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RETIREMENT DECISIONS EVIDENCE ON RETIREMENT ELASTICITIES

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─Abstract ─

The research of retirement decisions focus on the trade-off between the retirement wealth and the planned retirement span. Using 8 waves of the Household, Income and Labour Dynamics in Australia (HILDA) Survey in a continuous time model, we estimate the Frisch elasticity and the relative risk aversion. The retirement decision elasticities (0.21 to 0.25) is low compared to the elasticity of the intertemporal labour supply on the extensive margin. When compared to the theoretical solution using the same model setting the constant relative risk aversion estimate is high (2.2 to 2.3). The finding indicates a low responsiveness to retirement pension benefits. The graph of age profile and a set of regressions show a strong motive on smoothing consumption during the pre-retirement period. This snapshot provides new evidence to explain the impact of financial incentives in the Australian pension system that induces earlier retirement.

Key Words: *Risk Aversion, Intertemporal Labour Substitution Elasticity*

JEL Classification: J14 J26 C51 D10 E21 G11

1. INTRODUCTION

Retirement decisions involve the trade-off between time span of labour supply and retirement wealth. The efficient retirement timing of a life cycle is when the age wealth profile hits the reservation retirement wealth boundary (Kingston 2000). The retirement wealth is jointly determined by consumption and investment (Farhi & Panageas 2007). Building a log utility function into the

Merton continuous time model, the time-wealth trade-off implies the planned span of retirement should be proportional to the asset wage ratio at the time of retirement (Kingston 2000). We estimate the intertemporal labour supply substitution elasticity at extensive margin for the retirement decision. The retirement decision elasticity explains the percentage changes of retirement planning span corresponding to the variation of pension benefit. Similarly, the elasticity of retirement decision can be obtained by the percentage changes of retirement span on the changes of retirement wealth.

Using Household Income and Labour Dynamics in Australia (HILDA) data, we estimate the retirement elasticity at around 0.2-0.25 and the constant relative risk aversion (CRRA) at 2.2-2.3 under the same setting. This study uses Chetty's (Chetty 2003, 2009) new method of the risk aversion estimation method which demonstrates a direct relation between elasticity ratio and the coefficient of risk aversion on transition.

The graphic evidence suggests that income, wealth and the propensity of consumption are age dependent. The assumption for the constant elasticity of substitution (CES) and the constant relative risk aversion (CRRA) is less likely hold for the wealth effect, therefore, the CES and the CRRA are less meaning to be compared in the single number term. We examine the biasness estimation on the CES and the CRRA so we reach the conclusion that the estimation of CES is low and CRRA is high. In a similar study by Manoli and Weber’s (Manoli & Weber 2010) on Austrian pension reform. They also find a low intertemporal elasticity with respect to three discontinuous public pension reforms on tenure changes.

The retirement elasticity is useful for understanding the financial effects on retirement decisions. The construction of the model and the estimations of CES and CRRA are discussed in section two. A review of estimated elasticity is presented in section three; the sample data summaries and the proof are provided in Appendix.

2. RETIREMENT DECISION MODEL

2.1 The Retirement Incentive Measure

The commonly used retirement incentive measure are option value (Stock & Wise 1990), peak value (Coile & Gruber 2002) and Social Security Accrual (Mitchell & Fields 1983). With a number of justifications made to cater HILDA data, the data have been collected as after tax human capital income y_t^w, after tax pension income y_t^p , after tax non-human capital income y_t^k. The investment proportion π_t is defined as the proportion of non human capital income over the total income $\pi_t = y_t^k/(y_t^k + y_t^w)$ and $\pi_t = y_t^k/(y_t^p + y_t^k)$ in the pre-retirement period R and the post retirement period T-R respectively.

In a two-period setting, a representative agent earns after tax human capital income y_t^w from a labour market in pre-retirement period R and invests his savings in financial market. He receives after tax pension income y_t^p in the retirement period T-R. The investment generates after tax non-human capital income y_t^k and the consumption c_t in goods market is defined over life time T. The present value lifetime income at the time of retirement is W_R.

The present value lifetime income at the time of retirement W_R can be approached from the two periods. In pre-retirement period, people save and invest to accumulate the retirement wealth reservation. In post retirement period, people expect the discounted annualized retirement wealth. The present value of life income at retirement time (W_R) equal to the sum and the present value of total income or retirement wealth (*RW*) in pre-retirement period and the discounted present value of expected post-retirement pension income the Social Security Wealth (*SSW*) at time of retirement. The value function of total income is defined over the life time including:

$$W_R = RW + SSW = \underbrace{\int_0^R e^{r_i t}(y_t^w + y_t^k)\,dt}_{RW} + \underbrace{E\int_R^{T-R} e^{-r_i t}(y_t^p + y_t^k)\,dt}_{SSW} \qquad (1.)$$

The Social Security Wealth (SSW) is the expected total retirement income which includes a combination of all types of pension income. The Social Security Wealth accrual (ACC) at a given age captures the expected change in the social security wealth. Equivalently the Retirement Wealth Actual (RWC) is captures the expected change of unearned Retirement Wealth (RW). The efficient time to retire is when ACC is equal to RWC, .i.e. the marginal income equal to the expected marginal retirement benefit.

In solving a deterministic maximisation problem, the consumption level c_t , labour supply duration R and Lagrange multiplier λ_t are the control variables. To determine the optimal path for the endogenous variables, one chooses c_t and R optimally while the state variable asset accumulation a_t adjusted indirectly as a consequence of the choice of consumption level c_t and *R*.

$$da_t = \underbrace{\pi_t (y_t^{\,w} + y_t^{\,k} - c_t)dt}_{financial\ assets} + \underbrace{(1-\pi_t)(y_t^{\,w} + y_t^{\,k} - c_t)dt}_{nonfinancial\ assets} \qquad (2.)$$

2.2 CES and CRRA Estimation on a Two-Period Model

Consider a separable additive log utility with labour supply span R and instantaneous consumption c_t:

$$U(c_t, R) = \gamma \ln(c_t) - (\gamma - 1)\frac{R^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}} \qquad (3.)$$

Under intertemporal utility maximization and the consumption and labour supply span are independent.($U_{c_t n_t} = 0$) The intertemporal labour supply elasticity ε is measureless, or measures the marginal consumption level changes on the percentage change at extensive margin of career length R. The optimal labour supply R is related to time preference or utility from work period and retirement period $\frac{\gamma}{1-\gamma}$, labour income $y_t^{\,w}$ and consumption level c_t[1]

$$R = \left(\frac{\gamma}{1-\gamma}\frac{y_t^{\,w}}{c_t}\right)^{\varepsilon} \qquad (4.)$$

Taking log of each side, the income-constant Marshallian elasticity ε_M is defined as $\varepsilon_M = {lnR}/{\ln(y_t^{\,w})}$, the utility-constant Hicksian elasticity ε_H is smaller than ε_M:

$$\varepsilon_H = \frac{lnR}{\ln\left(\frac{\gamma}{1-\gamma}\frac{y_t^{\,w}}{c_t}\right)} = \frac{lnR}{\ln(y_t^{\,w})}\,\frac{1}{\ln\left(\frac{\gamma}{1-\gamma}\frac{1}{c_t}\right)} = \frac{1}{\ln\left(\frac{\gamma}{1-\gamma}\frac{1}{c_t}\right)}\,\varepsilon_M \qquad (5.)$$

The Frisch labour supple elasticity ε_F is ε in equation (3) when the marginal utility of consumption $\lambda_t = \frac{\partial U(c_t, R)}{\partial c_t} = \frac{\gamma}{c_t}$ holds constant.

$$\varepsilon_F = \frac{\partial R}{\partial\, (y_t^{\,w})}\frac{(y_t^{\,w})}{R} = \frac{U_R/R}{U_{c_tR} - \frac{(U_{c_tR})^2}{U_{c_tc_t}}} = \frac{U_R/R}{U_{RR}} = \frac{(1-\gamma)R^{\frac{1}{\varepsilon}}/R}{\frac{1}{\varepsilon}(1-\gamma)R^{\frac{1}{\varepsilon}-1}} = \varepsilon \qquad (6.)$$

[1] Refer to appendix2

The CRRA is:

$$\mathrm{CRRA} = -c_t \frac{\frac{\partial \partial U(c_t,R)}{\partial c_t \partial c_t}}{\frac{\partial U(c_t,R)}{\partial c_t}} = -c_t \frac{-\gamma c_t^{-2}}{\frac{\gamma}{c_t}} = 1 \qquad (7.)$$

The individual preference between (c_t, R) will be represented in the two periods utility preference ratio $(\gamma/(1-\gamma))$ and the Frisch labour supple elasticity ε with CRRA equal to 1.

However, if there is no specific utility function, the agent's life time overall constant relative risk aversion ($CRRA_T$) can be express as $CRRA_R$ of the pre-retirement period R and $CRRA_{T-R}$ of the retirement period T-R.[2]

$$\frac{1}{CRRA_T} = \frac{1}{CRRA_R} + \frac{1}{CRRA_{T-R}} \qquad (8.)$$

With unspecified the utility form, if the constant relative risk aversion is greater than 1, there is generally downward bias that the $CRRA_T$ is always smaller than the pre-retirement period $CRRA_R$ and his retirement period $CRRA_{T-R}$.. .

Let's rewrite the double log form of equation (4):

$$lnR = \varepsilon ln(y_t^{W}) + \varepsilon ln\left(\frac{\gamma}{c_t}\frac{1}{1-\gamma}\right) = \varepsilon ln(y_t^{W}) + \varepsilon ln\left(\frac{\lambda_t}{1-\gamma}\right) \qquad (9.)$$

We shall allow a positive constant in the regression equation (9). If not, the regression coefficient ε is over estimated by forcing $ln\left(\frac{\lambda_t}{1-\gamma}\right) = ln\left(\frac{\gamma}{c_t}\frac{1}{1-\gamma}\right) = 0$

In empirical study that Frisch elasticity of labour supply is at around 0.4-1 (Blundell & Macurdy 1999; Dandie & Mercante 2007). In this paper we use retirement planning horizon. The planning horizon is at fewer margins than career length, If the assumption for a separable additive log utility holds, the retirement elasticity shall be bounded at 0.4-1 , i.e. the percentage change in wage rate cause percentage changes in retirement planning horizon.

3. HILDA DATA

The 8 waves of the HILDA data collect a sample of approximately 20000 individuals of 7000 Australian households from year 2001 to 2008. We create a balanced panel data sample according to whether they are constantly presented in

[2] Refer to appendix 1

8 waves with the employment status recorded. People plan for retirement generally at a mature age; we keep data for people aged at least 41 years old at year 2001 and construct the age profile in the two balanced panel data files: the household data of household income and consumption and the personal data file of employment history.

Wealth and expenditure data are recorded on household basis and match with the individual characteristics of the household identifier. The household identifier is selected from Wave 1: The household identifier who is satisfied several criteria: stays in the family the longest time and provides the most information in the household. Then the partner for the Household identifier is selected if there is one. The information is matched across 8 waves to form a longitudinal record for the household file. Every household has a nominated reference person with the characteristics of the reference person in record. There are 4455 individuals and 2232 household is kept in our panel data file for the study, where their working status is in three categories: never in work force working for part time or full time ($D_{i,t} = 0$) and retired ($D_{i,t} = 1$).

The data selection is restricting the time effect to be zero by using CPI index to discount or appreciated the price from year 2001 to 2008 into the basis year 2007. So the time effect has already be considered in term of discounting. In presenting this research results the time refer age of individual or years of duration in a life cycle setting.

The social security income, or pension, refers to the sum of government age incomes support. The superannuation saving are collected only in wave 2 and wave 6. Other wealth data such as bank saving, insurance, business value, household debt are collected in wave 2 and wave 6. The household type refers to the double wage income with or without dependents (children or other dependents), the single income with or without dependents (children or other dependents) which is recoded from the original data.

4. RESULTS

We base on the two periods setting to run a double log model to estimate the elasticity to look into how people reallocate resource in the two periods. The retirement decision refers to the change in the planned retirement span which either brings retirement earlier or defers the retirement on the expected retirement benefits changes. The double log coefficient catches the partial elasticity of decision with respect to the pension income and the wage income.

Table 4-1 . The Frisch Elasticity On Extensive Margin

	Male (Std. Err)	Female(Std. Err)	All (Std. Err)
Wage	0.2108 (0.0009)	0.2074 (0.0010)	0.2092 (0.0007)
Pension	0.2278 (0.0013)	0.2566 (0.0012)	0.2448 (0.0009)
ACC	0.4143 (0.0012)	0.3882 (0.0012)	0.4010 (0.0008)
SSW	0.1802 (0.0006)	0.1720 (0.0006)	0.1761 (0.0004)
Net wealth	0.1710 (0.0007)	0.1649 (0.0007)	0.1681 (0.0005)
Risk Aversion	2.3	2.257	2.277

From the summary output of elasticity estimation in table 4-1, both female and male have low level elasticises, while male respond more on labour wage than on pension benefit, while female responds more on pension to wage. Individuals are relatively sensitive to the changes in marginal incentive for continuing work e_{ACC} than the changes in wealth e_{SSW}. Intuitively the explanation is that how people response to the price change more than they respond to wealth, however the ratio of e_{SSW}/e_{ACC} indicate high CRRA.

5. CONCLUSION

Low retirement elasticity implies less responsiveness to expected retirement benefits change. And there is generally trend for people to work longer for financial reasons.

The low elasticity can be accounted for three reasons. Firstly, in the sample: the current retiree who receives flat rate pension. The invariability of pension rate and unrelated to earning history may lead to the low responsiveness. Two third people retired at eligible retirement age, this reduces the variation of retirement span. The current working people, who not yet receive superannuation payment and intent to working loner and are making contribution to superannuation funds, are less responding to public pension rate change. This reduces the variability of retirement span and expectation on public pension rate in overall. Secondly the mix of PSYG and accumulation funds in Australia leads bias estimation: high CRRA and low elasticity. Thirdly there is the shorter retirement planning horizon comparing with intertemporal labour supply elasticity at extensive margin of career length.

The findings of high relative risk aversion coefficients indicate Australians prefer steady flow in consumption at low level income than a more erratic flow at a high level, which implies people increase present consumption rates more than increasing wealth level. The evidence of age profile, the financial ratio at the time of retirement and the set of regression also confirm the same results

The findings of low retirement elasticity and high relative risk aversion coefficients further exploit the explanation on the financial incentive in Australian pension system. It is less conniving to conclude social security itself is the direct incentive induces earlier retirement. The incentive lies on the widely accessible low rate but steady public pension. The public pension provides a sense of security against contingency and longevity risk at a low flat rate. People save more than is required for retirement with a high the precaution saving rate. The working people demonstrate higher wealth-consumption ratio and allocate more of net worth on financial asset than the retirees.

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Appendix 1 the Two-Period CRRA

The overall consumption of the two periods*:*

$$c_t = c_{1t} + c_{2t} \quad \Longrightarrow \quad \frac{\partial c_{1t}}{\partial c_t} + \frac{\partial c_{2t}}{\partial c_t} = 1 .$$

The share among the overall utility*:*

$$U'_{c_t} = U'_{c_{1t}} \frac{\partial c_{1t}}{\partial c_t} = U'_{2t} \frac{\partial c_{2t}}{\partial c_t} \quad \longrightarrow \quad U'_{c_{1t}} = \lambda_t U'_{c_{2t}}$$

where λ_t is the time dependent

$$U''_{c_t} = U''_{c_{1t}} \frac{\partial c_{1t}}{\partial c_t} \quad \Longrightarrow \quad \frac{U''_{c_t}}{U'_{c_t}} = \frac{U''_{c_{1t}}}{U'_{c_{1t}}} \frac{\partial c_{1t}}{\partial c_t} = \frac{U''_{c_{2t}}}{U'_{c_{2t}}} \frac{\partial c_{2t}}{\partial c_t}$$

By definition of risk-aversion: $RA = \frac{-U''_{c_t}}{U'_{c_t}}$

$$\Longrightarrow \frac{\frac{U''_{c_t}}{U'_{c_t}}}{\frac{U''_{c_{1t}}}{U'_{c_{1t}}}} + \frac{\frac{U''_{c_t}}{U'_{c_t}}}{\frac{U''_{c_{2t}}}{U'_{c_{2t}}}} = \frac{\partial c_{1t}}{\partial c_t} + \frac{\partial c_{2t}}{\partial c_t} = 1 \Longrightarrow \frac{1}{RA} = \frac{1}{RA_1} + \frac{1}{RA_2}$$

By definition the Arrow-Pratt measure of the coefficient of relative risk aversion: $CRRA = \frac{-c_t U''_{c_t}}{U'_{c_t}}$. The overall CRRA has the same relationship as RA. The overall CRRA is smaller than either $CRRA_1$ or $CRRA_1$ if it is greater than 1.

Appendix 2 Computing Frisch labour supply elasticity ε_F

At the beginning of period t the endowment of asset a_t and interest rate r:

$$\varepsilon_F = \left\{ \frac{\partial n_t}{\partial\,(y_t{}^{w})} \frac{(y_t{}^{w})}{n_t} \middle| \lambda_t \ constant \right\}$$

The objective maximizing utility function: $U(c_t, n_t) = \sum_t u(c_t, n_t)$

$$\mathcal{L} = U(c_t, n_t) + \lambda_t(\, y_t{}^{w} n_t + (1+r)a_t - c_t - a_{t+1})$$

FOCs: $\mathcal{L}_{c_t} = U_{c_t}(c_t, n_t) - \lambda_t = 0$

$$\mathcal{L}_{n_t} = U_{n_t}(c_t, n_t) - \lambda_t\, y_t{}^{w} = 0$$

$$\mathcal{L}_{\lambda_t} = (y_t{}^{W} n_t + (1+r)a_t - c_t - a_{t+1}) = 0$$

The first two FOC provide the condition for marginal utility λ_t:

$$\lambda_t = U_{c_t}(c_t, n_t) = \frac{U_{n_t}(c_t, n_t)}{y_t{}^{w}} \qquad \text{and} \qquad y_t{}^{w} = \frac{U_{n_t}(c_t, n_t)}{U_{c_t}(c_t, n_t)}$$

Taking derivative for the first two FOC with respect to $y_t{}^{W}$:

$$U_{c_t c_t}(c_t, n_t)\frac{\partial c_t}{\partial(y_t{}^{W})} + U_{c_t n_t}(c_t, n_t)\frac{\partial n_t}{\partial(y_t{}^{W})} = \frac{\partial U_{c_t}(c_t, n_t)}{\partial(y_t{}^{W})} = \frac{\partial \lambda_t}{\partial(y_t{}^{W})} = 0$$

$$U_{n_t c_t}(c_t, n_t)\frac{\partial c_t}{\partial(y_t{}^{W})} + U_{n_t n_t}(c_t, n_t)\frac{\partial n_t}{\partial(y_t{}^{W})} = \frac{\partial U_{n_t}(c_t, n_t)}{\partial(y_t{}^{W})} = \frac{\partial(-\lambda_t\, y_t{}^{W})}{\partial(y_t{}^{W})} = -\lambda_t$$

Solving for $\frac{\partial n_t}{\partial(y_t{}^{W})}$ in the above two equations

$$\frac{\partial n_t}{\partial(y_t{}^{w})} = \frac{\lambda_t U_{c_t c_t}(c_t, n_t)}{U_{c_t n_t}(c_t, n_t) U_{c_t n_t}(c_t, n_t) - U_{c_t c_t}(c_t, n_t) U_{n_t n_t}(c_t, n_t)}$$

Replacing the constant marginal utility λ_t , we derive the expression for Frisch labour supply elasticity:

$$\varepsilon_F = \frac{\partial\,(y_t{}^{w})}{\partial n_t}\frac{n_t}{(y_t{}^{w})} = \frac{U_{n_t}/n_t}{U_{n_t n_t} - \dfrac{(U_{c_t n_t})^2}{U_{c_t c_t}}} = \frac{\lambda_t/n_t}{U_{n_t n_t} - \dfrac{(U_{c_t n_t})^2}{U_{c_t c_t}}}$$