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THE IMPORTANCE OF ECONOMIC EXPECTATIONS FOR RETIREMENT ENTRY*

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We estimate hazard rates of retirement entry as a function of the option value of work. Individuals' economic expectations about the future economy are represented as expectations about rates of return on superannuation retirement savings. These are incorporated into the option value of work, through which they can impact on the timing of retirement entry. We find that individuals have an incentive not to leave the labour force when they expect high returns on their pension savings, while still working. In a scenario where individuals expect negative returns, the average annual hazard rate of retirement entry of 6.9 percent is increased by 0.2 percentage points (or 2.9 percent) compared to a scenario where individuals expect strong positive returns. Rudimentary calculations find an implied tax revenue loss of $26.7 million. Given that the expectations in this model are short-term and *merely perceived*, holding real economic conditions constant, this effect is sizable.

JEL Codes: J26, D84, J32

Keywords: CASiE, expectations, HILDA, option value, pensions, retirement

1. INTRODUCTION

In 2006, Australia experienced an extraordinary boom in the mining sector that resulted in excellent conditions in the labour market as well as the capital markets. The average rate of return on private pension funds in Australia was almost 14 percent and stayed at that level the following year (APRA, 2013). An employed person near retirement age who was deciding whether to leave the workforce immediately or stay in employment, say for another two years, could thus increase his[1]

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[1]We use the male possessive pronoun throughout the text. All of what we have studied applies to females equally, however for simplicity, we focus the empirical estimations on males, and thus refer to male forms throughout without loss of generality to females.

total retirement savings by more than a third when opting to remain in employment. Two years later in 2008, the Global Financial Crisis (GFC) began to unfold, and although its impact in Australia was less severe than in many other parts of the world, the situation in capital markets changed fundamentally. The average rate of return on private pension funds plummeted to −8.1 percent in 2008 and further reduced to −11.5 percent by 2009. An average worker near retirement-age facing the same decision as his colleague did two years earlier, would have lost about a quarter of his retirement savings simply by delaying retirement entry by two years. Such a difference in economic circumstances, *if anticipated*, should matter to both workers' decisions. This paper analyses empirically how strongly such anticipated economic circumstances might impact on individuals' actual retirement decisions.

The GFC hit the world unexpectedly, and thus neither retiring nor continuing workers could have incorporated its impact into their decision making process. Previous analyses of *unexpected* changes in retirement wealth due to the development in the capital markets find them to have small effects on retirement behaviour. However, what happens when conditions in the capital markets *are* expected? This paper explores the importance of incorporating future economic expectations directly when modelling the timing of retirement. We study the case of Australia, where a mandatory savings scheme implies that the vast majority of workers have retirement savings subject to changes in the capital markets. Australia is ideally suited to study the impact of those changes, because its public pension scheme has very small distortionary effects compared to most other industrialised countries.[2] It is thus possible to study the effects of capital markets on privately funded pension schemes in near isolation from the publicly funded pension scheme, which ensures that the results can be transferred to other countries' institutional framework, to the extent that those countries rely on private savings for retirement.

The findings of this paper are most relevant to the countries that have *high ratios* of superannuation savings to GDP, as outlined by OECD (2013). For 2012, Australia's ratio is 91 percent, which is higher than the OECD average of 77 percent. Similar countries are the United Kingdom with 95 percent, the United States with 74 percent and Canada with 67 percent. Equally relevant is the importance of superannuation savings in *absolute* terms; the United States leads the world with USD 11.6 trillion, the United Kingdom with USD 2.3 trillion, Australia with USD 1.4 trillion and Canada with USD 1.2 trillion.

This paper has two objectives: The first is to establish empirically that individuals have an incentive to delay retirement when they expect high returns on retirement investments while still working. The second is to map out the extent to which these economic expectations matter, in order to gauge their economic significance.

The first step in this analysis is to model the responsiveness of older Australian workers to changes in their option value of work. We build on existing studies that apply a reduced-form version of the option value model as it is applied in the seminal work of Gruber and Wise (2004). The novelty of our approach is that we allow workers to have varying expectations about the state of the economy in the future that enter the workers' option value of remaining at work. The second step

[2]This is mostly due to the fact that the level of public pension paid during retirement is relatively low and its receipt not subject to a work test.

is to map out the maximum range of plausible expectations an individual could have, based on historically observed economic outcomes, and to calculate the maximum variation in option values this *could* create. The third step is to then simulate retirement entry rates over that range of option values, which is based on the most positive or most negative, plausible economic expectations about the future.

This process allows us to obtain an estimate of the number of workers who could be swayed, either to retire or remain in the labor force, *purely* because of their expectations, above and beyond the impacts of real status variables such as health, age or actual changes to income and wealth. We find that this expectation effect is statistically and economically significant.

2. Related Literature

Previous analyses of *unexpected* changes in retirement wealth due to the development in the capital markets find them to have small effects on retirement behaviour. Coile and Levine (2011) find that the GFC's impact on retirement wealth caused only a small delay in retirement entries, and this effect was more than outweighed by the impact of rising unemployment rates which pushed workers out of the labour market and into retirement. Their result is supported by Goda *et al*. (2012), Hurd *et al*. (2009) and Coile and Levine (2006). The first paper analyses stock market data from 2000 to 2008 and does not find a strong relationship between realised stock market returns and retirement *intentions*. The latter two papers analyse the stock market crash of the early 2000s and similarly find no evidence of a substantial impact on the timing of retirement.

However, shocks on the stock market represent an *unexpected* change in retirement wealth. Since Stock and Wise (1990) developed their option value model, numerous empirical studies from many different countries have confirmed their basic finding: the current wealth level has only a minor effect on retirement entry, whereas the main financial drivers are *expected* changes in retirement income if entry into retirement were to be delayed. (See Samwick, 1998; Coile and Gruber, 2001; Gruber and Wise, 2004; Giesecke, 2016, for a collection of studies from 12 different countries.) Hence it is not very surprising that only a small effect is found in analyses that are limited to a stock market-induced loss of wealth: the main impact of stock market events may not be in the manner in which they affect wealth levels, but rather, the manner in which they shape individuals' *expectations* about their future. This phenomenon has so far not been studied and this is the main contribution of this study.

The forward-looking nature of the retirement entry decision implies that people form expectations about their own future income, as in Stock and Wise (1990). The foregone expected income, when one decides to retire and start dissaving, instead of accruing and collecting returns on one's retirement savings, can vary quite substantially at different points in time. How strongly do expectations of our personal future income streams vary—over time and across individuals? Further, how do these expectations relate to our overall expectations about the state of the economy?

The risk of job loss varies considerably across the business cycle, and it has been shown that job displacement has a long-lasting and strong impact on an individual's probability of being employed particularly near retirement age (Chan and Stevens, 2001; Davis and von Wachter, 2011). At the same time, rates of return in capital markets vary considerably, and are crucial for savings accruals. However, not only do the economic conditions change over time, but also different individuals at the same point in time will also form different expectations about the state of the economy for the medium-term future, as some are more optimistic than others and act on these expectations. Puri and Robinson (2007) show how an individual's level of optimism is indeed related to savings behaviour, investment choices, and expected retirement entry. Moreover, different individuals receive different signals about the current state of the economy, which may inform their expectations about the future.

However, how important are those *differences* in expectations? Do they affect real economic behaviour? We will analyse retirement entry as a function of future income streams, as is standard in the retirement literature. The novelty of this study is that these future income streams *depend explicitly on expectations* about the future state of the economy, as formed by individuals. We will test a wide range of expectations that an individual could plausibly have, based on the *distribution of actual observed* superannuation rates of return, in order to map out the range of possible behavioural responses.

3. Institutional Background

When calculating work/retirement option values, it is necessary to take into consideration Australian institutions. Australia's retirement system is two-tiered: the federal government runs the Age Pension and private organisations run the superannuation funds. The tax-funded, means-tested Age Pension is designed to ensure a basic living standard and prevent poverty in old-age and is available for all Australian residents at age 65.[3] The age of eligibility was previously 60 years for women, but has been increased in half-year intervals since 1995, first affecting the birth cohort of 1935. For the cohorts born on or after January 1 1949, the age of eligibility is the same for men and women. Beginning in 2017, the age of eligibility was increased further in half-yearly steps until it reaches age 67 for pensioners born on or after January 1 1957. The maximum payment rate per fortnight is A\$842.80 for singles and A\$1,270.60[4] for couples, and is increased in line with average wage growth over time.[5] The age pension does not depend on past labour market history. Formally, there is also no requirement to end current labour market activity in order to receive the pension; however, the payment amount is determined by an individual's or couple's total income (including labour market income and non-labour market income). The full pension is paid to singles (couples) with earnings

[3]To qualify for an Age Pension, some other criteria must be met, such as residence in Australia for a total of ten years.

[4]All monetary amounts are henceforth expressed in Australian dollars.

[5]For comparison, the national minimum wage for fulltime employees (38 hours per week) is \$1281.80 per fortnight.

of up to $156 ($276) per fortnight (every two weeks); if the income exceeds that threshold, the pension is reduced by $0.50 ($0.25) per dollar of earnings.[6]

The second pillar of the Australian retirement system is its mandatory savings scheme "Superannuation Guarantee" (SG); all employees aged 18 or older who earn at least $450 per month are covered by the SG. Employers pay at least 9 percent of employees' wages in an approved superannuation fund chosen by the employee.[7] Employers as well as employees can make additional voluntary contributions. Superannuation contributions are taxed at a flat-rate of 15 percent, and are thus implicitly tax-subsidised for middle and high-income earners. For low-income earners, government co-payments for voluntary contributions are available. In 2012, total assets held in superannuation amounted to 92 percent of Australia's GDP; Australia ranks fifth in the OECD in terms of its "pension assets-to-GDP" ratio and thus well above the OECD average (OECD, 2013). The majority of assets is held in defined contribution plans ($906 billion) or hybrids of defined contribution plans and defined benefit plans ($597 billion). Pure defined benefit plans are rare and make up less than 5 percent of total assets held. Benefit payments during the financial year 2013 totalled $50 billion (APRA, 2013). The high prevalence of defined contribution plans in combination with the size of the superannuation scheme, in terms of the near universal coverage as well as the total amount of assets held and benefits paid out, implies that the performance of superannuation funds has a potentially large impact on older Australians' work/retirement option values and thus on direct retirement entry decisions.

4. Estimation Strategy

The analysis is performed in three major steps: step [1], we estimate hazard rates of retirement entry as a function of financial incentives, most importantly the option value of remaining in the labour force. At this stage, the financial incentive variable is calculated under the standard implicit assumption that economic expectations are constant over time and across individuals, as is implemented in Gruber and Wise (2004). This step yields an estimate of individuals' responsiveness to financial incentives. In step [2], we derive a range of *plausible scenarios* for alternative economic expectations that individuals might hold, and re-calculate what their option value of work would be, if they formed any of these expectations. This allows us to gauge the possible variation in financial incentives caused by economic expectations. In step [3], we predict hazard rates of retirement entry, using the model coefficients from step [1] and the whole range of financial incentive measures developed in step [2]. This allows us to map out the entire range of possible behavioural responses to economic expectations to quantify the effect

[6]Some additional asset tests apply. The maximum allowable amount of assets for receiving a full pension is $196,750 for singles and $279,000 for couples, *excluding* the principal home. For couples or singles who do not own a home, the allowable maximum assets are increased by $142,500. Once those thresholds are exceeded, the fortnightly pension is reduced by $1.50 per $1,000 of excess assets. The assets test and income test are applied separately; the smaller of both resulting pension amounts is paid.

[7]Generally, employees have the right to choose the fund that the employer's contributions are paid into, as well as the investment strategy applied by the fund. However, the majority of workers opts for the fund's default investment strategy (Gerrans *et al*., 2010).

that economic expectations can have in affecting *real* outcomes, such as entry into retirement. We describe these steps in detail in the following paragraphs.

4.1. *Step [1]: Retirement Entry and Responsiveness to Financial Incentives*

We estimate hazard rates of retirement entry for discrete data. A dummy variable denotes the event in question, i.e. the retirement entry $Retire_{it}$, and is set to one at time t if the person i is not yet observed to be retired in t, but is observed later to be retired in $t+1$. For simplicity, the decision to retire is assumed to be irreversible, and indviduals are censored in our analysis after a retirement entry is observed. The hazard is estimated with a simple non-linear logit probability model with retirement entry as the binary dependent variable, and a financial incentive measure (the option value) OV_{it} as the main explanatory variable as in Gruber and Wise (2004). We control for "retirement wealth" V_{it}, a quadratic in age, as well as a vector of sociodemographic control variables $\mathbf{X_{it}}$ which include the individual's health, education, home-ownership status, state dummies and a linear time trend as in (1):

$$(1) \qquad Prob(Retire_{it}=1)=\Lambda(\beta_0+\beta_1 OV_{it}+\beta_2 V_{it}(t)+\beta_3 Age_{it}+\beta_4 Age_{it}^2+\beta_5\mathbf{X_{it}}.)$$

The financial incentive measure, the option value of work OV_t, is derived from the net present value of the future utility stream from income and leisure (discounted to the current period t) which results from retirement at date r: the "retirement wealth" $V_t(r)$.[8]

$$(2) \qquad V_t(r)=\sum_{s=t}^{r-1}[\beta^{s-t}E_t[Y_s^{\gamma}]\pi_{ts}]+\sum_{s=r}^{S}[\beta^{s-t}E_t[kBenefit_s(r)^{\gamma}]\pi_{ts}]$$

As in Gruber and Wise (2004), the term Y_s in (2) denotes labour market income in period s in the periods in which the individual is still participating in the labour market, i.e. from the current period t until the period *immediately before* retirement entry $r-1$. The term $Benefit_s(r)$ represents benefits in period s for those periods when the individual has already retired, i.e. from the period r until the period of death S. The exact stream of future retirement income depends on the chosen time of retirement r. The manner in which expectations about the future economic development impact on the expected future income during retirement is described in detail in the following section.

Following Blundell *et al.* (2002, 2004), the parameter β is a discount factor set to 0.03; γ is set at 0.75 to account for risk aversion, while k represents the preference

[8]In what follows, we drop the index i for simplicity.

for leisure and is set to 1.5 to reflect that income gained while not working is more valuable than income gained while working[9]; π_{ts} is the probability of survival until period s in period t. The option value of work OV_t is the difference between the discounted present value of the expected utility stream when entering retirement at time r^* (the retirement entry date which maximizes the utility stream) and when entering retirement immediately at time t, as in:

$$OV_t = V_t(r^*) - V_t(t) \quad \text{with} \quad r^* = argmax(V_t(r)). \tag{3}$$

In other words, the option value OV_t represents the maximal gain in utility for the potential retiree of staying in the labour market, as opposed to entering retirement immediately.

We assume that individuals who are still participating in the labour market receive earnings if they are employed, and draw unemployment benefits if they are not employed, yet not retired. Expected income before retirement entry Y_s is the weighted average of the earnings in period s and the unemployment benefit entitlement in period s, weighted with the probability of being employed or unemployed in that same period. Because of potential heterogeneity with respect to individual unemployment proabilities, we assume that an individual's unemployment probability $u(s)$ in period s equals the *average age-specific unemployment rate* at the individual's age in s to make calculation tractable. Individuals keep making mandatory contributions to their superannuation accounts while they are still working as is required by law, and in our model, are not allowed to dissave during that period for model simplification. Employed people's superannuation accounts thus continue to grow by the amount of additional contributions that are made, and by the returns that are earned on investing that money (i.e. the superannuation market returns).

The retirement income benefit $Benefit_s$ after retirement is determined by the retirement savings the individual has accumulated by the time of retirement and described in equation (4). The day the individual retires, for simplicity and tractability, we assume that superannuation accounts are converted into savings accounts that earn a secure interest payment i_{ret}.[10] The retiree now begins to withdraw money from this savings account to provide income during retirement. We assume that withdrawals are designed to smooth consumption over time, the dominant retirement dissaving strategy: at the day of retirement entry, the individual expects to live for a certain number of additional years, and simply withdraws an amount actuarily optimised so that he could withdraw for the remainder of his expected life span, when fully dissaving all superannuation savings. The following year, the individual will update his expected life span, and adjust further withdrawals

[9]See Blundell *et al.* 2002, p. C165) or Blundell *et al.* 2004, p. 662) for the specification of these standard parameters. This cornerstone study is widely cited in the literature. These parameter estimates are very close to those estimated by Stock and Wise (1990). Blundel (2004), other similar studies are done for various countries such as Canada, Belgium, Japan, Netherlands, etc, which use these standard parameters. We also use these parameters for our Australian analysis to allow for immediate international comparison. We have tested sensitivity of our results to the inclusion or exclusion of risk aversion and the preference for leisure in our model. The results are entirely stable and available on request.

[10]In the empirical analysis, i_{ret} is set to the average target cash rate set by the Reserve Bank of Australia during the period of observation.

accordingly. If the individual's superannuation wealth falls below a certain level, he will become eligible for a government age pension to supplement his income.[11]

Specifically, retirement income benefit $Benefit_s$ can expressed as:

$$(4) \qquad E_t[Benefit_s(r)] = E_t\left[\frac{i_{ret}}{1-(1+(i_{ret})^{E_t[LS_s]})}E_t[S_s(r)]\right] + A_s(E_t[S_s(r)]).$$

The term LS_s in the first portion of (4) is the further expected life span in period s given the individual has survived until period s; this expectation is formed in t.[12] The term $S_s(r)$ denotes the individual's superannuation wealth in period s, given that he retired in period r. The term A_s denotes the age pension one is eligible for in period s. The age pension is means tested and thus depends on the superannuation wealth in the same period.

As long as the potential retiree is still working, superannuation contributions are made and superannuation wealth is accrued. Before the superannuation savings are claimed upon retirement entry, our potential retiree earns returns from the capital markets $i_{lfp}(t)$. The returns earned in the last years before retirement entry thus alter directly the disposable income during retirement. Consequently, mere *expected* rates of return in the future *can change* the option value of work *today*, and thus potentially alter the timing of retirement entry. This is a crucial point for our analysis. For step [1] of the analysis, we assume that every individual expects the rate of return $i_{lfp}(t)$ to be constant over time and equal to the single long-term average rate of return in superannuation funds. Step [2] relaxes that assumption, and re-calculates option values of work for an entire range range of plausible individual expectations of $i_{lfp}(t)$ in a series of simulations. This will allow us to examine explicitly the role of economic expectations on the timing of reitrement entry.

4.2. *Step [2]: Variation in Financial Incentives Caused by Economic Expectations*

Medium-term expectations about the overall state of the economy enter the individuals' retirement decisions through their expectations about future rates of

[11]Conversion into an account with a secure interest payment, as well as smoothed dissaving, are not mandatory. Retirees may buy an annuity from their superannuation savings (which will lead to a stream of future consumption similar to the one outlined here), or they may receive a lump-sum payment (which can then be consumed faster, slower, or in a way similar to what was outlined above). They can also, in theory, invest their superannuation savings at the capital market of their own accord, instead of earning a secure interest payment. However, in our sample used for this analysis (see Section 5 for details on the estimation sample from the Household, Income and labour Dynamics in Australia (HILDA) study), only 11 percent of all individuals who are observed to enter retirement are ever observed to receive a lump-sum payment from their superannuation fund instead of an annuity. Assuming that at least some of those who choose a lump-sum payment will still use their savings in the intended fashion, consumption smoothing is the *dominant option* to spend one's mandatory retirement savings. Continued investment in the equity market is even rarer than non-smoothed consumption: only 7 percent of all individuals who are observed to enter retirement receive a lump sum and have any equity investments during retirement, and only 4 percent receive a lump-sum and have equity investments that exceed 20 percent of the received superannuation payment. Although other investment strategies are possible in theory, the overwhelming majority of retirees in our sample chooses conversion into safe assets upon retirement, as so we model benefit conversion in this manner.

[12]In the empirical analysis, LS_s will be derived from official life-table data by age, year and gender from multiple releases from the Australian Bureau of Statistics, Life Tables Australia, Catalogue 330.0.55.001, which are available online for public download.

return. Individuals who decide in time t whether to retire, form expectations about a sequence of rates of return $i_{lfp}(s)$, $s = t, \ldots T$. This *expected sequence* impacts on the retirement savings they expect to have, *if they were to retire* at different points in the future. In the absence of directly *observed* expectations of such future rates of return, our model makes assumptions about what such sequences are, for different individuals and at different points in time. This is not straightforward; there is no immediate reason for individuals' expectations to be a precise or unbiased forecast of the true future rates of return. However, this is a reasonable assumption for the purposes of our model, to demonstrate the range of outcomes through the simulations.

We derive different scenarios in order to describe the range of *plausible* assumptions about the expected sequence of future rates of return. Superannuation funds inform members about their superfund's performance in the past year through annual statements. In our data, we do not observe which individuals are members of which specific superannuation fund and thus impose the same rate of return on all persons. We assume that the available information on the returns that were realised in the preceding twelve months is a plausible starting point for the returns one may expect for the following twelve months: $i_{lfp}(s = t)$ equals last year's observed rate of return. In order to avoid unrealistic scenarios of permanently low rates of return for all forseeable time, or conversely, permanently high rates of return for all forseeable time, we further assume after initial expections, that in subsequent periods $s = t + 1, \ldots, T$, individuals expect the rate of return on their superannuation fund to *converge* to its long-term equilibrium at the empirically estimated convergence rate.

While we do not have access to data that enables us to test directly whether individuals do indeed match their expectations for the next year to their experience from last year (but adopt expectations in line with long-term outcomes after that), we believe this to be supported by two arguments: first, individuals can explicitly be assumed to be aware of last year's performance, because every member of a superannuation fund receives a letter stating the fund's performance annually.[13] Secondly, drawing on consumer survey data, we can see that past returns are closely aligned with expectations for the overall economy in the next twelve months, *but not longer*.

To illustrate this point, we use data from the Consumer Attitudes, Sentiments & Expectations (CASiE) in Australia survey and plot them against average rates of returns in superannuation funds. CASiE is a nationally representative, cross-sectional telephone-survey conducted on a monthly basis. Among questions on the individual's own financial situation and intentions to make major purchases, CASiE also asks respondents about their economic expectations about the economy as a whole, (a) for the next twelve months and (b) for the next five years. Respondents are asked to make a subjective ordinal forecast for the state of the economy on a 5-point scale.

Figure 1 shows the population share giving the most optimistic answer, or one of the two most optimistic answers, when asked about economic expectations

[13]Using stock market data from 2008 and 2009 in the Netherlands, Hoffmann and Post (2017) show that experienced past returns indeed do influence investors' expectations about future returns.

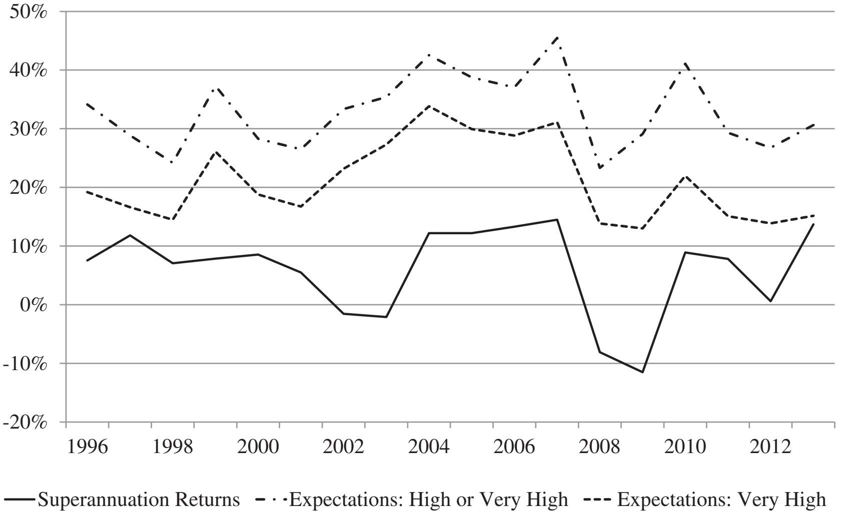

Figure 1. Economic expectations and rates of return on superannuation funds—Next 12 months
Note: Expectations data from CASiE. Superannuation data from ARPA (2013).

for the coming year. The figure also plots realised superannuation returns in the past twelve months for comparison. Figure 2 shows the analogous information on expectations for the next five years. With the exception of the bursting of the "Dot-com bubble" in 2003, which did not seem to affect consumer sentiments in Australia much, it is clearly visible that *overall* economic expectations for the next twelve months move very closely in line with the past year's superannuation returns. We therefore believe it plausible that expectations about the *superannuation market* for the next twelve months will also move in line with past year's returns. However, there is not such a visible link between superannuation returns and longer-term expectations. It thus seems appropriate to assume that current expectations be in line with long-term outcomes for later years and revert to the long run rate of return $i_{lfp}(t)$.

In order to quantify the "starting value" $i_{lfp}(s = t)$ for the sequence of expected future rates of return, we turn to the *distribution of observed rates of return* on superannuation funds. Individuals must choose from (a) a range of different approved superannuation pensions funds and additionally (b) a range of different investment strategies from their chosen superannuation fund, on a continuum of low-risk/low-return to high-risk/high-return. This implies that there is wide variation in returns on retirement savings across individual accounts at any given point in time. In addition, returns also vary obviously over time periods, according to market forces.

Because we do not observe returns on individual accounts, or which superannuation fund applies to which particular individual, we simulate behavioural responses to the full range of returns observed at the fund level in each year of the observation period. In so doing, we will examine two sets of scenarios: "Within" and "Between". The "Within" set consists of nine scenarios, one for each of the deciles 1 through 9 of the distribution of superannuation rates of return, and the

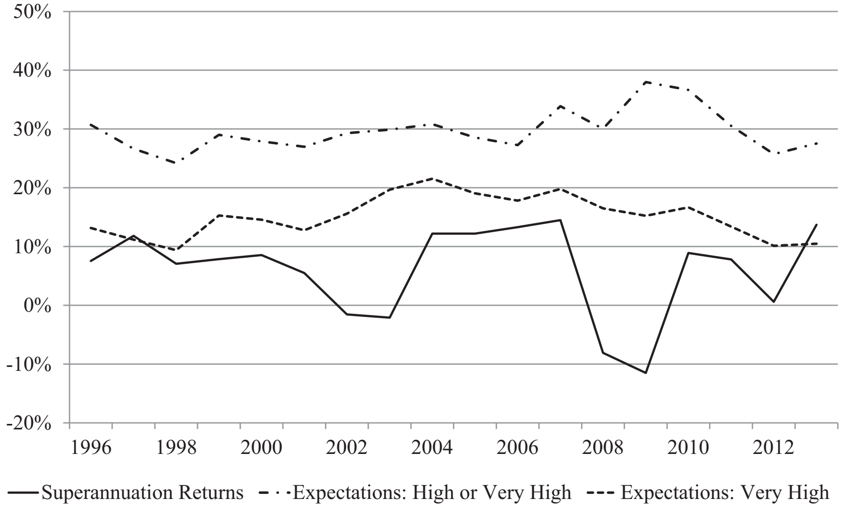

Figure 2. Economic expectations and rates of return on superannuation funds—Next 5 years
Note: Expectations data from CASiE. Superannuation data from ARPA (2013).

"Between" set consists of one scenario for each year in the observation period, 2004 through to 2012. Examining both dimensions, allows us to assess which of the two is the more powerful driver of retirement behaviour: (a) one's own position in the distribution relative to other insured workers *at a given time point*, or (b) the performance of the market as a whole, and how it *changes over time*? This is one of the main contributions of this paper.

Within Scenarios

Our first set of scenarios calculates nine option values of work for each individual at every point in time, setting the rate of return $i_{lfp}(s = t)$ to *different percentiles* in the distribution of observed rates of return *within the current year*. We cover the full range of rates of return by chosing the first, second, third … and ninth decile of the distribution. This set of scenarios maps out the extent to which financial incentives can vary across individuals at any given point in time, because of their fund's position in the distribution. This "Within"-set of scenarios, hereafter referred to ScenarioW1 through ScenarioW9, maps out the extent to which expectations vary with investment funds' performance relative to other funds in the same year; it does not look at overall ups and downs in the market over time. For interpretability, we choose ScenarioW5 (the median rate of return) as a baseline. All other scenarios in this set are then interpreted in relation to this baseline, and whether the other scenarios (other deciles) are statistically different from the (median) baseline.

Between Scenarios

We define a second set of scenarios, in which the rate of return $i_{lfp}(s = t)$ is set to the *median rate of return* as they were observed at *different points in time*. We use the median rate of *each year* in our period of observation.[14] Since this time period covered both extremely good and extremely bad economic times (first the Mining Boom, then the Great Recession), this "Between"-set of scenarios, hereafter referred to ScenarioB1 through ScenarioB9, maps out the extent to which economic expectations can cause financial incentives to vary *only over time*. For interpretability, we choose ScenarioB4 (the year 2007) as a baseline. All other scenarios in this set are then interpreted in relation to this baseline, and whether the other scenarios (other years) are statistically different from the (2007) baseline.

These two sets of nine scenarios each map out the range of plausible expectations for next year's rates of return: *within* time periods ScenarioW1, …, ScenarioW9 and *between* or over time periods ScenarioB1, …, ScenarioB9.

We then assume that individuals expect the superannuation fund rate of return *to converge* to its long-term equilibrium in the manner we previously described. At the fund level, because we do not observe individual accounts, we estimate the rate of convergence by regressing the rate of return in a given year on the rate of return in the previous year: $i_{lfp}(s) = c_1 + c_2 \cdot i_{lfp}(s-1)$, which implies a long-term equilibrium rate of return of $c_1/(1-c_2)$. Through the regression, we identify the empirical coefficients c_1 and c_2 and use them to calculate an empirically realistic path of convergence over time to the long-term equilibrium rate and rate of convergence on all scenarios. We report the values of c_1 and c_2 in the empirical section of this study.

4.3. *Step [3]: Simulating Behavioural Responses through Different Scenarios*

Using the estimated coefficients described in step [1], we predict retirement entry hazards for different financial incentives, as they result from the Within scenarios (ScenarioW1–ScenarioW9) and the Between scenarios (ScenarioB1–ScenarioB9), described in step [2].

5. Data and Descriptives

5.1. *Step [1] Responsiveness to Financial Incentives*

We estimate equation (1) using data from the Household, Income and Labour Dynamics in Australia study HILDA. The nationally representative household survey was conducted for the first time in 2001 and followed individuals over time with annual interviews. The HILDA contains all necessary information on individuals' labour force status, earnings and current superannuation wealth that are necessary for the analysis of retirement entry behaviour. A person is assumed to be retired, if not currently working and not looking for work, and reports the main reason for this to be retirement. Retirement *entry* occurs in $[t, t{+}1)$ if a person is observed *not* to be retired in time t and is later observed to be retired in time $t{+}1$. We use HILDA waves 4 to 13 which thus allow us to observe retirement entries between 2004 and 2012,[15] and restrict the analysis to men aged 55 to 75. For sim-

[14]The "Between" scenarios are thus equivalent to the 5th decile run of the "Within" simulations, *but separately by year*.

[15]Fund-level data on rates of return is available to us only for year 2004 and later. Earlier waves of the HILDA thus could not be used for this analysis.

TABLE 1
Socio-demographic characteristics

Variable	Mean	N
Age (Years)	59.7	5455
Health		
Excellent or Very Good	40.2%	2191
Good	38.7%	2109
Fair or Poor	14.3%	781
Missing	6.9%	374
Total	100.0%	5455
Education		
Postgraduate	13.7%	749
Bachelor/ Bachelor (Honours)	11.5%	630
Cert III/IV, (Advanced) diplomas	38.8%	2116
Year 12, Cert I/II	8.7%	476
Y11 or less	27.2%	1484
Total	100.0%	5455
Home ownership		
Rented	12.0%	656
Owned	85.8%	4678
Other/ Don't know	2.2%	121
Total	100.0%	5455
State		
New South Wales	29.6%	1614
Victoria	25.7%	1400
Queensland	18.9%	1031
South Australia	10.2%	557
Western Australia	11.2%	609
Tasmania	2.2%	122
Nothern Territory	0.6%	35
ACT	1.6%	87
Total	100.0%	5455

Note: Own calculations using HILDA data.

plicity, we discard observations after retirement entry has occurred, which gives us a sample of 6,442 person-year observations of 1,689 men.

We then remove all observations of 173 individuals who were retired before being included in HILDA for the first time, or who have never been employed (neither before entering HILDA, nor afterwards), as well as the observations of 316 individuals for whom necessary information on income and superannuation savings is missing.[16] This leaves us finally with 5,455 observations from 1,208 individuals to estimate men's responsiveness to their option value of work. Table 1 shows key demographic characteristics.

Table 2 shows hazard rates into retirement together with the option value of work and the retirement wealth by age, each for constant expectations across individuals and over time. The average option value of 27,330 means that the average individual in our sample expects that, by staying in the labour force until he reaches

[16]Information on superannuation is collected in 2002, 2006 and 2010. For the waves inbetween those years, we extrapolate the superannuation wealth from reported contribution and the average rate of return of all superannuation funds in the given year. If we extrapolate the superannuation wealth to a year when it is included in HILDA again, the extrapolated and reported values correspond quite closely. More detail is given in Appendix A.

TABLE 2
Retirement entry and financial incentive by age

Age (Years)	Hazard Rate (0 - 1)	Option Value (Mean)	Option Value (Std. Dev.)	N
55 years	0.024	36,845	19,014	655
56 years	0.024	34,207	18,469	624
57 years	0.018	31,894	15,415	606
58 years	0.044	29,950	15,059	571
59 years	0.075	28,162	14,776	522
60 years	0.059	26,950	14,839	458
61 years	0.068	25,717	15,537	413
62 years	0.054	23,014	12,534	369
63 years	0.116	21,553	10,874	320
64 years	0.193	19,335	10,896	264
65 years	0.148	17,535	11,606	189
66 years	0.154	15,306	9,423	136
67 years	0.152	13,774	8,204	112
68 years	0.133	11,273	5,347	83
69 years	0.141	9,773	4,519	71
70 years	0.210	7,257	3,529	62
Total	0.068	27,330	16,472	5455

Note: Own calculations using HILDA data.

his maximum utility stream, he will be able to gain an additional 27,330 "utility units" compared to his utility from retiring immediately. A "utility unit" is closely related to the discounted present value of $1 additional income at some point in the future, adjusted for utility from leisure and risk aversion. The average option value declines sharply with age: the older an individual is, the less utility they can gain from an additional year of work.[17] Parallel to a decrease in the option value by age, we observe an opposite increase in the probability of retirement entry.

5.2. *Step [2] Variation in Financial Incentives Due to Expectations*

The information on rates of return on superannuation is provided by the Australian Prudential Regulation Authority (APRA), the statutory authority that oversees the financial services industry, including most superannuation funds. ARPA publishes financial performance indicators including rates of return at the fund-level on an annual basis. Table 3 shows deciles of the distribution of rates of return by year. For example, the average rate of return in 2004 was 11.8 percent; 10 percent of all funds realised a rate of return of 6.5 percent or lower, while 10 percent realised a rate of return of 15.0 percent or higher. Rates of return show *much greater variation over time* than they do across funds, reflecting the importance of modelling financial markets in the formation of economic expectations.

As described in Section 4, the Within set of scenarios ScenarioW1 …, ScenarioW9 set $i_{lfp}(s = t)$ to one of the deciles of the distribution of rates of return in the current year; the Between set of scenarios ScenarioB1, …, ScenarioB9 set it to the median of a chosen point in time. In both cases, convergence to the

[17]At age 74, the option value reaches zero by construction, since we consider 75 to be the last possible age of retirement entry.

TABLE 3
Rates of superannuation return by year

Year	Mean	Std. Dev.	1st Decile	9th Decile
Mean and Deciles of Distribution				
2004	0.118	0.041	0.065	0.150
2005	0.120	0.039	0.070	0.149
2006	0.135	0.070	0.079	0.164
2007	0.144	0.041	0.069	0.170
2008	−0.083	0.067	−0.154	−0.028
2009	−0.113	0.091	−0.150	0.025
2010	0.085	0.061	0.029	0.108
2011	0.075	0.055	0.020	0.095
2012	0.004	0.065	−0.027	0.027

Note: Superannuation data from ARPA (2013).

long run equilibrium rate of return is assumed afterwards, following the path $i_{lfp}(s) = c_1 + c_2 \cdot i_{lfp}(s-1)$. We estimate this equation using superannuation rates of return from 1996 to 2012, which yields estimates of $c_1 = 0.046$ and $c_2 = 0.231$.

6. Estimation Results

6.1. *Step [1]: Responsiveness to Financial Incentives*

In order to assess the potential behavioural response to these different scenarios, we first estimate the individual responsiveness to financial incentives. Estimating equation (1) yields the effect of the option value of work on the hazard rate of retirement entry. Table 4 shows the coefficients and marginal effects of the option value for different model specifications. In column 1, the standard controls in $\mathbf{X_{it}}$ are restricted to three dummy variables representing the individuals self-reported health; in column 3, it is expanded to include education and home ownership and the full set of covariates is included. The coefficient on OV_t is negative and highly significant; the higher the option value of work, the lower the probability that an individual retires within the next year. This result is completely in line with the international evidence from numerous different countries (Samwick, 1998; Gruber and Wise, 2004), as well as a study by Warren and Oguzoglu (2010) for Australia.

The average marginal effect across all individuals is −0.009 (Table 4, column 1), which means that the hazard rate of retirement entry will drop on average by 0.9 percentage points, if the option value of work is increased by 10,000 utility units (=about two thirds of a standard deviation, as shown in Table 2). The marginal effect is thus not only highly significant, but also economically substantial. Columns 2 and 3 present the coefficients and average marginal effects for two extended versions of the model that also control for education and home ownership, and for state dummies and a linear time trend. The coefficient on the option value and its marginal effect remain robust to the additional controls.[18]

For our preferred specification, we thus follow the literature, such as Gruber and Wise (2004), and estimate *without earnings controls* in order to avoid

[18]See Appendix for additional robustness checks.

TABLE 4
THE OPTION VALUE AND ITS EFFECT ON THE HAZARD RATE OF RETIREMENT ENTRY

	(1)	(2)	(3)
Coefficients	−0.157**	−0.149**	−0.140**
(Std. Err.)	(0.051)	(0.052)	(0.051)
Average Marginal Effect	−0.009**	−0.009**	−0.008**
(Std. Err.)	(0.003)	(0.003)	(0.003)
Number of observations	5455	5455	5455
Log-likelihood	−1242.396	−1239.859	−1236.060
Control variables			
Retirement wealth	Y	Y	Y
Age (linear)	Y	Y	Y
Age (squared)	Y	Y	Y
Health (3 categories)	Y	Y	Y
Education (6 categories)	N	Y	Y
Home ownership (3 categories)	N	Y	Y
State of residence (8 states)	N	N	Y
Year (linear)	N	N	Y

Note: The table shows the coefficient of the option value of work (see Table 2) on the probability of retirement entry in a logit model. The average marginal effect is the marginal effect for each individual at their observed characteristics, averaged across all individuals in the sample. The stars ***, ** and * denote statistical significance at the 0.1%-level, 1%-level and 5%-level.

over-controlling. However, an alternative specification with added earnings controls is also reported in the Appendix. As expected, the estimator is less precise when earnings are included in the estimation. However, the estimated average effect changes only marginally.

6.2. *Step [2]: Variation in Financial Incentives Caused by Economic Expectations*

We now re-calculate the financial incentive variables according to the scenarios outlined in Section 5. Table 5 shows variation in the option value of work (as well as the retirement wealth) for the "Within"-set of scenarios. The variation is modest: if financial incentives are calculated according to the information received by those ten per cent of the population with the *lowest* rates of return, the average option value of work is 26,896 "utility units". It increases by 3.6 percent (from 26,896 to 27,859) if calculated according to the information received by those ten per cent of the population with the *highest* rates of return in any given year.

As compared to the "Within"-set of scenarios (Table 5), the variation in financial incentives in the "Between"-set of scenarios is *substantially larger*, as shown in Table 6. We see this by the maximum result from the "2007"-scenario (good year) and minimum result from the "2009"-scenario (bad year), for both option value and retirement wealth. If the option value is calculated for the "2007"-scenario, it amounts to 28,511 utility units; this is 9.1 percent larger than if it is calculated according to the "2009"-scenario when it is 26,119 utility units.

6.3. *Step [3]: Behavioural Impact of Economic Expectations*

Within Scenarios (ScenarioW1 to ScenarioW9)

By how much will the *probability of retirement entry change*, if an individual adopts different expectations about the future rate of return, which in turn, affect

TABLE 5
Financial incentives by expected rates of return—Within Scenarios

Scenarios	Decile	Option Value	Retirement Wealth	N
ScenarioW1	1st Decile	26,896	27,686	5455
ScenarioW2	2nd Decile	27,147	28,138	5455
ScenarioW3	3th Decile	27,266	28,338	5455
ScenarioW4	4th Decile	27,352	28,489	5455
ScenarioW5	5th Decile	27,425	28,615	5455
ScenarioW6	6th Decile	27,491	28,733	5455
ScenarioW7	7th Decile	27,566	28,861	5455
ScenarioW8	8th Decile	27,664	29,042	5455
ScenarioW9	9th Decile	27,859	29,392	5455

Note: Financial incentives are calculated using sequences of expected rates of return as defined by the Within-scenarios, where the starting value $i_{lfp}(s = t)$ equals a decile of the current year's rates of return. For an example (ScenarioW7), see Appendix.

TABLE 6
Financial incentives by expected rates of return—Between Scenarios

Scenarios	Year	Option Value	Retirement Wealth	N
ScenarioB1	2004	28,237	30,016	5455
ScenarioB2	2005	28,211	29,984	5455
ScenarioB3	2006	28,474	30,297	5455
ScenarioB4	2007	28,511	30,339	5455
ScenarioB5	2008	26,242	26,265	5455
ScenarioB6	2009	26,119	25,819	5455
ScenarioB7	2010	27,721	29,353	5455
ScenarioB8	2011	27,578	29,153	5455
ScenarioB9	2012	26,840	27,854	5455

Note: Financial incentives are calculated using sequences of expected rates of return as defined by the Between-scenarios, where the starting value $i_{lfp}(s = t)$ equals the median rate of return for the years 2004 to 2012. For an example (ScenarioB4), see Appendix.

the option value of work? We first simulate the behavioural response to the Within set of scenarios, setting the rate of return $i_{lfp}(s = t)$ to the deciles of rates of return within the *current year*, as shown in Table 7.

In the top panel of Table 7, we present the hazard rate of retirement entry if the option value is calculated at the year-specific *median rates of return*. Over the individuals, the mean hazard rate is 6.996 percent. Looking over the hazard distribution from left to right, the lowest quarter of all individuals has a hazard of retirement entry of 2.584 percent or lower; the median hazard rate of retirement entry is 4.990 percent and the top quarter has a hazard rate of 9.726 percent or higher.

In the bottom panel of Table 7, we show the changes in the hazard rates, as *deviations from the baseline* calculated at the median (or 5th-decile). Here we compare the option values calculated at the 1st-decile rates of return to the option values calculated at the 5th-decile (median) rates of return and display whether it is significantly different from the median. We repeat this for the option values calculated at the 2nd-decile rates of return and compare to the option values calculated at the 5th-decile (median) rates of return. We further calculate option values at all decile rates of return up to the 9th-decile rate of return. In so doing, we map out

TABLE 7

Within Scenarios: Predicted hazard rates of retirement entry for different scenarios of economic expectations

Distribution of Predicted Hazard Rate of Retirement Entry									
		Baseline: when Option Value Assumes Current Year's Median Rate of Return							
		Mean Hazard		**25-percentile Hazard**		**Median Hazard**		**75-percentile Hazard**	
Baseline	Decile	**Level**	SE (Level)	**Level**	SE (Level)	**Level**	SE (Level)	**Level**	SE (Level)
ScenarioW5	5th	6.996***	0.371	2.584***	0.311	4.990***	0.374	9.726***	0.530
Difference to (Median) Baseline: when Option Value Assumes Other Percentiles of Current Year's Rate of Return									
		Mean Hazard		**25-percentile Hazard**		**Median Hazard**		**75-percentile Hazard**	
Compare	Compare Decile	**Diff.**	SE (Diff.)	**Diff.**	SE (Diff.)	**Diff.**	SE (Diff.)	**Diff.**	SE (Diff.)
ScenarioW1–W5	1st–5th	+0.045*	0.020	+0.009	0.010	+0.012	0.016	+0.084**	0.031
ScenarioW2–W5	2nd–5th	+0.024*	0.010	+0.003	0.006	+0.009	0.011	+0.047*	0.019
ScenarioW3–W5	3rd–5th	+0.013*	0.006	+0.001	0.004	+0.004	0.008	+0.032*	0.014
ScenarioW4–W5	4th–5th	+0.006*	0.003	+0.001	0.002	+0.003	0.005	+0.020*	0.009
Baseline	-	-	-	-	-	-	-	-	-
ScenarioW6–W5	6th–5th	−0.006*	0.002	−0.006**	0.002	−0.002	0.004	−0.019*	0.009
ScenarioW7–W5	7th–5th	−0.012*	0.005	−0.012**	0.004	−0.006	0.007	−0.048***	0.013
ScenarioW8–W5	8th–5th	−0.020*	0.009	−0.012*	0.006	−0.017	0.010	−0.085***	0.019
ScenarioW9–W5	9th–5th	−0.036*	0.016	−0.017	0.010	−0.031*	0.014	−0.094***	0.025

Note: The simulation results are based on the coefficients from Table 4 column (3) and the financial incentives from Table 5. Standard errors are bootstrapped with 1000 repetitions. The stars ***, ** and * denote statistical significance at the 0.1%-level, 1%-level and 5%-level.

the entire distribution space for option values calculated at each decile of the rates of return *and* the respective quartile of the distribution of retirement entry hazard rates. This will give an excellent overview of the extent to which the decile of rate of return will impact on the resulting retirement entry hazard rate.

Changes for the *mean hazard rate* (the "Mean" column) are small: the hazard rate increases by 0.045 percentage points (statistically significant) if an individual has expectations according to ScenarioW1 or the "1st Decile"-scenario. In contrast, for ScenarioW9, the mean retirement entry hazard rate decreases by 0.036 percentage points if the 9th-decile of rate of returns is used instead (statistically significant). In other words, our scenarios imply that on average, only 81 out of 100,000 individuals would be swayed to retire, rather than stay in the workforce if they received among the ten per cent most "negative" signals of the current year (1st decile of rate of return), as opposed to receiving among the ten per cent most "positive" signals of the current year (9th decile of rate of return).

Similarly, instead of focussing on the mean of the retirement entry hazard distribution as above, but rather at the 75-percentile of the retirement entry hazard rate distribution (column "75- percenttile"), the retirement entry hazard rate increases by 0.084 percentage points (statistically significant) if an individual has expectations according to ScenarioW1, and it decreases by 0.094 percentage points if the 9th decile of rates of returns is used instead as in ScenarioW9.

We can further contrast this in Table 7 to examine the the behavioural response among those who had a *relatively low hazard of retirement entry*, namely at the *25-percentile* of retirement entry hazard rates with a baseline effect of 2.584 percentage points. Their response is even smaller than that of the average of 6.996 percentage points. Conversely, the behavioural response is about twice as large among those with a *high risk of retirement entry* at the *75-percentile* (typically older individuals and/or those in bad health). However, even at the *75-percentile* of hazard rates, the response is still not economically significant. This reflects the low variation in financial incentives across individuals within a given year.

Between Scenarios (ScenarioB1 to ScenarioB9)

We next simulate the behavioural response to the Between set of scenarios, where $i_{lfp}(s = t)$ equals the median rates of return for the years 2004 to 2012. The uppermost panel of Table 8 shows the predicted hazard rate of retirement entry if the option value is calculated according to the "2007"-scenario (ScenarioB7), *the scenario with the highest returns observed in our sample*, just before the Global Financial Crisis. The mean retirement entry hazard rate is 6.905 percent. A quarter of all individuals have a hazard of retirement entry of 2.556 percent or lower; the median hazard rate of retirement entry is 4.907 percent; the top quarter has a retirement entry hazard rate of 9.623 percent or higher.

The lower panel of Table 8 shows again by how much the hazard rates change if the option value of work is calculated according to the other scenarios. Since the baseline year of 2007 was the year with the highest returns and thus the lowest incentive to retire, the hazard rates increase across the board in *all* other scenarios, yet these increases vary quite substantially in size. The "2006"-scenario increases the hazard rate of retirement entry by only 0.003 percentage points compared to

TABLE 8

Between Scenarios: Predicted hazard rates of retirement entry for different scenarios of economic expectations

Distribution of Predicted Hazard Rate of Retirement Entry

		Baseline: when Option Value assumes 2007 Median Rate of Return							
		Mean Hazard		**25-percentile Hazard**		**Median Hazard**		**75-percentile Hazard**	
Baseline	Year	**Level**	SE (Level)	**Level**	SE (Level)	**Level**	SE (Level)	**Level**	SE (Level)
ScenarioB4	2007	6.905***	0.366	2.556***	0.306	4.907***	0.372	9.623***	0.535
		Difference to 2007 Baseline: when Option Value assumes Median Rate of Return in Other Years							
		Mean Hazard		**25-percentile Hazard**		**Median Hazard**		**75-percentile Hazard**	
Compare	Compare Year	**Diff.**	SE (Diff.)	**Diff.**	SE (Diff.)	**Diff.**	SE (Diff.)	**Diff.**	SE (Diff.)
ScenarioB1–B4	2004–2007	+0.023*	0.010	+0.004	0.006	+0.007	0.010	+0.030	0.020
ScenarioB2–B4	2005–2007	+0.026*	0.011	+0.004	0.007	+0.008	0.010	+0.031	0.021
ScenarioB3–B4	2006–2007	+0.003*	0.001	+0.000	0.001	+0.001	0.003	+0.003	0.003
Baseline	-	-	-	-	-	-	-	-	-
ScenarioB5–B4	2008–2007	+0.191*	0.081	+0.049	0.033	+0.144**	0.055	+0.325**	0.102
ScenarioB6–B4	2009–2007	+0.201*	0.086	+0.050	0.034	+0.146**	0.057	+0.345***	0.106
ScenarioB7–B4	2010–2007	+0.068*	0.029	+0.011	0.013	+0.044*	0.021	+0.047	0.042
ScenarioB8–B4	2011–2007	+0.081*	0.035	+0.020	0.015	+0.067**	0.024	+0.073	0.050
ScenarioB9–B4	2012–2007	+0.141*	0.061	+0.037	0.024	+0.115***	0.039	+0.173*	0.079

Note: The simulation results are based on the coefficients from Table 4 column (3) and the financial incentives from Table 6. Standard errors are bootstrapped with 1000 repetitions. The stars ***, ** and * denote statistical significance at the 0.1%-level, 1%-level and 5%-level. All differences are positive, because the Baseline ScenarioB4 (2007) has the most positive expectations, and hence lowest rates of retirement entry. Thus, these deviations reflect by definition higher retirement hazards compared to the particularly good year of 2007.

the “2007”-baseline—or 3 in 100,000 individuals. However, the financial incentives that follow from the “2009”-scenario (a particularly “bad” year economically, with the Global Financial Crisis in full swing) imply that the average hazard of retirement entry increases by 0.201 percentage points (201 in 100,000 individuals), or 2.9 percent. Again, this effect is *even higher, the more likely an individual is to retire*. At the upper quarter of hazard rates of retirement entry, the effect increases to 0.345 percentage points (345 in 100,000 individuals) or 3.6 percent.

We performed some back-of-the-envelope calculations to gauge the overall economic significance of this increase in hazard rates of retirement. We compare retirement entry behaviour caused by financial incentives as they result from ScenarioB4 in 2007 and ScenarioB6 in 2009 - the scenarios for which expectations provide the lowest and highest incentives to retire. The economic impact can be characterised by total number of additional retirement entries in ScenarioB6 compared to ScenarioB4, and by the resulting tax losses associated with those additional retirement entries. It is important to remember that these real economic changes would be caused *merely by perceived* differences in economic expectations as measured by expected returns to superannuation funds.

Using overall population weights available in HILDA, the increase in annual hazard rates of retirement entry implies that in an average year of our observation period, on average 1,586 individuals would have retired had they formed expectations according to ScenarioB6 and would have remained at work in ScenarioB4.

We then calculated the total income received and tax paid by each individual in the sample in the years before they entered retirement, as well as the amount of non-labour income they would have received and tax they would have paid in the same year had they stopped working. The difference gives us an estimate of the income and tax loss that would be caused by this individual’s retirement entry. On average, each individual in our sample would have earned \$57,922 less and paid \$17,057 less in tax had they been retired in a year in which they were working.[19]

The higher the individual’s hazard rate of retirement entry in a given year, the more likely it is that this income and tax loss is realised. The income and tax loss multiplied by the increase in the hazard rate of retirement entry thus gives an estimate of the economic impact and revenue loss incurred by negative expectations. The individual increase in hazard rates is highest for workers with high wages, again increasing the likely tax loss. In our observation period, had people formed expectations in accordance with the ScenarioB6 instead of the ScenarioB4, the income loss attached to that would have amounted to as much as \$146.4 million per year, with a resulting revenue loss of as much as \$53.4 million per year. The revenue loss of \$53.4 million assumes systematic retirement entry in the very first month of the next period. If we assume that retirement entry is evenly distributed across the 12 months in the year of retirement entry, we can conservatively estimate a 6 month average, which leads to \$73.2 million in reduced earnings and \$26.7 million in reduced revenue, or half the maximal amounts.

[19]Our calculations are based on the income tax rules as they applied at the time of observation. All taxes and tax rebates are calculated assuming that spousal income remains unchanged. We take into account: Income Tax, Medicare Levy, Low Income Tax Rebate, Senior Australians and Pensioners Tax Rebate, and Mature Age Worker Tax Rebate.

Note that these are costs attached to the mere *expectation* of future economic developments - they incur over and above the costs (or benefits) that are attached to behavioural responses if individuals actually *experience* such expected developments. Considering the purely perceived or hypothetical nature of the economic stimulus, a possible behavioural response of this magnitude is substantial and economically significant.

7. Conclusion

This study builds on the existing literature that applies a reduced-form version of the option value model as it is applied in the seminal work of Gruber and Wise (2004), in order to model the extent of responsiveness of retiree-age Australian workers to changes in their option value of work due to the role of economic expectations. This is the first paper to combine reported forward looking economic expectations with nationally representative data on retirement and labour market participation. These economic expectations play a role and are economically and statistically significant.

After having estimated the responsiveness of potential retirees to economic expectations, we outline a maximal range of empirically observed economic expectations and quantify the magnitude of behavioural changes they can induce. We do so by mapping out a grid of economic expectations over individuals and over time using survey data (2004–2012), and simulating the behavioural response to each of them. Our parameter estimates are not only statistically significant, but also economically significant, as demonstrated by the simulations within year and over time. The simulations outline the extent to which economic expectations can play in real economic decision making for entry to retirement, controlling for standard determinants and drivers.

Taking economic expectations into account, which reflect the the range of values as experienced over time (the Between scenarios), has a *substantially larger impact* on the hazard rate to retire than the range of values experienced within year (the Within scenarios). In our simulations, if people had formed expectations based on superannuation fund rates of return as observed in 2009 (the economically worst year in our period of observation), it would have led to a 3 percent increase in exit rates from employment to retirement, compared to a situation in which they formed expectations based on rates of return as observed in 2007 (the economically best year in our period of observation) - in response to no *real* economic stimulus. Seen in absolute terms, this implies increasing the exit rate from 6.9 percentage points to 7.1 percentage points (+0.2 percentage points).

The effects of economic expectations are however not uniform over all individuals, such that individuals *already with a high propensity to retire*, experience the greatest behavioural impact of their economic expectations. Extrapolating our results for this simulation to the overall population in Australia, this weighted estimate implies 1,586 additional retirement entries in a given year, simply if economic expectations are very negative rather than very positive.

There are fiscal ripple-on implications in addition to these direct retirement effects. For those individuals simulated to have entered into full retirement, by definition they would no longer be earning labour income (forgoing $73.2 million in conservative estimates), paying income tax on labour earnings and superannuation withdrawals become at that point, income tax-free. Thus, the federal government would be expected to forgo substantial tax revenues from this additional increase in the exiting population, which we roughly estimate at $26.7 million. These forgone tax revenues would additionally exacerbate the falling revenues from the overall tax base during an actual downturn, i.e. the goods and services value-added tax (GST), corporate tax, tax on earnings and capital gains. At the same time, the federal government would experience increased expenditures on welfare, unemployment insurance and other transfers.

Despite Australia having previously enjoyed growth without recession for over 25 years, high levels of economic growth are becoming less likely for Australia in the near future and currently in 2019 stagnating to under 1 percent per annum. Thus the role of economic expectations in real economic decision making such as retirement or saving behaviour is likely to be more important than ever, given the far less dependable nature of growth in Australia and in many of its trading partners in the world.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix A Imputation of Superannuation Wealth
Table 9: Observed and imputed superannuation Wealth
Appendix B Sequences of Expectations
Table 10: Sequences of expected rates of return—Example ScenarioW7: 7th Decile, current year
Table 11: Sequences of expected rates of return—Example ScenarioB4: 5th Decile, 2007
Appendix C Robustness checks
Table 12: The option value and its effect on the hazard rate of retirement entry