take their 'lump-sum' accumulated pension savings and purchase an annuity or an account based pension or make some other financial investment.

Pension coverage in Australia is high. Around 92 per cent of adult males and 90 per cent of adult females have some pension savings (see Table 1). National pension savings is also high; at June 2021 A$2.3 trillion was held in pension funds regulated by the Australian Prudential Regulation Authority (this does not include funds in self-managed superannuation funds (SMSFs)) (APRA, 2022). Australia now has the fifth largest pension fund market in the world (Australian Government, 2021). Navigating the pension landscape is, however, challenging. As Bateman *et al.* (2014, p.163) note, in 1992 when the second pillar was introduced, "The underlying assumption was that ordinary people would be both engaged in financial matters and able to make appropriate decisions using the information provided under financial product disclosure requirements." Thirty years later reforms are still being made to reduce complexity and inefficiencies in the system. Reforms are also aimed at helping individuals better understand their pension arrangements, including associated risks and returns. A particular focus of these reforms is the well-being of members who are either uninterested and/or unable to make informed pension decisions (Kingston & Thorp, 2019).

The most recent reform in this regard relates to "MySuper" products. The latter are default accounts that were first introduced in 2014 and are designed as low-cost and low-risk

options with minimum insurance cover, a transparent fee structure and a single investment option (e.g., balanced growth). They are also now the default pension accounts for new employees where no choice is made. Of the 22.2 million member accounts (with entities of more than four members) regulated by APRA, at June 2021 64.3 per cent of member accounts were classified as MySuper accounts, up from 58 per cent at June 2018 and 32 per cent at June 2014 (APRA, 2019; APRA, 2014). Following legislative change MySuper pension accounts will, from July 2021, also follow individuals as they change jobs. This reform is designed to reduce the high share of individuals holding multiple accounts and paying multiple fees and administrative charges to fund managers. It is estimated that, in Australia, over $30bn a year is paid in fees (excluding insurance premiums) and that even a small increase in fees (0.5 percentage points) could cost a typical full-time worker around 12 per cent of their pension savings by the time they retire (PC, 2018). At June 2020 the share of multiple account holders within the population of those with a pension account was 26 per cent, down from 39 per cent in 2017 (ATO, 2022).

There are four types of pension funds within the Australian system. Retail funds (similar to *401(k)* type plans in the US) are for-profit funds. Other fund types include Public Sector funds, Corporate funds, and Industry funds (originally established by trade unions and employer associations); all three are not-for-profit funds and, compared to Retail funds, charge lower fees (PC, 2018). Retail funds account for around 35 per cent of all funds (not including SMSFs), followed by Corporate (31 per cent), Industry (26 per cent) and Public Sector funds (9 per cent) (Ooi, 2020). The degree of openness (to membership) varies across fund types, from 24 per cent (amongst Corporate funds) through to 100 per cent amongst (Retail funds) *(ibid*.). As competition for members grows more funds are switching from closed to open membership arrangements.

When compared with pension arrangements in other countries, the Australian pension system offers considerable choice. Indeed, it is the scope of decisions that individuals may make which makes the Australian system somewhat unique. Also of note is the relative ease with which these decisions may be made—most may be made on-line without prior agreement or permission by the fund and with minimal cooling off time. Individuals may make decisions with respect to the type of fund (Retail, Industry etc.) and, having made this decision, may then choose which specific fund to save with (e.g., out of a set of 63 Industry funds, 48 are open (Ooi, 2020)), the product option (e.g., whether or not to invest in a MySuper option with default settings) and the investment strategy (if not in a MySuper product). Decisions may also be required with respect to account consolidation following a change of jobs, although going forward this may reduce. Recent reforms, as noted, now enable MySuper accounts to follow individuals as they change jobs.

Other decisions include the purchase of linked products (e.g., health and life insurance) and the frequency and level of voluntary contributions. In deciding on voluntary contributions individuals must decide whether to make them pre or post tax. Related decisions concern contribution limits and how to optimise tax concessions and incentives (if eligible). Decisions may also be made with respect to early drawdowns. The grounds for early access include incapacity, terminal medical condition, compassionate grounds for the individual or a dependant, and financial hardship. First home buyers may access their pension savings (limited to their voluntary contributions) to assist with the purchase of their first home. Older individuals may use their pension savings to fund a phased retirement, where the final years of employment are a mix of pension payments and earnings from employment. Individuals also have the option privately managing their retirement savings through a 'self-managed super fund' (SMSF). For further information about the Australian pension (superannuation) system see Kingston and Thorp (2019), PC (2018) and Australian Government (2020).

Notwithstanding the considerable array of saving and investment decisions that individuals may make within the Australian retirement income system, there is some debate as to how 'engaged' individuals are with their pension savings and thus how much 'choice' and active decision making is exercised. Gerrans (2012), for example, examined the level of investment change activity during the 2007/8 global financial crisis (GFC) within five pension funds in Australia covering 3.6 million accounts. In each year members could make one choice to reduce their exposure. He found that the majority of members did not change their investment strategy and risk exposure. Of those that did, most reduced their equity exposure as the market reached its bottom. He concludes that "The act of choice does not cast these individuals as informed investors, just as the lack of choice by the majority does not mean they are disengaged." (*ibid.,* p.436). Bateman *et al.* (2014) also caution against assuming that a lack of activity (particularly with respect to selecting the default investment option) equates with a lack of engagement. Additionally, they show that men were more likely than women to select the non-default investment option and that women had a higher likelihood of making voluntary contributions than men, although men were more likely than women to contribute on a pre-tax basis and contribute to their maximum limit. Similar findings are reported in Dobrescu *et al.* (2018) where they note that women are more likely than men to stay with the default investment option and that the incidence of voluntary contributions is higher for women than men. Men, however, make significantly more voluntarily contributions over their working life. Dobrescu *et al.* also demonstrates that those making an active choice (i.e., not remaining with the default option) achieve substantial increases in total pension savings.

Table 1 shows that there is considerable heterogeneity in pension savings in Australia, large male-female differences in pension savings within age groups, and a high share of non-retirees with a poor understanding of their pension arrangements, savings and contributions. For example, 8.6 per cent of males and 10.2 per cent of females report not knowing their

pension savings (either the exact amount or the amount within a broad range) and of those who are employees (and thus eligible for SG contributions), 13.1 per cent of males and 17.2 per cent of females report not knowing how much their employer contributes on their behalf. Knowledge of pension arrangements and savings appears to improve with age, perhaps reflective of greater engagement as individuals approach retirement. Table 1 estimates also show that similar proportions (around 16 per cent) of men and women make voluntary contributions to their pension accounts.

In 2018 average pension savings of all non-retired adults (aged 18-64) was around A$130,000 for men and A$80,000 for women, translating to a gender gap of 62 per cent. (In other words, if average male pension savings are to remain unchanged then, at the mean, female pension savings need to increase by 62 per cent to close the gender gap in pension savings). The gender gap is smaller amongst younger age groups but is, nevertheless, substantial, e.g., amongst those aged 25-34 it is equal to 36.2 per cent. Pension savings are also highly positively skewed. In 2018 non-retired adult men and women at the 95th percentile had pension savings of A$550,000 and A$350,000, respectively. At the 99th percentile the corresponding savings were A$1,057,524 and A$799,056, respectively. Figure 1 shows the cumulative distribution pension savings for those aged 45-54 disaggregated by sex. The median pension savings is equal to A$150,000 for men and A$80,000 for women.

	(1)	(2)
Table 1 **Australian Pension Coverage and Member Characteristics**		
	Males	Females
Percentage of non-retired adults who report not knowing their pension savings:		
- Age 18-24	*15.7%*	*19.7%*
- Age 25-34	*10.4%*	*12.5%*
- Age 35-44	*6.5%*	*7.9%*
- Age 45-54	*5.5%*	*8.2%*
- Age 55-64	*5.1%*	*6.0%*
- Age 18-64 (All)	*8.6%*	*10.2%*
Private pension coverage:		
- Percentage with positive pension savings	*92%*	*90%*
Mean pension savings:		
- Age 18-24	*$6,130*	*$5,092*
- Age 25-34	*$38,864*	*$28,536*
- Age 35-44	*$121,690*	*$69,796*
- Age 45-54	*$221,976*	*$133,592*
- Age 55-64	*$305,742*	*$313,249*
- Age 18-64	*$129,478*	*$79,754*
Percentage in receipt of employer contributions (if employee):		
- Don't know	*0.8%*	*0.5%*
- Yes	*89.9%*	*91.9%*
- No	*9.2%*	*7.6%*
Employer contribution rate as percentage of wages and salaries (if employed):		
- Don't know	*13.1%*	*17.2%*
- <=SG mandatory rate	*73.4%*	*72.5%*
- > SG mandatory rate	*13.5%*	*10.3%*
Do any of your pension funds contain a defined benefit component?		
- Don't know	*28.0%*	*34.8%*
- Yes	*3.8%*	*3.1%*
- No	*68.0%*	*62.0%*
Do you make additional voluntary contributions to your pension fund(s)?		
- No	*84.0%*	*83.5%*
- Yes – regular	*13.4%*	*14.2%*
- Yes – occasional	*2.4%*	*2.0%*
Does your spouse or partner contribute to any of your pension fund(s)? (if has a spouse or partner & pension savings >$0))		
- Don't know / refused / not-stated	*0.12%*	*0.8%*
- Yes	*1.0%*	*1.6%*
- No	*98.8%*	*97.7%*

Notes:
1. Estimates weighted to reflect population totals.
2. Sample is adults aged 18-64 who are not retired.
3. Source: *Household, Income and Labour Dynamics in Australia (HILDA) Survey.*

FIGURE 1

Cumulative Distribution of Male & Female Pension Savings,
Australia, Aged 45-54, 2018
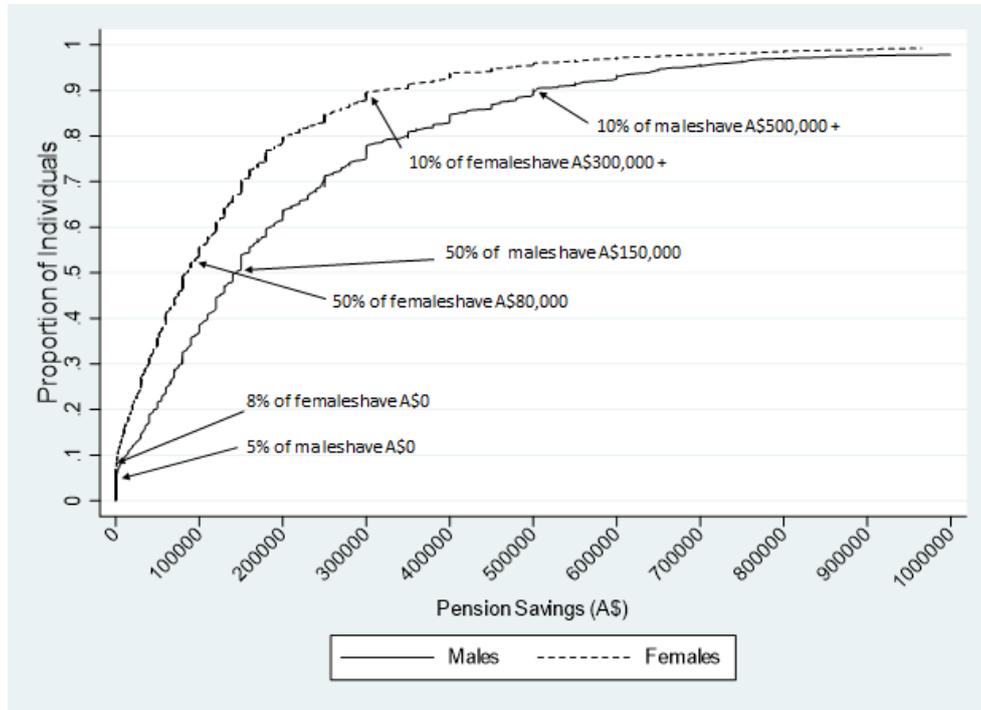
Notes:

1. For graphing, the underlying sample is restricted to pension savings of less than A$1m.
2. Sample: Aged 45-54 and not retired.
3. Source: HILDA, Wave 18.

IV.   Model

In order to inform the specification of the empirical analysis in the next sections, a simple theoretical model, relevant to Australian retirement income system, is outlined below. At the centre of this system is a defined-contribution component, which may be expressed as:

$$S_s = \rho(w \bullet t) \qquad (1)$$

where S_s is an individual's pension (superannuation) saving after t years of work; w is average (employment) earnings after t years of work. $w \bullet t$ is cumulative earnings after t years of work.

This expression states that an individual's pension savings is proportional to their average earnings weighted by the number of years worked. The parameter, ρ, is the ratio of pension savings to cumulative earnings: $\rho = S_s/(w{\bullet}t)$. This may be thought of as a summary measure of the financial "return" to the individual of the fund measured relative to their earnings. It is an estimate of the change in pensions savings associated with a change in cumulative earnings: $dS_s/d(w{\bullet}t) = \rho$. What determines the value of ρ is discussed below. It is important to note that, in this model, for an individual to have pension savings ($S_s > 0$), they must have been employed at some point in time ($t > 0$) and received positive earnings ($w > 0$). Therefore, if $t = 0$ then $S_s = 0$.

Initially it is useful to think about the model *ex post*. This refers to the pension savings of individuals who have already retired:

$$S_s{}^* = \rho^*(w^*{\bullet}t^*) \qquad\qquad\qquad (2)$$

The superscript * is used to denote that the individual is retired. For a such individuals, the number of years worked is known, t^*, and since the individual is retired (not working), future earnings are zero. For this individual, w^* is average "life-time" earnings and $w^*{\bullet}t^*$ is "lifetime" earnings. Pension savings at retirement are $S_s{}^*$. For retired individuals, $S_s{}^*$, w^* and t^* are known. Therefore, the return to the defined-contribution plan is also known: $\rho^* = S_s^*/(w^*{\bullet}t^*)$. It is important to recognise that individuals may continue to work after they "retire". For example, a person may retire from their main job but continue to work on a part-time basis. The assumption, made in this respect, is that the system is closed to the individual once they retire and no further contributions can be made.

Application of the model is more problematic *ex ante*. This refers to the pension savings of individuals who are not retired:

$$S_{st} = \rho_t(w_t \bullet t) \qquad\qquad (3)$$

The subscript t is used to denote that the individual is not retired. For non-retired individuals: $t < t^*$. Pension savings after t years of work is S_{st}. Average earnings after t years of work is w_t. The issue with applying this model to non-retired individuals is that (by definition), their working lives are not complete: $t^* - t > 0$. More importantly, given the role it plays in this model, average earnings after t years of work is not likely to equal average life-time earnings: $w_t \neq w^*$. As the future relating to t and w are not known with certainty, there is no guarantee that the return (ρ) after t years of work will equal the return at retirement: $\rho_t = \rho^*$. This uncertainty becomes less of a concern the closer the individual is to retirement: t $\rightarrow$ t*; w_t $\rightarrow w^*$; and $\rho_t \rightarrow \rho^*$.

It is important to recognise that Eq. (3) holds at *all* points prior to retirement. To illustrate, consider an individual who has worked for 20 years. Their pension savings at t=20 is: $S_{s20} = \rho_{20}(w_{20} \bullet 20)$. If this individual retires after 20 years of work (t = 20) then $\rho^* = \rho_{20}$. Assume this individual works a further 20 years. After 40 years of work (t = 40), their pension savings is: $S_{s40} = \rho_{40}(w_{40} \bullet 40)$. If this individual retires after 40 years of work $\rho^* = \rho_{40}$. However, if the individual has only worked 20 years ρ^* is not observed. As mentioned above there is no reason to assume that $\rho_{20} = \rho_{40} = \rho^*$. However, there is no reason assume that it will be vastly different either. If $\rho_t = \rho^*$ at any t, then the return is fixed. If ρ *is* fixed, then the only way pension savings can increase is if cumulative earnings increase and/or the number of years worked increases. If earnings, w, and years worked, t, are both measured without error, and ρ is fixed, then pensions savings is deterministic, with the value of S_s simply being a matter of arithmetic.

It is likely ρ is not fixed over t. If this is the case, it is necessary to understand the determinants of ρ; i.e. there is a deterministic component to ρ. Central to this component are the contribution "rules" governing the pension fund, with the contribution rate of employees (how much the employee pays in from their earnings) and the contribution rate of employers (how much the employer pays in on behalf of their employees). Contribution rates can, and do, change. Another part of the deterministic component, which is of particular relevance in this paper, is the extent to which individuals may "manage" their pension savings themselves (i.e., not necessarily rely on pension defaults). There is also a stochastic component. Investment decisions are inherently risky. This includes both "good" and "bad" decisions made by managers of pension funds. It also includes positive and negative shocks that impact on the value of the assets held by the pension fund. Given the stochastic component is random, it cannot be modelled econometrically. Notwithstanding the fact that this stochastic component might be an important determinant of the returns to savings in the pension fund, because it may not be modelled it is, therefore, not of interest to us. We are only interested in factors that impact on the deterministic component, with the role played by individual decision-making being of most interest.

A more realistic model, for non-retired individuals, that allows for decision-making that potentially affects the return, is:

$$S_t = S_{0t} + S_{st} = S_{ot} + \rho_t(w_t \bullet t)D \qquad (4)$$

As above, the subscript "t" indicates the model refers to non-retired individuals ($t < t^*$). In this model, S_t is "total" pension savings. It consists of two components. The first is an "other forms of pension savings" component, S_{0t}. The second is the defined-contribution component, S_{st}. One example of the former is savings accounts at private banks or financial institutions.

Evidence suggests that in Australia S_{0t} is small relative to S_{st}. In fact, it is likely so small that it is effectively zero: $S_0/S \approx 0$. However, this is not necessarily the case in other countries. For this reason there is value in including it in the model. S_{0t} is assumed to be independent of S_{st}. D is a parameter that influences mandatory pension savings by impacting on the return to pension savings independent of any impact on w_t and t. Since S_{ot} is independent of S_{st}, it is assumed not to be influenced by D. More generally, D can be thought of as the mechanism or channel by which individual decision-making can affect the return.

The key condition is the impact of D on the slope of the (defined-contribution component) pension savings relationship:

$$dS_{st}/d(w_t \bullet t) = \rho_t D \qquad\qquad (5)$$

This condition suggests (not surprisingly) that there are three possible outcomes resulting from individuals making decisions relating to their own pension savings: (1) if $D = 1$ then the return is not influenced by decisions made by the individual: $\rho_t D = \rho_t$; (2) if $D < 1$ then decisions made by the individual result in pension savings <u>less</u> than would have been the case in the absence of such decisions: $\rho_t D < \rho_t$; and (3) if $D > 1$ then decisions made by the individual result in pension savings <u>more</u> than would have been the case in the absence of such decisions: $\rho_t D > \rho_t$.

Figure 2 shows a stylised version of this pension savings model with individual decision- making. This figure shows the pension savings profile for a non-retired individual who has worked for 30 years (t=30). It is assumed that the individual will retire after 40 years of work. If this individual made no decisions relating to the management of their pension savings (D=1), at t=30, the return would have been $\rho 1$ with pension savings of $S_S(30: D=1)$. However, this individual, after 15 years of work (t=15), makes a pension investment decision

(D<1) that leads to a lower return (e.g., vis a vis staying with the default) in the period t=15 to t=30 of $\rho 2$. Pension savings after t=15 is $S_s(15)$ with return $\rho 1$. The pension loss from this decision is $S_s(30: D=1) - S_s(30: D<1) > 0$. The observed return at t=30 is $\rho 3$. This return will be a combination of $\rho 1$ and $\rho 2$, both of which are unobserved. Since the period t=30 to t*=40 is in the future, the return associated with this additional 10 years of work is not known. It is only observed after the individual retires.

FIGURE 2

Stylised Pension Savings Model with Individual Decision-making
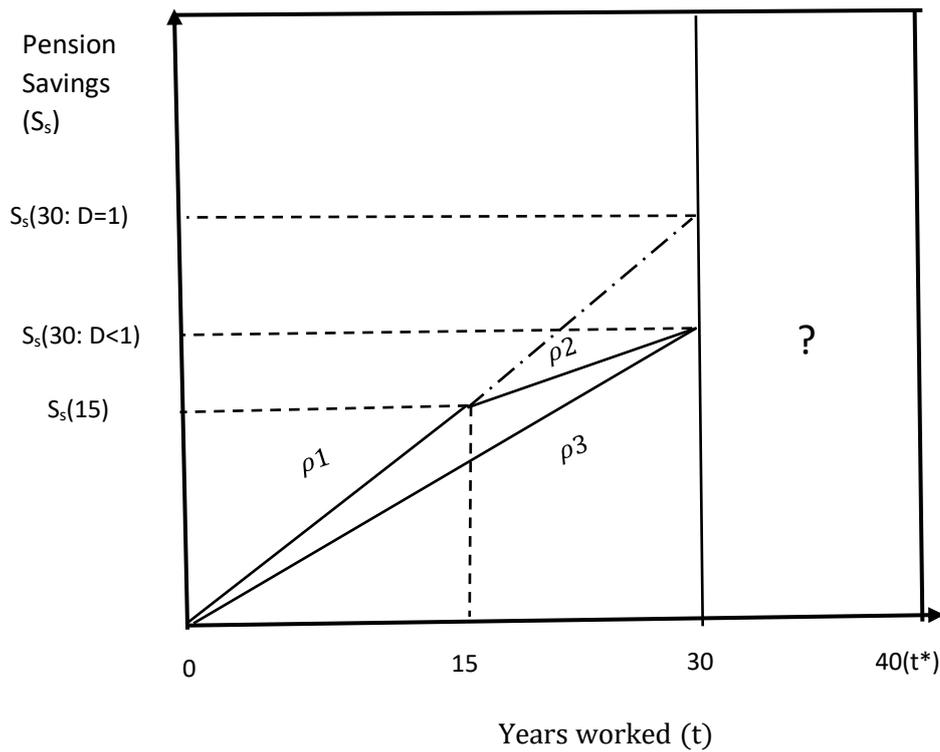
The magnitude of D is an empirical question. One way to move forward empirically is to make D a function of a set of observable variables, $\mathbf{X}$, relating to the individual: $D = f(\mathbf{X})$. Linearising the model by taking natural logarithms gives:

$$lnS_t = lnS_{0t} + ln\rho_t + lnw_t + lnt + lnD \qquad (6)$$

If $D = 1$, Eq. 6 reduces to:

$$lnS_t = lnS_{0t} + ln\rho_t + lnw_t + lnt \qquad (7)$$

since: $ln(1) = 0$. Note, from Eq. (6) that the elasticities of S_{0t}, ρ_t, w_t t and D are all 1 (one). The condition that $D \neq 1$ is fundamental since, if this is the not the case, individual decision-making has no impact on the return. The problem is that D (or lnD) and ρ_t (or $ln\rho_t$) are not observed separately. What is observed is: $\rho_t D$. Our contention is that Eq. (6) can be operationalised with individual-level survey data. Given survey data is being used in the empirical analysis, it is unlikely that S_{0t}, w_t, t and X are measured without error. An approximation to the empirical identity in Eq. (6) that is empirically tractable, in the sense that it may be estimated with survey data and econometric (regression) methods, is:

$$lnS_{ti} = a_o + a_1(lnw_{ti}) + a_2(lnt_i) + \mathbf{B'X}_i + e \qquad (8)$$

where: $i = 1,2,...N$ is a sample of non-retired individuals; a_0, a_1, a_2 and $\mathbf{B}$ $(b_1, b_2,...,b_k)$ set of parameters to be estimated; lnw_{ti}, lnt_i and $X_i (X_1, X_2,...,X_k)$ are individual-specific variables; and e is a stochastic error term. The constant term, a_0, is no longer exclusively pension savings from "other forms of pension savings", S_{0t}. For example, i_t also captures measurement error,

so the model property of $S_{st} = 0$ when $St = S_{0t}$ likely does not hold. This equation is a reduced-form equation since <u>all</u> the right-side variables are assumed to be exogenous. As is discussed below, this is questionable when it comes to financial literacy. In addition, it does not provide evidence that, for example, financial literacy impacts on pension savings through the return. In this sense it is not a test of any specific mechanism or channel. This is worrying because what is observed (e.g., a correlation between financial literacy and pension savings) may be spurious.

A more structural approach involves a two-step estimation strategy. As indicated above, it is not possible with individual survey data to separate out ρ_t from $\rho_t D$ if individuals are making decisions that impact on the return to their pension savings (unless of course their decisions have no impact on the return). However, it is possible to obtain an estimate of $\rho_t D$ using the same data as use in the reduced-form analysis. The first step involves backing out $\rho_t D$ for each individual i in the sample of non-retired individuals, from the following expression:

$$[\rho_t D]_i = S_{sti}/(w_{ti} \bullet t_i) \qquad (9)$$

The operator $[\bullet]$ is used to reinforce that D cannot be separated from $\rho_t D$ in observational survey data. The next step is to relate this value to the same set of $\mathbf{X}$ variables included in the reduced-form analysis:

$$[\rho_t D]_i = c_0 + \mathbf{C'X}_i + u \qquad (10)$$

Where: c_0 is a constant; $\mathbf{C}$ ($c_1, c_2, ..., c_k$) is a set of parameters to be estimated and u is stochastic error term. This specification provides a direct test of the variables included in $\mathbf{X}$ on the return. It is also a more direct test of the proposed mechanism that individual-decision making impacts on pension savings through the return than the reduced-form approach. Given financial literacy

is included in **X**, the specification also provides an opportunity to test if financial literacy improves the profitability of such decisions.

Several caveats about this empirical strategy are worth stressing here. Additional issues are discussed in the next section. The first is that it requires accurate information relating to pensions saving. There is some concern in the literature that self-reported pension data (such as that using in this study) may be poorly measured, hence a preference for administrative data. The second concern is that cumulative earnings data are rarely collected in surveys. What is usually collected is some measure of earnings around the date of the interview (e.g., the month or previous financial year). This necessitates the estimation of cumulative earnings and average labour earnings. As is discussed below, the approach that we follow with respect to the latter is the widely used econometric approach pioneered by Mincer (1958). The third concern relates to endogeneity. The empirical strategy that we follow (both the reduced-form and the more structural specification) assumes a specific direction of causality. There are several variables that we include in X that are potentially endogenous, including financial literacy.

V.   Methodology

(i)   Data

The data employed in this study are from the *Household, Income and Labour Dynamics in Australia* (HILDA) *Survey*. HILDA is a nationally representative longitudinal household survey that, at the time of writing, is comprised of 19 waves covering the period 2001 to 2019. The data are mostly collected via face-to-face surveys. All household members aged 15 years and older are interviewed, which is not usually the case in surveys of this type. Our analysis makes particular use of data from two special modules. The first, which was conducted in Wave 16 (2016), relates to financial literacy. The second, which was conducted in Wave 18 (2018),

relates to wealth (including pension savings). Further details, relating to the specifics of these two modules, are presented below. All the information in HILDA is self-reported, including the estimates of pension savings. We recognise the potential for measurement error in self-reported pension data, but also note the benefits of data of this type, particularly as it relates to studying pension savings decisions (Chan & Stevens, 2008).

(ii)   Sample

The main sample for analysis purposes is comprised of individuals aged between 18 to 64 years in 2018 (i.e., born between 1954 and 2000) who are not retired and reside in a private dwelling. In restricting the sample to those residing in private dwellings we exclude those residing in institutions (e.g., prisons). Persons born in 1974 (and, therefore, aged 18 in 1992) have a high probability of being covered by the mandatory pension system during their working life, as suggested by the estimates presented in Table 1. This, of course, does not necessarily apply to immigrants. Therefore, in our analysis, we control for "place of birth". Further research relating to the pension savings of immigrants is needed.

In Wave 18 there are 12,374 persons who meet our selection conditions. As the financial literacy information is collected in Wave 16, and the pension savings information is collected Wave 18 (discussed further below), financial literacy information is only available for 11,217 individuals (due to attrition). This is a sample size reduction of 1,157 individuals or 9 per cent. A further 726 individuals, or 6.5 per cent, were lost because of missing information on variables needed to calculate the number of years worked. This further reduced the sample size to 10,491 with the latter comprised of 5,058 men and 5,433 women. It is important to note, that 695 individuals, or 6.6 per cent report having no pension savings. The majority of our analysis focuses on individuals with positive pension savings; i.e., a sample of 9,796

observations (4,765 men and 5,031 women). In Section 6, we carry out analysis concerned with

the consequences of excluding individuals with zero pension savings.

(iii)   Statistical model

The main hypothesis of this paper is that the male-female gap in financial literacy is a

potential determinant of the male-female gap in pension savings: $S_m/S_f = f(FL_m/FL_f), f > 0$. In

In the previous section, a theoretical model was outlined aimed at guiding the empirical testing

of this hypothesis with individual-level data. The model suggests that there are two empirical

specifications that may be estimated with HILDA data relevant to this hypothesis [see Eqs. (8)

and (10)]. The first is a reduced-form specification, where pension savings is related to average

cumulative earnings, years worked and a set of "other" variables (**X**) thought to potentially

affect pension savings including financial literacy: $S = f(w,\ t,\ \textbf{X})$. The second is a (more)

structural specification, where the pension-to-earnings return (measured as the ratio of

cumulative pension savings to cumulative earnings) is related to the same set of "other"

variables (**X**) included in the reduced-form specification*: $\rho D = f(\textbf{X})$.* Since the sample is

initially restricted to individuals who have positive pension savings, both these models can be

estimated with ordinary least-squares (OLS) regression.

(iv)   Variables

Pension savings, *S,* in HILDA is the respondent's self-assessed estimate of total pension

savings. It is not a variable "matched into" the survey from administrative pension data. The

specific HILDA variable that is employed is "*pwsupwi*". This includes savings for retirement

from all pension funds, measured in 2018 Australian dollars (AUD). It is not possible to

measure pension savings within different accounts separately (if the individual has multiple

pension accounts). This is less than ideal, but likely not problematic. The variable is a HILDA

"derived" variable, with a considerable amount of imputation and top-coding being used in its construction. More specifically, 20 per cent of our sample (N = 1,929) have had their pension savings imputed (8 per cent (822 sample members)) "did not know" how much pension savings they had, 25 sample members refused to answer the question and the remaining 1,107 members could only provide an estimate within a broad range. (For further details on the HILDA imputation approach see Summerfield *et al.* (2020)).

The *pension return*, *ρD,* is measured as the ratio of pension savings, *S*, to cumulative earnings, *(w•t)*: *ρD = S/(w•t). "t"* is number of years worked and *"w"* is average cumulative earnings. Expressing cumulative earnings as the product of average cumulative earnings and number of years work is preferred since (as discussed in the previous section) it allows one to obtain an estimate of how each variable impacts on pension savings separately. Both *S* and *t* are known in the sense that information relating to both is collected in HILDA. However, this is not the case for *w*. In each wave of HILDA, gross wages and salary in the previous financial year is collected. Since HILDA is a panel survey it is possible to estimate cumulative earnings for some of the individuals included in our analysis by summating earnings from previous waves (see Austen & Mavisakalyan, 2018). However, our analysis includes individuals with number of years of work greater than 18, which is the number of years that the HILDA survey has been in existence at Wave 18. In addition, attrition is a problem. Of sample members with the potential for 18 years of HILDA data (i.e., aged 36 or more in 2018), only 9 per cent were 5interviewed in all previous waves. It is our view that trying to calculate "actual" cumulative earnings using the panel dimension of HLDA is not feasible for the sample that we are interested in. As an alternative, we estimate cumulative earnings based on the life-time earnings approach pioneered by Mincer (1979).

The first step involves estimating an earnings equation that includes schooling and work experience as the main explanatory factors. This equation is estimated separately for males and

females. These equations are then used to "predict" the individual's annual earnings at each year of work (i.e., for $t, t-1, t-2$, etc.). These predicted "each year of work" earnings are then cumulated to generate cumulative earnings after t years of work. In turn, this cumulative earnings is divided by t to create *average cumulative earnings*, 'w', which is the variable included in the regression equations estimated in the next section. The gender gap in 'w' is 47.5 per cent. (We note that this is on par with the 49.6 per cent gender gap in median long-term earnings estimated by Austen and Mavisakalyan (2018) who did sum up 15 years of HILDA data to examine gender gaps in long-term earnings). Further details relating as to how 'w' was created, including the full earnings equations estimates, are presented in the Appendix to this paper. Given we now have an estimate of cumulative earnings, it is straightforward to calculate the *pension return*, 'ρD'.

In addition to w and t, there are a set of other variables included in the analysis. These variables are denoted by the vector **X** of which financial literacy, *FL*, is of particular importance to us. In HILDA, information relating to financial literacy is obtained by asking five questions relating to their understanding of interest rates, inflation and risk. These questions are factual with "right and wrong" answers. They are not questions concerned with the respondent's self-assessed view of their financial understanding. It is important to note that these questions also contain the so-called "Big 3" financial literacy questions popularised by Lusardi and her numerous collaborators (see Lusardi & Mitchell, 2014). A summary of these questions is given in Table 2.

	Table 2 Financial Literacy of Adults Who Are Not Retired, Australia, 2018			
	(1)	**(2)**	**(3)**	**(4)**
	Males	**Females**	**Gap (1)-(2)**	**%Gap (3)/(2)x100**
Q1. Interest rate: *"Suppose you put $100 into a no-fee savings account with a guaranteed interest rate of 2% per year. You don't make any further payments into this account and you don't withdraw any money. How much would be in the account at the end of the first year, once the interest payment is made?"*	*91.6%*	*82.3%*	*9.3%pts*	*11.3%*
Q2: Inflation: *"Imagine now that the interest rate on your savings account was 1% per year and inflation was 2% per year. After one year, would you be able to buy more than today, exactly the same as today, or less than today with the money in this account?"*	76.0%	61.4%	14.6%pts	23.8%
Q3: Diversification: *"Buying shares in a single company usually provides a safer return than buying shares in a number of different companies."* [True, False]	77.4%	74.5%	2.9%pts	3.9%
Q4: Risk: *"An investment with a high return is likely to be high risk."* [True, False]	87.7%	78.3%	9.4%pts	12.0%
Q5: Money Illusion: *"Suppose that by the year 2020 your income has doubled, but the prices of all of the things you buy have also doubled. In 2020, will you be able to buy more than today, exactly the same as today, or less than today with your income?"*	80.8%	80.2%	0.6%pts	0.7%

Notes:
1. Sample is aged 18-64, not retired, living in private dwellings.
2. N = 11,217 (N_M = 5,410 males and N_F = 5,807 females).
3. Estimates weighted to reflect population totals.
4. Source: *Household, Income and Labour Dynamics in Australia (HILDA) Survey.*

The mean number of correct responses is 4.2 for males and 3.8 for females for the sample employed Table 2. This implies a gender gap in financial literacy of 9.8 per cent. It would appear that the questions vary with respect to degree of difficulty, with 91.6 per cent of males and 82.3 per cent of females able to correctly answer (Q1) on interest rates and only 76.0 per cent of males and 61.4 per cent of females able to correctly answer (Q2) on inflation. It is interesting to note that the gender gap is largest for the most difficult question (Q2), although it is not the smallest for the easiest question (Q1). For all questions, and regardless of difficulty, the incidence of returning a correct answer is lower for females when compared to males. In other words, there is a sizeable gender gap in all types of financial understandings that these questions are intended to capture. The same pattern is observed in Table 3. This tables shows the number of correct responses for males and females disaggregated by place of birth, highest educational qualification obtained, rural-urban residence and a host of labour market related characteristics. Across all the groupings shown in Table 3 there are sizable (and statistically significant) gender gaps, with females consistently scoring lower than males in terms of correct responses. It appears that the gender gap in financial literacy is both endemic and deeply-rooted in Australia. For a recent analysis of the gender gap in financial literacy in Australia see Preston and Wright (2019).

	(1)	(2)	(3)	(4)
Table 3 **Financial Literacy (Mean Number of Correct Responses) by Select Characteristics**				
	Males	Females	Gap (1)-(2)	%Gap (3)/(2)x100
All	4.14	3.77	0.369***	9.8%
Place of birth:				
Australia	4.14	3.81	0.335***	8.7%
English speaking country	4.43	4.07	0.357***	8.8%
Non-English speaking country	3.95	3.48	0.470***	13.5%
Highest qualification obtained:				
Bachelor degree or higher	4.55	4.19	0.360***	8.6%
High-school or post-secondary	4.14	3.77	0.369***	9.8%
Less than high-school	3.51	3.33	0.186**	5.4%
Rural-Urban Residence:				
Urban	4.16	3.76	0.392***	10.6%
Rural	4.03	3.78	0.246***	6.6%
Labour market characteristics:				
Not employed	3.56	3.38	0.182	5.3%
Employed	4.22	3.86	0.356***	9.3%
Occ: Managers	4.50	4.13	0.351***	9.0%
Occ: Professionals	4.63	4.24	0.386***	9.2%
Occ: Technic. and Trades Workers	4.02	3.72	0.301**	8.1%
Occ: Community and personal service work	4.07	3.38	0.692***	20.4%
Occ: Clerical and administrative work	4.36	4.05	0.308***	7.7%
Occ: Sales workers, Mach. operators and Labourer	3.86	3.28	0.576***	17.7%
Industry: Health Care and Social Assist.	4.32	3.76	0.560***	14.9%
Industry: Education and Training	4.51	4.18	0.336***	7.9%
Industry: Retail Trade	4.05	3.60	0.445***	12.5%
Industry: Manufacturing	4.11	3.56	0.545**	15.4%
Industry: Financial and Insurance Services	4.65	4.27	0.379***	8.9%
Employed in public sector	4.52	4.11	0.396***	10.0%
Employed in private sector	4.15	3.74	0.406***	11.0%
Employed in not-for-profit	4.42	3.91	0.509***	13.0%
Trade union member	4.34	4.04	0.299***	7.4%
Not trade union member	4.10	3.72	0.388***	10.2%
Self-employed	3.96	3.58	0.387***	10.6%

Notes:
1. Sample is aged 18-64, not retired, living in a private dwellings.
2. N = 11,217 (N_M = 5,410 males and N_F = 5,807 females) .
3. Estimates weighted to reflect population totals.
4. Significance levels given by: *** p<0.01; ** p<0.05; and * p<0.1.
5. Source: *Household, Income and Labour Dynamics in Australia (HILDA) Survey.*

With observational survey data such as HILDA, variables are usually measured at the time of the survey. There is, therefore, always some concern about simultaneity bias. In the case of financial literacy and pension savings, the causal direction that we assume in our empirical work is that financial literacy affects pension savings: $FL \rightarrow S$. More specifically, the mechanism or channel that we promote is that individuals with higher financial literacy make more profitable decisions relating to the management of their pension savings. This results in higher pension savings than they would otherwise have had in the absence of such decisions. While such a causal direction is sensible, the reverse causal direction that pension savings affects financial literacy is equally relevant: $S \rightarrow FL$. It may very well be the case that individuals who make decisions relating to the management of their pension savings become more financially literate. In otherwards, the mechanism or channel is a type of financial "learn-by-doing", where the decisions individuals make relating to their pension savings improves their financial understanding. With observational data it is difficult (if not impossible) to determine which is the dominant causal direction. Establishing the appropriate causal direction is complicated even further if individuals with high levels of financial literacy remove pension savings from the system and make alternative investments targeted at their retirement. If the share of individuals doing this is large, then one would observe lower pension savings for individuals with high levels of financial literacy. However, we believe that this share would need to be very large for this effect to be observed. In addition, we are aware of no published evidence that suggest that individuals in large numbers (regardless of their level of financial literacy) are making investments of this type in Australia. We comment further on the importance of this mechanism below.

It would be beneficial if we had measures of financial literacy when individuals were young. This would provide a more convincing check of the assumed causal direction since time is central in the evaluation of "cause and effect". However, HILDA does not collect "early-

life" information of this type. The financial literacy information used in this paper was collected in Wave 16, while the pension savings information was collected in Wave 18. This means that our financial literacy variable is effectively lagged two years. While this no doubt helps reduce simultaneity bias, we believe that two years is not long enough to provide a reliable check. It seems unlikely that the level of financial literacy of someone who is aged 47 is much different to when they were aged 45. We, therefore, adopt an alternative approach in an attempt to address this issue. Research has established that there are three main correlates of financial literacy: education, age and sex (Lusardi & Mitchell, 2014). It is a near empirical fact that the relationship between age and financial literacy is an inverted J-shape. Given this functional form assumption, it is possible to remove the effect of age on financial literacy by regressing financial literacy on age and age-squared. The residual from this regression, *FLres*, is an age-independent measure of financial literacy. It can be thought of being a more likely value of financial literacy when the individual was young than the value collected at the time of the survey (or in our analysis, collected two years before the pension savings information was collected). This, of course, is more likely to be true the older the individual is at the time the financial literacy information was collected. Therefore, *FLres*, and not *FL*, is included as the financial literacy variable in our empirical analysis. We present empirical evidence in support in of this approach in the next section.

Before discussing the remaining variables included in the analysis, consider Table 4. This table summarises information, collected in HILDA, relating to individuals who report making voluntary contributions to their pension savings in 2018. The data suggest that 12.0 per cent of males and 11.5 per cent of females paid additional money into their pension savings in addition to their mandatory contributions based on their earnings. The table also suggest that, for both sexes, individuals with higher earnings and higher schooling have a higher probability of making voluntary contributions. The pattern with respect to age is less clear. With respect

to the main hypothesis of interest in this paper, there is a clear relationship with financial literacy. For both sexes, the probability of making contributions increases as financial literacy increases. In order to understand the magnitude of this relationship, consider the two extremes of financial literacy: zero correct and all five questions correct. For individuals who answered none of the five financial literacy questions correctly, 7.0 per cent of males and 3.3 per cent of females made voluntary contributions in this period. For individuals who answered all five questions correctly, 17.0 per cent of males and 18.3 per cent of females made voluntary contributions. Although the relationship between financial literacy and making voluntary contributions needs to be more comprehensively modelled, the positive correlation provides some evidence in support of our proposed mechanisms linking financial literacy and pension savings. In addition, it provides evidence that there are a large number of individuals with high levels of financial literacy who are not withdrawing from the pension system to make alternative investments relating to their retirement. If high financial literacy individuals were making such investments by withdrawing from pension savings, one would not expect them to be making voluntary contributions to pension savings (assuming money is neutral).

<table>
<thead>
<tr><th rowspan="3">Number of financial literacy questions correctly answered</th><th colspan="6">Males</th><th colspan="6">Females</th></tr>
<tr><th>(1)</th><th>(2)</th><th>(3)</th><th>(4)</th><th>(5)</th><th>(6)</th><th>(7)</th><th>(8)</th><th>(9)</th><th>(10)</th><th>(11)</th><th>(12)</th></tr>
<tr><th>% of Males</th><th>Mean Age</th><th>Years Schooling</th><th>Gross Wages & Salary 2017/18</th><th>Mean Pension Savings</th><th>% Making Voluntary Contributions</th><th>% of Females</th><th>Mean Age</th><th>Years Schooling</th><th>Gross Wages & Salary 2017/18</th><th>Mean Pension Savings</th><th>% Making Voluntary Contributions</th></tr>
</thead>
<tbody>
<tr><td>0</td><td>1.6%</td><td>37.5
(12.1)</td><td>12.5
(1.4)</td><td>$30,626
($41,740)</td><td>$42,670
($96,425)</td><td>7.0%</td><td>2.3%</td><td>37.1
(12.4)</td><td>12.7
(1.8)</td><td>$17,952
($23,732)</td><td>$26,573
($62,026)</td><td>3.3%</td></tr>
<tr><td>1</td><td>1.3%</td><td>28.6
(10.1)</td><td>12.5
(1.0)</td><td>$30,871
($26,089)</td><td>$21,040
($55,545)</td><td>5.1%</td><td>4.4%</td><td>34.2
(13.8)</td><td>13.1
(1.8)</td><td>$25,043
($26,292)</td><td>$23,688
($50,686)</td><td>7.5%</td></tr>
<tr><td>2</td><td>5.2%</td><td>32.2
(13.0)</td><td>12.5
(1.6)</td><td>$31,769
($38,532)</td><td>$49,632
($238,313)</td><td>4.4%</td><td>8.5%</td><td>33.4
(11.4)</td><td>13.4
(1.9)</td><td>$27,459
($29,814)</td><td>$30,526
($81,152)</td><td>2.6%</td></tr>
<tr><td>3</td><td>13.1%</td><td>34.0
(11.8)</td><td>13.2
(1.9)</td><td>$48,253
($41,489)</td><td>$59,280
($106,861)</td><td>7.8%</td><td>17.0%</td><td>35.9
(12.6)</td><td>13.5
(2.0)</td><td>$35,575
($40,763)</td><td>$55,556
($188,478)</td><td>8.6%</td></tr>
<tr><td>4</td><td>25.9%</td><td>39.2
(12.2)</td><td>13.7
(2.2)</td><td>$66,715
($56,894)</td><td>$117,34
($195,983)</td><td>8.4%</td><td>28.7%</td><td>39.8
(12.3)</td><td>14.1
(2.3)</td><td>$42,469
($38,372)</td><td>$75,615
($132,779)</td><td>8.9%</td></tr>
<tr><td>5</td><td>52.9%</td><td>42.2
(12.4)</td><td>14.4
(2.3)</td><td>$82,578
($75,881)</td><td>$184,078
($288,754)</td><td>17%</td><td>39.1%</td><td>43.0
(12.2)</td><td>14.8
(2.5)</td><td>$57,059
($56,467)</td><td>$127,944
($222,662)</td><td>18.3%</td></tr>
<tr><td>All</td><td>-</td><td>39.4
(12.8)</td><td>13.9
(2.2)</td><td>$69,114
($65,989)</td><td>$136,665
($242,294)</td><td>12.0%</td><td>-</td><td>39.4
(12.8)</td><td>14.1
(2.3)</td><td>$43,809
($46,197)</td><td>$83,558
($177,143)</td><td>11.5%</td></tr>
</tbody>
</table>

Table 4
Financial Literacy and Other Characteristics of Non-Retirees in Australia, 2018

Notes:
1. Sample is aged 18-64, not retired, living in a private dwellings.
2. N = 11,217 (N_M = 5,410 males and N_F = 5,807 females).
3. Estimates weighted to reflect population totals.
4. Standard deviation in parentheses.
5. Pension savings includes those with zero pension savings.
6. Source: *Household, Income and Labour Dynamics in Australia (HILDA) Survey*.

It is recognised that pension savings in 2018 will be determined by activities, events and decisions made in the past. Although HILDA does contain some information of this type, detailed life-histories and employment-histories, based on retrospective questioning, have not (to date) been collected. This seriously limits what additional variables, relating to the past, may be included in the analysis. The approach that we, therefore, follow is to include a set of what may be termed "ever variables" aimed at measuring activities, either current or in the past, that may affect pension savings. These include five dummy variables relating to marital status: married (and never de-facto, divorced or widowed) (*Married*); de-facto - either currently living in a de-facto relationship or, in the past, ever lived in a cohabiting relationship (*Ever-cohab*); current or previously divorced (*Ever-div*); currently or previously widowed (*Ever-wid*). Marital status variables may be expected to have an effect on pension savings that is separate from their effect on earnings. Legislative provision, for example, allows for the splitting of pension savings on divorce. In most states and territories, couples separating from a de-facto relationship may also seek access to a portion of their partner's pension savings (see West & Mitchell, 2021). Likewise, as discussed in Section 3, there are various tax incentives that may see one partner make co-contributions into the pension savings of another partner. A variable capturing whether the respondent has ever had children is also included (*Ever-child*). The presence of a child (or children) might capture a break in contributions following time out on parental leave and/or see a diversion of resources away from saving for retirement towards children through, for example, reduced voluntary contributions and cash withdrawals.

Five dummy variables relating to the type of job the individual holds, or has held in the past, are included: ever employed part-time (*Ever-pt*); ever self-employed (*Ever-se*); ever unemployed (*Ever-unemp*); ever in a union (*Ever-union*); and ever employed in the public sector (*Ever-govt*). We believe these factors likely impact on pension savings in addition to the earnings differences they are correlated with. For example, union membership or government

employment may affect pension savings arising from pension related information sessions provided to union member and public-sector employees. Public-sector employment also likely capture the greater incidence of pension coverage, especially historically, of public sector versus private sector employees. Unemployment almost certainly leads to a break in individual and employer contributions being made. A large spell of unemployment, especially when an individual is young, will lower pension savings. Compared to full-time-employment, we believe that part-time employment is qualitatively different. For example, job-turnover is higher for part-time employees compared to full-time employees and part-time employees are more likely than full-timers to be employed on a casual basis. We also believe that compared to paid employment, self-employment is qualitatively different. For example, there is much more churning from self-employment to paid-employment than from paid-employment to self-employment.

One would expect home-ownership to affect pension savings. However, this relationship is complicated. As discussed in Section 3, provisions exist for first-time home-buyers to withdraw pension savings to contribute to a down payment on a home. Owning or purchasing a property (a measure of wealth) may, therefore, lead to lower pension savings. In a similar manner, mortgage payments means that there is less money available to make additional voluntary contribution (Feng, 2018). However, home-ownership may lead to higher pension savings, particularly if pensions savings are used to cover housing debt (Kingston & Thorp, 2019). While it is not possible to sign the effect of home ownership *a priori* (it is an empirical question), we believe it is factor that should be included in our analysis. Therefore, a dummy variable capturing whether the respondent currently or ever owned their home (E*ver-home*) is included in the regressions.

The remaining variables in the analysis include a dummy variable that captures if the respondent has had a spell of non-employment since they left school (*Ever-gap*). This variable

is equal to one if the number of years since leaving full-time education is greater than the time spent in paid employment (i.e., potential work experience > actual work experience). Our sample includes respondents who were employment before the mandatory pension system was introduced in 1992. For example, someone aged 60 in 2018, would have been aged 34 in 1992. A significant share of their working life would, therefore, have elapsed before the introduction of the mandatory arrangements. In order to account for this discontinuity, we include a dummy variable coded 1 is the respondent was born before 1974 (*Born<1974*). A person born in 1974 would be aged 18 in 1992 and therefore be "just" of working age. For foreign-born individuals, their pension savings will be dependent on age at which they immigrated to Australia. In order to capture the effect of being foreign-born on pension savings, a dummy variable was included coded 1 is the respondent is foreign-born (*Foreign*). The final variable included in the analysis is measure of education, measured as the number of years of schooling completed (*Schooling*). Further variable definitions, and descriptive statistics, for all the variables included in the analysis is presented in Table 5.

		(1)	(2)	(3)	(4)
				Gap	**%Gap**
				(1)-(2)	**(3)/(2)x100**
Mnemonics	**Variable Definition**	**Males**	**Females**		
S	Respondents pension savings (superannuation savings) in 2018 Australian dollars ($)	$154,519 ($254,975)	$97,317.2 ($190,364)	$57,202	58.8%
ρD	Ratio of pension savings to cumulative earnings (%)	10.4% (11.7%)	11.6% (18.9%)	-1.2%point	-10.3%
W	Average cumulative earnings in 2018 Australian dollars ($)	$57,185 ($21,167)	$38,776 ($14,026)	$18,409	47.5%
t	Number of years worked	20.9 (12.5)	18.0 (11.6)	2.9	16.1%
FL	Respondent's financial literacy (number of correct responses)	4.2 (1.0)	3.9 (1.2)	0.3	7.7%
FLres	Age standardised financial literacy	0.253 (1.0)	-0.102 (1.2)	0.355	-348.0%
Married	Dummy variable: = 1 if the respondent is married and has never been separated, widowed, divorced or cohabitated	34.9%	35.6%	-0.7 %point	-2.0%
Ever-cohab	Dummy variable: = 1 if the respondent has ever been in a cohabitating relationship	36.3%	38.2%	-1.9 %point	-5.0%
Ever-div	Dummy variable: = 1 if the respondent has ever been divorced	5.9%	8.2%	-2.3 %point	-28.0%
Ever-wid	Dummy variable: = 1 if the respondent has ever been widowed	0.9%	1.2%	-0.3 %point	-25.0%
Ever-child	Dummy variable: = 1 if the respondent has ever had any children	59.3%	67.5%	-8.2 %point	-12.1%
Ever-pt	Dummy variable: = 1 if the respondent ever worked part-time in their main job	50.3%	82.0%	-31.7 %point	-38.7%

Table 5

Mnemonics, Variable Definitions and Descriptive Statistics of Regression Variables

Males and Females, Aged 18-64, Australia, 2018

Ever-se	Dummy variable: = 1 if the respondent was ever self-employed in their main job	26.6%	17.8%	8.8 %point	49.4%
Ever-unemp	Dummy variable: = 1 if the respondent was ever unemployed	26.3%	26.7%	-0.4 %point	-1.5%
Ever-union	Dummy variable: = 1 if the respondent was ever a trade union member or member of an employee association	35.2%	34.4%	0.8 %point	2.3%
Ever-govt	Dummy variable: = 1 if the respondent ever worked in the public sector in their main job	26.5%	41.1%	-14.6 %point	-35.5%
Ever-home	Dummy variable: = 1 if the respondent ever owned their own home	65.1%	66.2%	-1.1 %point	-1.7%
Ever-gap	Dummy variable coded as 1 if the respondent's actual years of work experience is less than their potential years of work experience	70.1%	85.0%	-14.9 %point	-17.5%
Born<1974	Dummy variable: = 1 if the respondent was born before 1974	41.0%	39.6%	1.4%point	3.5%
Foreign	Dummy variable: = 1 if the respondent was born outside of Australia	28.7%	28.9%	-0.2 %point	-0.7%
Schooling	Years of schooling	14.0 (2.3)	14.3 (2.4)	-0.3	-2.1%
N		4,765	5,031		

Note:
1. Sample is aged 18-64, not retired, living in private dwellings.
2. N=9,796 (N_M = 4,765 males and N_F = 5,031 females).
3. See text for the approach used to estimate average cumulative earnings and age-standardised financial literacy.
4. A continuous measure of years of schooling was derived from information on respondent's highest qualification and information on years since leaving school and level of qualification currently enrolled in.
5. Estimates weighted to reflect population totals.
6. Standard deviation is reported in parentheses.
7. Source: *Household, Income and Labour Dynamics in Australia (HILDA) Survey*.

(v)   *Decomposition method*

In order to formally test our key hypothesis of interest, a statistical decomposition, suggested by Oaxaca (1973) and Blinder (1973), is used. The approach involves partitioning the gender gap in pension savings in two components. The first is the so-called "explained component", which is the share of the gender gap (usually expressed as percentage) that can be attributed to gender differences in measured characteristics (such as cumulative earnings, years worked, financial literacy, etc). The second is the so-called "unexplained component", which is the share of the gender gap that can be attributed to gender differences in coefficients (sometimes referred to as the "returns" to the measured characteristics).

More formally, the Oaxaca-Blinder decomposition may be written:

$$lnS_M = \alpha_M + \boldsymbol{\beta}_M \boldsymbol{Z}_M + \varepsilon_M \qquad (11)$$

$$lnS_F = \alpha_F + \boldsymbol{\beta}_F \boldsymbol{Z}_F + \varepsilon_F \qquad (12)$$

where the subscripts "*M*" and "*F*" denote male and female, respectively, the natural logarithm of pension savings (*lnS*) is the outcome variable of interest and the vector $\boldsymbol{Z}$ is a set of variables that, in our analysis, is comprised of *w, t* and **X** (where **X** denotes all other variables as previously described, including financial literacy). When the outcome variable is 'pD' we only include the vector **X** (i.e., we do not control for *w* and *t*); $\boldsymbol{\beta}$ is a set of coefficients to estimated; and α is a constant term (also to be estimated). After estimation, subtracting Eq. (12) from Eq. (11) and rearranging the terms, the gender gap in pension savings may be given as:

$$Gap = \overline{lnS_M} - \overline{lnS_F} = (\overline{\boldsymbol{Z}}_M - \overline{\boldsymbol{Z}}_F)\widehat{\boldsymbol{\beta}}_M + \overline{\boldsymbol{Z}}_F(\widehat{\boldsymbol{\beta}}_M - \widehat{\boldsymbol{\beta}}_F) + (\widehat{\alpha}_M - \widehat{\alpha}_F) \qquad (13)$$

Explained component   Unexplained component

The explained and unexplained components may be easily expressed as percentage shares of the raw gap. Since financial literacy is one of the variables included in *X*, the O-B decomposition provides an estimate of the share of the gender gap in pension savings (or the gender gap in pension return) that may be attributed to the gender gap in financial literacy. Hence, it is our view that the O-B decomposition provides a direct, meaningful and easy to interpret test of the key hypothesis of this paper.

VI.   Results

The main regression results are presented in Table 6. Columns (1)-(4) are for pension savings, *S*. Columns (5) and (6) are for the pension return, ρD. The results of the associated Oaxaca-Blinder decomposition of the gender gap in pension savings and pension return are presented in Table 7. The regression estimate, and results of the Oaxaca-Blinder decomposition, for pension savings will be considered first followed by the same for the pension return. The section concludes with some robustness testing, where the analysis is carried out on more homogenous samples. Tobit regressions that allow for the inclusion of respondents with zero pension savings into the analysis, are also estimated as a further form of robustness testing. It is important to note that since both *w* and *FLres* are predicted variables, the errors in the regressions will be heteroskedastic. Therefore, the standard errors have been corrected for heteroskedasticity following White (1980).

No.	(1)	(2)	(3)	(4)	(5)	(6)
	Table 6					
	Regression Estimates					
	Pension Savings (S) and Pension Return (ρD)					
	Males and Females, Aged 18-64, Australia, 2018					
Outcome	*ln(S)*				*ρD(%)*	
Sex	Males	Females	Males	Females	Male	Female
ln(w)	1.276***	0.938***	0.615***	0.352**	--	--
	(0.092)	(0.075)	(0.174)	(0.155)		
ln(t)	1.051***	1.338***	1.229***	1.353***	--	--
	(0.050)	(0.035)	(0.069)	(0.070)		
FLres	--	--	0.121***	0.107***	0.686***	0.874***
			(0.022)	(0.020)	(0.205)	(0.221)
Married	--	--	0.006	0.036	-0.867	0.309
			(0.084)	(0.082)	(0.651)	(0.916)
Ever-cohab	--	--	-0.011	0.141**	-1.026*	0.004
			(0.074)	(0.061)	(0.561)	(0.749)
Ever-div	--	--	-0.200***	-0.095	-1.765***	-1.717**
			(0.077)	(0.079)	(0.660)	(0.872)
Ever-wid	--	--	0.047	0.059	3.106	1.813
			(0.283)	(0.200)	(4.799)	(1.941)
Ever-child	--	--	-0.024	-0.175***	-0.205	-1.641***
			(0.057)	(0.060)	(0.491)	(0.594)
Ever-pt	--	--	-0.339***	-0.278***	-1.700***	-5.283***
			(0.045)	(0.079)	(0.431)	(0.986)
Ever-se	--	--	-0.408***	-0.360***	-1.390***	0.426
			(0.054)	(0.074)	(0.471)	(0.867)
Ever-unemp	--	--	-0.084	-0.240***	-0.683	-1.669***
			(0.052)	(0.057)	(0.436)	(0.575)
Ever-union	--	--	0.231***	0.101*	1.554***	0.461
			(0.042)	(0.058)	(0.412)	(0.568)
Ever-govt	--	--	0.246***	0.330***	2.780***	2.720***
			(0.047)	(0.050)	(0.531)	(0.565)
Ever-home	--	--	0.361***	0.362***	2.423***	2.877***
			(0.067)	(0.069)	(0.488)	(0.473)
Ever-gap	--	--	-0.212***	-0.099	-1.761***	-1.371**
			(0.046)	(0.064)	(0.452)	(0.690)
Born<1974	--	--	-0.242***	-0.086	-0.082	3.647***
			(0.060)	(0.083)	(0.421)	(0.602)
Foreign	--	--	-0.243***	-0.236***	-2.048***	-2.882***
			(0.055)	(0.063)	(0.504)	(0.619)
Schooling	--	--	0.044**	0.044**	0.119	-0.457***
			(0.019)	(0.021)	(0.095)	(0.123)
Constant	-5.904***	-2.999***	0.403	2.692**	9.766***	21.418***
	(0.884)	(0.755)	(1.503)	(1.271)	(1.442)	(2.559)
R^2(%)	58.9%	52.2%	64.9%	57.3%	6.6%	5.6%
N	4,765	5,031	4,765	5,031	4,765	5,031

Notes:
1. Sample is aged 18-64, not retired, living in private dwellings.
2. Estimates weighted to reflect population totals.
3. Standard errors corrected for heteroskedasticity following White (1980).
4. Significance levels given by: *** $p<0.01$; ** $p<0.05$; and * $p<0.1$.

No.	(1)	(2)	(3)	(4)
Decomposition of Gap in…	Pension Savings *ln(S)*		Pension Return *(ρD)*	
Component:		**% of Raw Gap**		**% of Raw Gap**
(A): Explained component	0.498***	98.4%	0.538**	-42.9%
	(0.081)		(0.2117)	
(B:) Unexplained component	0.008	1.6%	-1.793***	142.9%
	(0.076)		(0.391)	
(C): Raw Gap (C =A +B)	0.506***	100.0%	-1.255***	100.0%
	(0.054)		(0.346)	
Decomposition of Explained component…		**% of Expl Component**		**% of Expl Component**
(D): ln(w)	0.227***	45.6%	--	--
	(0.064)			
(E): ln(t)	0.174***	34.9%	--	--
	(0.034)			
(F): X variables not including financial literacy	0.055**	11.0%	0.294	54.6%
	(0.022)		(0.199)	
(G): Financial literacy	0.043***	8.6%	0.243***	45.2%
	(0.009)		(0.076)	
Explained component: (A)	0.498	100.0%	0.538**	100.0%
	(0.081)		(0.217)	
Component of Gap explained by FL *(G/C)*	0.043***	8.5%	0.243***	-19.4%
	(0.009)		(0.076)	

Table 7
Oaxaca-Blinder Gender Gap Decomposition
Pension Savings (S) and Return (ρD)
Males and Females, Aged 18-64, Australia, 2018

Notes:
1. N= 9,796.
2. Estimates weighted to reflect population totals.
3. Standard errors in parentheses.
4. Significance levels given by: *** p<0.01; ** p<0.05; and * p<0.1.

Columns (1) and (2) of Table 6 show the regression estimates for pension savings, separately for males and females, for the specification that only includes average cumulative earnings, w, and years worked, t. Three points about these estimates are worth stressing. First, it is clear for both males and females, that average cumulative earnings and years worked are strong predictors of pension savings. In terms of variance explained, the R^2 values are very high, with over half the variance in pension savings, for both males (58.9%) and females (52.2%), being "explained" by these two variables. This is encouraging remembering that the regressions are estimated with individual-level data and R^2-values of over 50 per cent are not common with this type of data.

Second, since S, w and t, are all expressed in natural logarithms, the coefficients of w and S may be interpreted as elasticities. For both males and females, none of the elasticities are exactly equal one (1). That said, none of the elasticates are widely different to one. Therefore, they are not too different to the elasticities implied by the theoretical model outlined in Section 4 [see Eqs. (6) and (7)]. This close to one is also encouraging given that S, w and t are all likely measured with considerable error. Third, it is interesting to note that male pension savings are more responsive to average cumulative earnings [$\eta(S,w)_M=+1.3$] compared to years worked [$\eta(S,t)_M=+1.1$]. However, the opposite is case for females, with pension saving being more responsive to years worked [$\eta(S,t)_F=+1.4$] than average cumulative earnings [$\eta(S,w)_F=+0.94$]. It is not clear why this is the case. It could be the case that measurement error is a more serious problem for females compared to males since the employment experience of females is, on average, is more intermittent. If this is true, then years worked (and work experience used in the estimation of average cumulative earnings) is likely less accurately measured for females.

Columns (3) and (4) of Table 6 show the estimates for the reduced-form specification of pension savings, again separately for males and females. The inclusion of the X-variables (see Table 5) increases the variance explained (R^2-totals) from 58.9 per cent to 64.9 per cent

for males and from 52.2 per cent to 77.3 per cent for females. For both sexes, this is a statistically significant improvement in goodness of fit ($p < 1\%$). The elasticities of w and t remain positive, and statistically significant, for both males [$\eta(S,t)_M=+1.2$] and females [$\eta(S,t)_M=+1.4$] and are quite similar in magnitude. However, the elasticity of average cumulative earnings, for both males [$\eta(S,w)_M=+0.62$] and females [$\eta(S,w)_F=+0.35$] are considerably smaller than what was observed prior to adding in the *X*-variables (i.e., when compared to the coefficients in columns (1) and (2)).

With respect to financial literacy, *FLres*, its effect on pension savings is positive and highly statistically significant for both males and females ($p < 1\%$). The coefficient of the financial literacy variable is larger (more positive) for males [$\beta(FLres)_M = 0.121$] than for females [$\beta(FLres)_M = 0.107$]. These point estimates imply that the marginal effect of financial literacy on pension savings is *12.9* per cent for males and *11.2* per cent for females. These percentage marginal effects are calculated following Halvorsen and Palmquist (1980), where: *Marginal Effect(β) = (exp(β)-1) • 100.* The 95 per cent confidence interval for males is 12.7 per cent to 13.0 per cent and for females is 12.7 per cent to 13.0 per cent. Since the two 95 per cent confidence intervals do not overlap, the difference of 1.7 percentage points between males and females is statistical significant at the 5 per cent level. More generally, these findings suggest that financial literacy is an important correlate of pension savings for both males and females.

As for the other X-variables, several of the marital status variables are statistically significant (i.e., $p < 10\%$). There are two notable differences between males and females. For females, divorce (*Ever-div*) is not statistically significant. However, for males the effect of divorce is negative, large and statistically significant ($p < 1\%$). The point estimate suggests that divorce is associated with around 18 per cent lower pension savings. For females the effect of cohabitating (*Ever-cohab*) is positive, large and statistically significant ($p < 1\%$). The point

estimate suggests that divorce for females is associated with around 15 per cent higher pension savings. The effect of having children (*Ever-child*) is negative, and only statistically significant for females, with the effect for females being sizeable (*-16.3%*).

With respect to the included employment-related variables, pension savings are lower for individuals who have worked part-time (*Ever-pt*), with the effect being more negative for males (*-28.8%*) compared to females (*-20.6%*). Likewise, pension savings are lower for individuals who have been self-employed (*Ever-se*), with the effect being larger for males *(-33.5%*) compared to females (*-30.2%*). The effect of public sector employment (*Ever-govt*) and union membership (*Ever-union*) are both positive. The effect of public sector employment is considerably larger for females (*39.1%*) compared to males (*27.9%*). The effect of union membership is larger for males (*26.0%*) compared to females (*10.6%*). The effect of unemployment (*Ever-unemp*) is negative, and only statistically significant for females, with the marginal effect for females being sizeable (*-21.3%*). The opposite pattern is observed for time out of employment (*Ever-gap*), with the effect being only statistical significant and sizeable for males (*-19.1%*).

The effect of home ownership (*Ever-home*) is positive and very large for both males and females. In fact, the marginal effects for males (*43.5%*) and females (*43.6%*) are almost identical. As expected, being foreign-born (*Foreign*) is associated with lower pension savings. The effect is sizeable and nearly identical in magnitude for males (*21.6%*) and females *(-21.0%*). It is interesting to note that being of employment age before the superannuation system was introduced (*Born<1974*) is negative with the effect being statistically significant, and large, only for males (*-21.5%*). Finally, there is a positive relationship between education (*Schooling*) and pension savings, with the size of this effect being the same for males and females. For both sexes, an additional year of schooling is associated with 4.5 per cent higher pensions savings.

Turning to the Oaxaca-Blinder decomposition, Columns (1) and (2) of Table 7 show the results of the decomposition for pension savings based on the reduced-from specification. The mean pension savings is around A$155K for males and around A$97K for females. This is a male-female gap of nearly 60 per cent (see Table 5), which is a natural logarithm difference of +0.506 (row (C), column (1) of Table 7). As Table 7 shows, the "explained component" is 98.4 per cent of the male-female gap, with the "unexplained component" being very small at 1.6 per cent (and not statistically different to zero). In other words, almost all the difference in pension savings between males and females may be attributed to average cumulative earnings (w), years worked (t), financial literacy (*FLres*) and other included variables (***X***, not including *FLres*). With respect to the explained component itself, over 80.5 per cent can be attributed to earnings (*45.6%*) and years worked (*34.9%*). Likewise, around 19.5 per cent can be attributed to financial literacy (*8.6%*) and the other (15) variables included in ***X*** (*11.0%*). Focussing on the variables other than earnings and years worked, financial literacy is by far the most important in explaining the male-female pension savings gap. In fact, almost half (43.6 per cent) of gap not attributed to earnings and years worked, can be attributed to financial literacy. Most importantly, the decomposition suggests that 8.5 per cent of the (raw) male-female pension gap is explained by financial literacy. We believe this is considerable support for the main hypothesis of interest in this paper that the gender gap in financial literacy is an important determinant of the gender gap in pension savings.

Returning to Table 6, Columns (5) and (6) report the regression estimates for the pension return. Column (5) is for males and Column (6) is for females. It is important to note at the outset that the variance explained totals for the pension return are much lower than for pension savings. The R^2-value is 6.6 per cent for males and 5.6 per cent for females, which are around 1/10 of the R^2-values for pension savings. This is not surprising given the pension return combines pension savings, average cumulative earnings and years worked into a single

variable. However, these R^2-values are statistically significant (p < 1%), suggesting that the included variables do capture some of the systematic variation in the pension return.

Generally, the variables that are important in the pension return regressions are also important in the pension savings regressions. For both sexes, divorce (*Ever-div*), being foreign-born (*Foreign*), part-time employment (*Ever-PT*) and time out of employment (*Gap-Year*) are associated with a lower pension return. Public-sector (*Ever-govt*) and home-ownership (*Ever-home*) are associated with a higher pension return for both males and females. For females (but not males), having children (*Ever-child*), unemployment (*Ever-unemp*) and very surprisingly education (*Schooling*) are associated with a lower pension return while being of labour force age before the superannuation scheme was introduced (*Born<1974*) is associated with a higher pension return. For males (but not females), cohabitation (*Ever-cohab*) and self-employment are associated with a lower pension return and union membership (*Ever-union*) is associated with a higher pension return. The similarity in the importance of the included variables in both the pension savings and pension return regressions, remembering that there is a large difference in the variance explained totals, is encouraging since it is pointing to a common set of factors likely correlated with pension decision-making.

With respect to financial literacy, *FLres*, its effect on the pension return, as was found for pension savings, is positive and highly statistically significant for both males and females (*p < 1%*). The coefficient of the financial literacy variable is larger (more positive) for females [$\beta(FLres)_M = 0.874$] than for males [$\beta(FLres)_M = 0.686$]. These point estimates imply that the effect of financial literacy on pension savings is 0.7 percentage points for males and 0.9 percentage points for females. These are large effects remembering that the mean pension return is 10.4 per cent for males and 11.6 per cent for females (see Table 5). In percentage terms (and not percentage points), these are effects of 6.7 per cent for males 7.8 per cent for females. The 95 per cent confidence interval for the point estimates for males is 0.680 per cent

to 0.692 per cent and for females it is 0.868 per cent to 0.880 per cent. Since the two 95 per cent confidence intervals do not overlap, the difference of about 1.255 percentage-points between males and females is statistically significant at the 5 per cent level. In short, the estimates in columns (5) and (6) of Table 6 suggest that financial literacy is an important correlate of the pension return amongst males and females. The estimates also reinforce what was found for pension savings and, arguably, provide more direct evidence in support of the proposed mechanism, i.e., that financial literacy impacts on pension savings through individual decision-making. Males and females with higher financial literacy have higher pension returns and higher pension savings.

Columns (1) and (2) of Table 7 shows the results of the Oaxaca-Blinder decomposition for the pension return. As mentioned above, the mean pension return is 10.4 per cent for males and 11.6 per cent for females (see Table 5). Given the pension return is larger for females than males, the male-female gap is negative, around -1.255 percentage points. In percentage terms, this is a male-female gap of -10 per cent. Because the male-female gap is negative, the interpretation of the decomposition estimates becomes more complicated. The "explained" component is 0.538 and "unexplained" component is -1.793. Adding these two components together equals the gap of -1.255. The negative unexplained component is mainly an outcome of the large difference in constant terms between males (9.766) and females (21.418). Fortunately, our main interest relates to the explained component, which is positive. With respect to this component, 45.2 per cent can be attributed to financial literacy (*FLres*) and 54.6 per cent can to the other included variables (*X,* not including *FLres*). In other words, financial literacy is almost as important as the collective effect of the other (15) variables included in the analysis. With respect to the (raw) male-female gap of -1.255, around -19 per cent of this can be attributed to the male-female gap in financial literacy. To be clear, the estimates imply that the male-female gap in the pension return would become "more negative" the smaller the male-

female gap in financial literacy. We believe this is direct evidence supporting the main hypothesis of interest in this paper that the gender gap in financial literacy is an important determinant of the gender gap in pension savings.

The estimates presented so far in this Section only include individuals who have positive pension savings and consequently a non-zero pension return. As was discussed in Section V, zero pension savings is not in any sense a "data error". In 2018 the share of males and females aged 18-64 and not-retired reporting zero pension savings was 2.2 per cent and 11.5 per cent, respectively. Individuals with zero pension savings are likely different to individuals with positive pension savings in terms of observable and unobservable characteristics. If this is the case, excluding individuals with zero pension savings from the analysis may be a source of "selection", which could lead to biased estimates and incorrect inference. In order to explore this issue, persons with zero pension savings were included in the sample and Tobit regressions were estimated. The key results from this analysis are given in Row (2) of Table 8. The associated baseline estimates are given in Row (1) (taken from Table 7) for comparative purposes. The estimate of main interest is in Column (10). This shows the percentage share of the raw gender gap in pension savings that may be attributed to the gender gap in financial literacy. For the baseline (with positive pension savings) this share is 8.5 per cent. When Tobit regression is used, the share is slightly smaller at 6.7 per cent. Both shares are similar in magnitude, and both use the same variable specification but are based on different regression methods. We, therefore, conclude that our key finding is robust to the exclusion of individuals with zero pension savings.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Table 8
Robustness Analysis
Oaxaca-Blinder Gender Gap Decomposition of Pension Savings (*S*)
Australia, 2018

	Sample	N$_M$	N$_F$	Age group	Estimator	Raw Gap	Explained Component (%)	Unexplained Component	Percentage of explained component due to financial literacy	Percentage of raw gap due to financial literacy
(1)	Baseline (see Table 7)	4,765	5,031	18-64	OLS	0.506***	98.4%***	1.6%	8.6% ***	8.5%***
(2)	Baseline	5,058	5,433	18-64	Tobit	$63,542***	99.2%***	0.8%	6.8%***	6.7%***
(3)	Older and younger individuals excluded	3,375	3,651	25-54	OLS	0.571**	89.7%***	10.3%	10.4%***	9.3%***
(4)	Older individuals excluded	3,933	4,206	18-54	OLS	0.477**	90.4%***	9.6%	10.4%***	9.4%***
(5)	Younger individuals excluded	4,207	4,474	25-64	OLS	0.584***	96.6%***	3.4%	8.9%***	8.6%***
(6)	Baseline + Risk tolerance	4,272	4,622	18-64	OLS	0.554***	95.8%***	4.2%	6.8%***	6.5%***

Notes:
1. The detailed regression results and decomposition results are available from the authors on request
2. Significance levels given by: *** p<0.01; ** p<0.05; and * p<0.1.

The baseline analysis (Row (1)) pertains to individuals aged 18 to 64. Including older individuals in the analysis may be problematic. Older individuals (e.g., between the ages of 55 and 64) in employment may not be representative of all individuals in this age group. With respect to 54-64 year-olds, Wave 18 of HILDA indicates that around 69 per cent of males and 56 per cent of females aged 55-64 are employed and 23 per cent of males and 34 per cent of females report are retired. Older employed individuals are, therefore, likely not representative of all individuals in this age group. This is a further source of selection that could bias estimates. Including younger individuals, between the ages of 18 and 24, into the analysis could also be problematic for a similar reason. With respect to 18-24 year-olds, Wave 18 of HILDA indicates that 73 per cent of males and 76 per cent of females report being employed and 34 per cent of males and 37 per cent of females in this age group report being a full-time student. Younger employed individuals are, therefore, likely not representative of all individuals in this age group. To examine whether the inclusion of younger and older individual is problematic, the baseline specification was estimated for individuals aged 25-54. The key results are shown in Row (3) of Table 8. Using this sample, 9.3 per cent of the gender gap in pension savings may be attributed to the gender gap in financial literacy. This is not too different to the baseline value of 8.5 per cent (Row (1)). Row (4) shows the results when individuals aged 54-64 are excluded from the sample. Row (5) presents the results where individuals aged 18-24 are excluded from the sample. When older individuals are excluded, 9.4 per cent of male-female gap may be attributed to the male-female gap in financial literacy. When younger individuals are excluded, the share of the gender gap in pension savings explained by the gender gap in financial literacy is 8.6 per cent. In both cases, the share is not too different to the baseline share of 8.5 per cent. These estimates based on more age-homogenous samples suggest that selection bias resulting from the inclusion of younger and/or older individuals in the analysis

is not problematic. Therefore, our main finding of a positive and sizeable relationship between the gender gap in pension savings and the gender gap in financial literacy is unchanged.

Row (6) shows the results for a specification that controls for financial risk tolerance. Attitudes towards financial risk may correlate with pension savings. For example, married individuals may be able to risk-share and allowing one partner to opt for higher-risk/higher return investment strategies (Dobrescu *et al.,* 2018). If women have lower risk tolerance than men they may be less inclined to opt out of default settings and less inclined to make higher risk/higher (potential) pension return decisions. In the HILDA survey information on attitudes to financial risk is captured via a self-completion questionnaire (SCQ). In wave 18 (2018) 9 per cent of respondents did not submit their SCQ. Of those who did and who were aged 18-64 and not retired, HILDA estimates suggest a 16 per cent gap (*p < 1%*) (higher for men) in the mean financial risk tolerance scores of men and women. We use this information to generate a zscore and we then enter the latter into our regressions. Our sample is comprised of 4,272 males and 4,622 females (i.e., we have 10 per cent fewer observations than the baseline regression on account of missing SCQs). It is likely that this sample is affected by selection and therefore not representative. The summary estimates in Column (10) of Row (6) show that, even in the presence of a control for risk tolerance, the gender gap in financial literacy accounts for 6.5 per cent of the raw gender gap in pension savings. Note, when the baseline regression is estimated on the sub-sample in row (6) the share of the raw gender gap due to financial literacy is 7.3 per cent. In other words, the share of the gap due to financial literacy is only marginally smaller (7.3-6.5=0.8 percentage points) when controlling for risk tolerance. There is no statistical difference in the two estimates.

In all the estimates presented so far, it is assumed that the causal order in financial literacy impacts on pension savings. As discussed above, the reverse causal order is also relevant. In order to address the potential endogeneity of financial literacy, an instrumental

variable (IV) approach is adopted. The approach requires finding a least one variable (the so-called "instrument') that is highly correlated with financial literacy and not correlated with pension savings. The empirical studies of Behrman *et al.* (2012) and Ćumurović, and Hyll (2019) suggest that parental education is a suitable instrument for financial literacy in several applications. In this paper, we employ father's education (*FatherSch*) as the instrument, measured in terms of years of schooling completed. The full IV estimates are given in Table 9. The corresponding Oaxaca-Blinder decomposition is given in Table 10.

Columns (1) and (2) of Table 9 show the "first-stage" estimates for males and females separately. The outcome variable in these regressions is financial literacy. F-tests confirm that the inclusion of father's schooling generates a statistically significant improvement in goodness-of fit for both males ($F_F = 10.0, p < 1\%$) and females ($F_M = 25.2, p < 1\%$). Father's schooling is a good predictor of financial literacy for both males and females. Columns (3) and (4) report the "reduced-form" analysis. The outcome variable in these regressions is pension savings. F-test confirm that the inclusion of fathers schooling does not generate a statistically significant improvement in goodness-of-fit for males or females. F-tests for improvement in goodness-of-fit are not statistically significant below the 10 per cent level for males ($F_M = 0.4$) or females ($F_F = 2.5$). Taken together, the first-stage and reduced-form estimates suggest that father's schooling is a good instrument for testing the causal direction between financial literacy and pension savings (Bound, Jaeger and Baker, 1995).

A Hausman test firmly rejects the endogeneity of financial literacy (Hausman, 1978). The Hausman test statistic, which is an F-test, is 1.2 males and 1.1 for females—both values are not statistically significant below the 10 per cent level. This suggests that our assumed causal direction of financial literacy on pension savings is appropriate, and the OLS is the appropriate estimator. These estimates are shown in Columns (5) and (6). For completeness, Columns (7) and (8) ignore the results of the Hausman test, and report the IV estimates. This

essentially means replacing the actual value of financial literacy with the predicted value of financial literacy form the first-stage. As Table 10 shows, when financial literacy is assumed exogenous, around 8.6 per cent of the male-female gap in pension savings can be attributed to the male-female gap in financial literacy. When financial literacy is assumed to endogenous this share is negative and not statistically significant below the 10 per cent level. Given IV is not the appropriate estimator, such a finding is of no real substantive interest.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	First Stage	**First Stage**	**Reduced Form**	**Reduced Form**	**OLS**	**OLS**	**IV**	**IV**
Outcome	FL	FL	ln(S)	ln(S)	ln(S)	ln(S)	ln(S)	ln(S)
Sex	Males	Females	Males	Females	Males	Females	Males	Females
FatherSch	0.033***	0.061***	-0.007	0.019	--	--	--	--
	(0.011)	(0.012)	(0.010)	(0.012)				
FL	--	--	--	--	0.123***	0.105***	-0.142	0.397
					(0.022)	(0.020)	(0.213)	(0.251)
ln(w)	0.355**	-0.138	0.631***	0.303*	0.584***	0.325**	0.693***	0.130
	(0.162)	(0.140)	(0.175)	(0.156)	(0.173)	(0.155)	(0.203)	(0.197)
ln(t)	0.104	0.385***	1.215***	1.380***	1.207***	1.338***	1.241***	1.310***
	(0.081)	(0.051)	(0.069)	(0.071)	(0.069)	(0.070)	(0.078)	(0.079)
Married	-0.191**	0.129*	-0.015	0.048	0.011	0.033	-0.021	0.067
	(0.081)	(0.075)	(0.086)	(0.083)	(0.083)	(0.082)	(0.089)	(0.084)
Ever-cohab	-0.115	0.105*	-0.022	0.152**	-0.008	0.140**	-0.027	0.167***
	(0.074)	(0.060)	(0.076)	(0.062)	(0.074)	(0.061)	(0.079)	(0.062)
Ever-div	-0.071	0.123	-0.214***	-0.084	-0.204***	-0.099	-0.210***	-0.094
	(0.071)	(0.083)	(0.078)	(0.080)	(0.077)	(0.079)	(0.078)	(0.080)
Ever-wid	-0.465**	-0.235	-0.027	0.040	0.049	0.059	-0.068	0.154
	(0.227)	(0.217)	(0.274)	(0.200)	(0.283)	(0.200)	(0.287)	(0.215)
Ever-child	-0.001	-0.123**	-0.029	-0.200***	-0.029	-0.189***	-0.047	-0.151**
	(0.053)	(0.058)	(0.058)	(0.061)	(0.057)	(0.060)	(0.062)	(0.073)
Ever-pt	0.037	-0.176***	-0.330***	-0.292***	-0.335***	-0.273***	-0.341***	-0.261***

Table 9
Regression Estimates,
Pension Savings (S)
Instrumental Variables (IV) Estimates
Males and Females, Aged 18-64, Australia, 2018

	(0.062)	(0.055)	(0.047)	(0.079)	(0.045)	(0.079)	(0.050)	(0.079)
Ever-se	0.043	0.075	-0.405***	-0.354***	-0.411***	-0.361***	-0.395***	-0.383***
	(0.042)	(0.055)	(0.055)	(0.075)	(0.054)	(0.074)	(0.057)	(0.077)
Ever-unemp	-0.141**	-0.123**	-0.105**	-0.257***	-0.088*	-0.243***	-0.122**	-0.210***
	(0.056)	(0.055)	(0.053)	(0.057)	(0.052)	(0.057)	(0.057)	(0.064)
Ever-union	-0.049	-0.032	0.225***	0.100*	0.231***	0.102*	0.221***	0.112*
	(0.041)	(0.050)	(0.042)	(0.059)	(0.042)	(0.058)	(0.042)	(0.061)
Ever-govt	0.116***	0.023	0.262***	0.334***	0.246***	0.330***	0.268***	0.319***
	(0.044)	(0.049)	(0.047)	(0.050)	(0.047)	(0.050)	(0.048)	(0.053)
Ever-home	0.214***	0.232***	0.385***	0.382***	0.357***	0.358***	0.415***	0.298***
	(0.065)	(0.067)	(0.067)	(0.069)	(0.067)	(0.069)	(0.084)	(0.087)
Ever-gap	-0.004	0.188***	-0.213***	-0.082	-0.214***	-0.105*	-0.206***	-0.101
	(0.045)	(0.059)	(0.046)	(0.064)	(0.046)	(0.063)	(0.047)	(0.065)
Born<1974	0.034	0.004	-0.250***	-0.098	-0.251***	-0.101	-0.244***	-0.114
	(0.062)	(0.066)	(0.061)	(0.083)	(0.060)	(0.083)	(0.060)	(0.084)
Foreign	-0.178***	-0.233***	-0.264***	-0.268***	-0.246***	-0.241***	-0.294***	-0.184**
	(0.062)	(0.062)	(0.057)	(0.065)	(0.055)	(0.063)	(0.071)	(0.082)
Schooling	0.073***	0.129***	0.055***	0.059***	0.045**	0.046**	0.064***	0.033
	(0.018)	(0.020)	(0.018)	(0.021)	(0.019)	(0.021)	(0.023)	(0.027)
Constant	-1.350	1.611	0.235	2.679**	0.303	2.578**	-0.127	3.695***
	(1.374)	(1.162)	(1.514)	(1.282)	(1.504)	(1.272)	(1.596)	(1.415)
R-squared (%)	14.5%	17.8%	64.4%	56.9%	64.9%	57.3%	64.4%	56.9%
F-test:*FatherSch=0*	10.0***	25.2***	0.44	2.5	--	--	--	--
N	4,765	5,031	4,765	5,031	4,765	5,031	4,765	5,031

Notes:
1. Sample is aged 18-64, not retired, living in private dwellings.
2. Estimates weighted to reflect population totals.
3. Financial literacy instrumented by father's schooling. The approach follows Behrman *et al.* (2012).
4. Hausman test for endogeneity: $F_{Males}=1.2$ and $F_{Females}=1.1$
5. Standard errors corrected for heteroskedasticity following White (1980).
6. Significance levels given by: *** $p<0.01$; ** $p<0.05$; and * $p<0.1$.

No.	(1)	(2)	(3)	(4)
Table 10 **Oaxaca-Blinder Gender Gap Decomposition** **Pension Savings (S)** **Instrumental Variable (IV) Estimates** **Males and Females, Aged 18-64, Australia, 2018**				
Decomposition of Gap in…	*Exogenous*		*Endogenous*	
Component:		**% of Raw Gap**		**% of Raw Gap**
(A): Explained component	0.484***	95.5%	0.453***	89.4%
	(0.080)		(0.054)	
(B:) Unexplained component	0.023	4.5%%	0.054	10.6%
	(0.080)		(0.075)	
(C): Raw Gap (C =A +B)	0.506***	100.0%	0.506***	100.0%
	(0.054)		(0.054)	
Decomposition of Explained component…		**% of Expl Component**		**% of Expl Component**
(D): ln(w)	0.216***	44.6%	0.256***	56.4%
	(0.064)		(0.074)	
(E): ln(t)	0.171***	35.3%	0.175***	38.7%
	(0.033)		(0.034)	
(F): X variables not including financial literacy	0.054**	11.2%	0.050**	11.0%
	(0.022)		(0.024)	
(G): Financial literacy	0.043***	9.0%	-0.028	-6.1%
	(0.009)		(0.042)	
Explained component: (A)	0.484	100.0%	0.453***	100.0%
	(0.081)		(0.054)	
Component of Gap explained by FL *(G/C)*	0.043***	8.6%	-0.028	-5.4%
	(0.009)		(0.042)	

Notes:
1. N= 9,796.
2. Estimates weighted to reflect population totals.
3. Standard errors in parentheses.
4. Significance levels given by: *** p<0.01; ** p<0.05; and * p<0.1.

VII   Conclusion

In this paper we use data on pension savings and financial literacy for a sample of non-retired adults in Australia to empirically examine whether the male-female gap in financial literacy is a determinant of the male-female gap in pension savings. This is an important research topic as research shows that in most countries there is a sizeable gender gap in the retirement savings of non-retired (working) individuals and in the incomes (and hence standard of living) of retired individuals. It is also a timely study given the increasing popularity of privately-managed defined-contribution pension schemes aimed at supplementing (if not replacing) state-sponsored pay-as-you-go defined-benefit schemes. There is some evidence to suggest that defined-contribution schemes exacerbate the gender gap in pension savings and retirement benefits. Understanding the source of the gender gap in pension savings therefore matters, particularly for improving, if not ensuring, the economic and financial security of women in old age.

Our analysis draws on data from the *Household, Income and Labour Dynamics in Australia* (HILDA) Survey. In 2018 this data suggests that there is both a sizeable gender gap in pension savings and a sizeable gender gap in financial literacy. Put simply, relative to their male counterparts, women of working age have, on average, lower pension savings and lower financial literacy. Financial literacy is measured as the ability to understand important financial concepts such as interest rates, inflation, risk and diversification. Consistent with expectations, our analysis shows that earnings and labour supply are the main correlates of pension savings. We also find that, for both males and females, higher financial literacy is associated with higher pension savings. In addition, we find that financial literacy is associated with a higher "pension return" where the latter is measured as the ratio of pension savings to cumulative earnings. We offer this as empirical evidence in support of the mechanism that more financially literate individuals make more profitable decisions related to the management of their pension savings.

We find that around 8.5 per cent of the gender gap in pension savings may be attributed to the gender gap in financial literacy. In other words, our analysis strongly suggests that the gender gap in financial literacy is an important determinant of the gender gap in pension savings.

Our findings should be of interest to policy makers, particularly those concerned with gender equality and the economic and financial security of women in retirement. Interventions aimed at improving the financial literacy of women (e.g., through educational programs) and/or supporting and assisting them (e.g., via financial counselling programs) as they make important pension saving decisions can be expected to reduce the gender gap in pension savings and the gender gap in retirement incomes in old age. Given marked differences in financial literacy skills by age, education and other characteristics, it is likely that such interventions will need to be tailored for different groups. Differentiation might be with respect to stage in life (e.g., commencing work, birth of first child, divorce and nearing retirement).

In Australia, much of the policy response aimed at addressing the gender gap in pension savings has been to encourage voluntary contributions through tax incentives and, more recently, to introduce "MySuper" (low cost, default) pension savings accounts. While these initiatives may assist women at the margin, they are unlikely to see a substantive narrowing in the gender gap in pension savings. Indeed, studies show that default arrangements may be a constraint on the accumulation of pension savings (Dobrescu *et al.,* 2018). As shown in this paper and noted above, the gender gap in pension savings is largely driven by gender differences in earnings and labour supply. While interventions such as financial literacy training/financial advice can be expected to narrow the gender gap in pension savings, it remains the case that the provision of an adequate safety net (e.g., the Age Pension in Australia) along with other support measures such as rent assistance will, for the foreseeable future, be the most effective way of minimising gender disparities in income in retirement.

Notwithstanding this conclusion, given the changing demographic landscape, the increasing expectation that individuals will save for their own retirement, the increased levels of debt holding amongst younger generations (e.g., student debt, mortgage debt) and stalled wages growth (PC, 2020), it is important that we better understand how younger individuals are planning and saving for their financial futures. This includes moving beyond individual analysis and examining how decisions related to the financial futures of women are made within couple households. This is particularly important within countries such as Australia where the pension system offers a relatively high degree of choice with respect to how pension savings are managed. For example, it has been suggested that around 70,000 women may have been coerced into withdrawing their pension savings in 2020/21 when the Australian Government temporarily relaxed the drawdown rules during the COVID-19 pandemic (Curtis, 2020).

Additional research is also required to better understand the relationship between financial education, professional financial advice usage and pension savings. Recent work by Burke and Hung (2021), for example, show that, in the US, financial advice usage is low and that it correlates with trust in the financial sector. Their experimental work also shows that indiscriminately providing unsolicited financial advice has little impact on behaviour, even where there is high financial trust. We also required a better understanding of the impact of fund fee and fund performance information (including how the information is presented and the accessibility of dashboards) on pension savings decisions disaggregated by sex. Within Australia this has been the focus of some attention (PC, 2018) but further work is required.

Finally, given the rising importance of defined-contribution pension schemes, there is a need for more detailed and regular (e.g., annual) reporting on the pension savings of males and females. More frequent reporting of data (by sex and marital status) on pension coverage, savings (including zero savings), voluntary contributions (incidence, amount, pre/post tax),

drawdowns, default usage, advice seeking/ usage, etc. would enable a richer understanding of the pension saving behaviour and outcomes of males and females. The Australian Taxation Office "ALife" (ATO Longitudinal Information Files) goes someway to meeting these data needs, although it has its limitations (for further information on the "ALife" data and its usefulness for retirement policy research see Polidano *et al.* (2020)).

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		Descriptive Statistics		Regression Results	
Appendix Table					
Regression Estimates Used to Construct Cumulative Earnings, Males and Females, Aged 18-64, Australia, 2018					
		(1)	**(2)**	**(3)**	**(4)**
		Males	**Females**	**Males**	**Females**
Natural logarithm of gross wages and salaries in 2017/18 financial year.		11.044	10.601	-	-
		(0.889)	(0.989)		
Schooling (years completed)		14.063	14.396	0.072***	0.104***
		(2.271)	(2.387)	(0.007)	(0.009)
Work experience (years)		16.952	9.137	0.118***	0.162***
		(10.560)	(6.128)	(0.006)	(0.014)
Work experience^2		401.6	119.1	-0.003***	-0.005***
		(402.5)	(134.3)	(0.000)	(0.001)
Partnered (=1 if married or cohabiting)		65.5%	66.1%	0.278***	-0.022
				(0.037)	(0.041)
Urban (=1 if resides in an urban area)		85.5%	85.3%	0.058	0.005
				(0.044)	(0.038)
VIC (=1 if resides in Victoria)		27.3%	28.2%	-0.021	-0.033
				(0.040)	(0.047)
QLD (=1 if resides in Queensland)		18.5%	19.5%	0.011	-0.053
				(0.039)	(0.058)
SA (=1 if resides in South Australia)		6.2%	6.4%	-0.162***	-0.020
				(0.057)	(0.058)
WA (=1 if resides in Western Australia)		10.2%	10.2%	0.047	-0.102*
				(0.060)	(0.062)
TAS (=1 if resides in Tasmania)		2.0%	2.2%	-0.159**	-0.193**
				(0.068)	(0.098)
NT (=1 if resides in Northern Territories)		1.1%	0.8%	0.195*	0.210*
				(0.105)	(0.127)
ACT (=1 if resides in Australian Capital Territories)		1.8%	1.8%	0.119*	0.398***
				(0.070)	(0.093)
Constant		-	-	8.836***	8.272***
				(0.115)	(0.137)
N		4,356	4,476	4,356	4,476

Notes:
1. Sample is non-retired adults aged 18-64 residing in private dwellings.
2. Work experience adjusted for part-time employment (16% for males and 48% for females)
3. Estimates weighted to reflect population totals.
4. Standard deviations/standard errors in parentheses.
5. Significance levels given by: *** p<0.01; ** p<0.05; and * p<0.1.
6. Source: *Household, Income and Labour Dynamics in Australia (HILDA) Survey*