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How Well Does the Australian Aged Pension Provide Social Insurance?

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Abstract

Social security plays an essential role in an economy, but if designed incorrectly, it can distort individual's labour supply and savings behaviour. We explore how well the Australian means-tested pension system provides social insurance by changing the settings of the system and calculating the impact on welfare. In order to exclude trivial welfare gains, we keep the cost of the programmes constant. We find that the means-tested pension system is welfare reducing, but does provide a better outcome than a PAYG system of equivalent cost. We also find that if the benefit amount is held constant, and hence the cost of the pension programme is allowed to vary, a taper rate of 1.0 is optimal. However, once we hold the cost of the program constant, a universal benefit scheme provides the best welfare outcome.

Keywords: Social Security, Welfare, Superannuation

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1 Introduction

Social insurance plays an important role in the Australian economy, providing a form of insurance to people against risks such as illness, disability and longevity. In the 2014-15 financial year expenditure on social security and welfare is expected to account for over 30% of total government expenditure, with assistance for the aged a key driver of expenditure growth.[1] Growth in expenditure on aged pension is a common theme across many countries, including the U.S., U.K. and Europe. For this reason, the provision of an aged pension is a topic of much debate, with government policy experts and economists looking to reform current policies to ensure optimal provision of benefits to elderly individuals in society.

The Pay As You Go (PAYG) system and the means-tested system are two pension programmes analysed in the literature. PAYG is an intergenerational risk sharing system for social insurance whereby agents pay a specific social insurance tax and are provided with a benefit in times of retirement proportional to their average earnings. In times of a growing population and economic growth, this system works well as the new generation is funding the retired generation. But where an economy has an ageing population, with fewer working people funding more retirees, funding a PAYG system starts to become problematic and raises the question of efficient benefit allocation.

Due to the funding problem a PAYG system faces, means-tested pension systems have been the focus of many recent studies as this type of system reduces the fiscal burden through benefit targeting. This benefit targeting is achieved by providing payments to aged citizens based on their income and savings. The means-tested system is currently employed in many countries, including Australia.

The focus of our research is to explore how changes to the Australian means-tested pension system can provide welfare gains, using an open economy overlapping generations model. We first compare the current system and a stylised PAYG system against an economy where no pension system is in place, focusing on welfare gains and distributional effects. We then explore how changes to the current means-tested pension settings impact the labour supply and savings behaviour of individuals.

Possible welfare gains resulting from adjustments to social security systems have been explored quite extensively. In the U.S. context, where a PAYG system is in place, Auerbach & Kotlikoff (1987) find that the PAYG system significantly reduces welfare. However, their paper does not take into account sources of uncertainty, which underlie the theory for government funded social insurance. Huggett & Ventura (1999) and Imrohoroglu *et. al* (1995) extend on Auerbach and Kotlikoff's work by including life-span uncertainty and wage rate uncertainty. The results from their work indicate that, in the presence of incomplete annuity markets, the U.S. PAYG system can provide insurance benefits against longevity risk and income fluctuations.

Huggett & Parra (2010) take a different approach to assessing the U.S. social security system. They first find the maximum welfare gains possible and then see how close the PAYG system and variations of this system come to reaching the maximum welfare level. Their results are similar to those found by Huggett & Ventura (1999) and Imrohoroglu *et. al* (1995), in that whilst the PAYG

[1] This includes the following categories: Income support for seniors (age pension), Residential and flexible care, Veterans' community care and support, Home support, Home care, National partnership payments - assistance to the aged, Mature age income support, Allowances - concessions and services for seniors, Ageing and service improvement, Workforce and quality, Access and information, and Other.

system doesn't achieve the maximum welfare gains possible, it does provide significant welfare gains.

In recent years there has been a large amount of emerging literature on means-tested social insurance systems. Sefton & van de Ven (2009) explored the U.K. system with a means-tested framework and found that means-tested benefits are strictly preferred to a universal benefit structure. However, they also found that the means-tested system provides a disincentive for richer households to save but encouraged savings in poorer households. Kumru & Piggott (2009) extended this work further by incorporating a second tier of the U.K. system, which represents a PAYG system, and explore optimal taper rates. They also find that a means-tested system is preferred to a universal pension system, and further, that a 100% income taper rate provides the highest level of welfare gains.

In the Australian context, Kudrna & Woodland (2011) explore the impacts of different income taper rates on the savings and work behaviour of Australians and find, similar to Sefton & van de Ven's (2009) results, that the current system provides a disincentive for older middle and higher income Australians to work. Tran & Woodland (2014) extend on this work by exploring both changes to income taper rates and benefit payment rates. They find that, conditional on compulsory pension systems, when the maximum pension benefit is relatively low, an increase in the taper rate will always lead to a welfare gain. However, when maximum pension benefits are relatively more generous an increase in the benefit and taper rate will lead to welfare declines.

This paper builds on previous work, notably Kumru & Piggott (2009), by adjusting both income taper rates and benefit payments simultaneously to fix the present value cost of the pension benefit system. As the pension system is funded by the government through general taxes, a higher taper rate results in a lower costing system, and hence less taxes are collected to fund the programme. By fixing the cost of the programme, we ensure that any welfare gains due to simply collecting less tax is excluded, and can then focus on identifying welfare gains due only to reallocation between individuals.

Our main model does not include the phenomenon of population ageing. Rather our analysis simply makes a steady state comparison of welfare gains under the various pension systems. To explore the impact of a population's age on welfare gains we include a sensitivity analysis that compares two economies with differing survival rates. We use lower U.K. survival probabilities for the comparison.

We find that, similar to Auerbach & Kotlikoff (1987) and Tran & Woodland (2014), the means-tested system is welfare reducing. However, it provides higher welfare outcomes when compared to a PAYG style system. Significant differences in savings behaviour can be seen between poor and wealthy households under each system, with means-tested providing a disincentive for wealthy households to save. We also find that, similar to findings by Trans & Woodland, the largest welfare gains within the means-tested system can be made with a taper rate of 1.0 as the insurance incentive offsets the distortionary effects on savings. However, when we fix the cost of the system a universal benefit scheme provides the optimal outcome. This implies that when the cost of the system is allowed to vary, welfare gains are due to a lower costing system.

The paper is organised as follows. Section 2 outlines the model that will be used in the analysis. Section 3 discusses the parameterization of the model to the Australian economy. Results are presented in section 4 with a sensitivity analysis presented in section 5, and section 6 concludes.

2 The Model

This section provides detail on the model used to analyse changes to the Australian pension programme. We use a simple partial equilibrium economy composed of heterogeneous households, a production sector and a government sector.

2.1 Demographics and Endowments

Our model economy is populated by overlapping generations who live up to a maximum of J periods, with conditional probability of surviving from age j to $j+1$ denoted by v_j. Every period t a new generation is born with the population growing at an exogenous rate n.[2] There are constant cohort shares due to the constant growth rate and stationary demographics, which are defined as:

$$\mu_j = \frac{\mu_{j-1} v_j}{1+n} \quad for \quad j = 2, 3, 4, ...J \tag{1}$$

with $\sum_{j=1}^{J} \mu_j = 1$.

Individuals face exogenous age-efficiency profiles, ϵ_j, which represent changes to ability over time and are the same for all individuals. The productivity of an individual at a particular time period depends not only on age j but also depends on the idiosyncratic productivity shocks s_j.

2.2 Preferences

In our model all individuals have identical preferences over consumption and leisure, which is denoted by the expected utility function with discount factor β as follows:

$$E\left[\sum_{j=1}^{J} \beta^j \left(\prod_{i=1}^{j} v_i\right) u(c_j, 1-l_j)\right] \tag{2}$$

Each period individuals are endowed with 1 unit of labour, and they choose the amount of labour and leisure in that period, given by l_j and $1-l_j$ respectively. Instantaneous utility is obtained through consumption and leisure, and defined as:

$$u(c, 1-l) = \frac{c^{1-\rho}}{1-\rho} + \kappa \frac{(1-l)^{1-\varphi}}{1-\varphi} \tag{3}$$

The coefficient of relative risk aversion is given by $\rho \in (0, +\infty)$ with the the inter-temporal elasticity of substitution of consumption given by $\frac{1}{\rho}$. The Frisch elasticity of leisure is given by $-\frac{1}{\varphi}$, with $\varphi \in (0, +\infty)$. κ captures the dislike for work relative to enjoyment of consumption.

[2] The time notation is excluded from the rest of the model description for simplicity.

2.3 Production sector

The production sector consists of many perfectly competitive large firms, which is equivalent to one large firm that maximises profits. The representative firm produces output Y at time t using effective labour services L and capital K with exogenously given technology level A. The technology is represented by a Cobb-Douglas constant returns to scale production function:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{4}$$

The firm chooses capital and labour to maximise its profits, which can be expressed as:

$$\max_{K,L}\{AK^{\alpha}L^{1-\alpha} - rK - wL\} \tag{5}$$

2.4 Government sector

The government runs a pension programme and makes consumption expenditure. This section outlines the two pension programmes used in this model, as well as the taxation on consumption and income.

Means-tested pension

In the Australian benchmark model, the government runs a means-tested pension system. The benefit amount $b(y_j, a_j)$ is subject to two tests, an income test and an asset test, and can be written as:

$$b^m(y_j, a_j) = \min\{b^y(y_j), b^a(a_j)\}, \tag{6}$$

where $b^y(y_j)$ is the income test pension and $b^a(a_j)$ is the asset test pension. So an individual receives the minimum of the two tests. Each test is subject to a threshold amount and is given by:

$$b^y(y_j) = \begin{cases} b^{\max} & \text{if } \ y_j \leq \bar{y_1} \\ b^{\max} - t_y(y_j - \bar{y_1}) & \text{if } \ \bar{y_2} < y_j < \bar{y_2} \\ 0 & \text{if } \ y_j \geq \bar{y_2} \end{cases} \tag{7}$$

where $\bar{y_1}$ and $\bar{y_2} = \bar{y_1} + b^{\max}/t_y$ are the income thresholds and t_y is the taper rate for income, which is the rate at which the benefit is reduced for each dollar over $\bar{y_1}$.

$$b^a(a_j) = \begin{cases} b^{\max} & \text{if } \ a_j \leq \bar{a_1} \\ b^{\max} - t_a(a_j - \bar{a_1}) & \text{if } \ \bar{a_2} < a_j < \bar{a_2} \\ 0 & \text{if } \ a_j \geq \bar{a_2} \end{cases} \tag{8}$$

where $\bar{a_1}$ and $\bar{a_2} = \bar{a_1} + b^{\max}/t_a$ are the asset thresholds and t_a is the taper rate for assets, which is the rate at which the benefit is reduced for each dollar over $\bar{a_1}$.

Taxation

The government collects tax on both income and consumption to finance its general expenditure and age pension. The consumption tax is set at rate τ^c. Australia's income taxation system is progressive, whereby individuals in higher income bands are taxed more than those in lower income bands. It can be expressed as:

$$T(y_j) = T_k + \tau_k(y_j - \bar{y_k}), \quad y_j \in [\bar{y_k}, \bar{y_{k+1}}], \tag{9}$$

where τ_k is the marginal tax rate, T_k is the flat tax and $\bar{y_k}$ is the income threshold for the income bucket k. In the Australian context we have $T_1 = 0$, $\tau_1 = 0$ and $T_k = T_{k-1} + \tau_k(\bar{y_k} - \bar{y_{k-1}})$.

Pay-as-you-go (PAYG) pension

The PAYG pension system collects a specific social security tax from workers during their work life, and then provides a payment that is proportional to the individuals average earnings. In this system, the social security tax rate is denoted τ_{ss} and the tax collected through the social security tax can be expressed as:

$$T_j^s = \min \begin{cases} \tau_{ss} l_j \epsilon_j s_j w \\ e_{\max}, \end{cases} \tag{10}$$

where $e_{\max}$ is the maximum taxable level.

The benefit provided to retirees is denoted $b^s(x^s)$ where x^s is an accounting variable, i.e. equally weighted earnings before retirement.

2.5 An Individual's Decision Problem

Individuals are heterogeneous with respect to state variables of age, working ability and asset holdings. An individual's state variables at age j are denoted by $x_j = (e_j, a_j)$. Individuals realise their state x_j and choose the optimal consumption c_j, leisure time $1 - l_j$ (or working time l_j) and end of period asset holdings a_{j+1} given wage and interest rates, government tax and pension policies, survival probabilities, and their working ability.

Individuals have three sources of income; returns from savings ra_j, effective labour earnings $l_j \epsilon_j s_j w$, and possible pension payment b_j. Therefore their income can be expressed as:

$$y_j = \begin{cases} ra_j + l_j \epsilon_j s_j w & \text{if} \quad j < j* \\ ra_j + b_j(x) & \text{if} \quad j \geq j* \end{cases}$$

From this we can express an individual's growth-adjusted budget constraint as:

$$\left\{ \begin{array}{lll} c_j + (1+g)a_{j+1} \leq (1+r)a_j + (1 - \tau_s - \tau_p) l_j \epsilon_j s_j w - \tau(y_i) & \text{when} & j < j* \\ c_j + (1+g)a_{j+1} \leq (1+r)a_j + b_j + b'_j(x) - \tau(y_i) & \text{when} & j \geq j* \\ c_j \leq (1+r)a_j + b_j(x) + b'_j(x) - \tau(y_i) & \text{when} & j = J \end{array} \right\} \tag{11}$$

and we assume that individuals cannot borrow against future income:

$$a_j \geq 0, \forall j \tag{12}$$

Hence, an individual's decision problem in our model can be written as the dynamic programming problem below, where V_j is the value function of the individual at age j and x' is the next period state vector.

$$V_j(x) = \max_{c_j, l_j} \{u(c_j, l_j) + \beta v_{j+1} E V_{j+1}(x')\} \tag{13}$$

subject to equations 11 and 12.

2.6 Equilibrium

Our equilibrium definition follows Auerbach & Kotlikoff (1987), Imrohoroglu *et. al* (1995), and Kumru & Piggott (2009).

Given government policy settings for taxation and the pension system, the constant population growth rate, and exogenous interest rate, a stationary equilibrium is such that:

1. a collection of individuals' decisions $\{c_j(\cdot), l_j(\cdot), a_{j+1}(\cdot)\}_{j=1}^{J}$ solve the individual decision problem (13) subject to constraints (11) and (12)

2. age dependent distributions of individuals are calculated as:

$$\Lambda_{j+1}(x) = \sum_s \prod (s_{j+1}, s_j) \int_X d\Lambda_j,$$

   where $\prod(s_{j+1}, s_j)$ is the transition matrix for the shocks. $\Lambda_1(x)$ is given.

3. the firm chooses labour and capital inputs to solve the maximisation problem (5)

4. the lump-sum bequest transfer (Ω) is equal to the sum of accidental bequests:

$$\Omega = \sum_{j=1}^{J} \mu_j \int_X (1 - v_{j+1}(z)) a_j(x) d\Lambda_j$$

5. aggregate capital (K), labour (L) and consumption (C) is derived from individuals' behaviour

$$K = \sum_{j=1}^{J} \mu_j \int_X a_j(x) d\Lambda_j$$
$$L = \sum_{j=1}^{J} \mu_j \int_X l_j(x) d\Lambda_j$$
$$C = \sum_{j=1}^{J} \mu_j \int_X c_j(x) d\Lambda_j$$

6. age pension programmes are self-financing:

$$\sum_{j=j*}^{J} \mu_j \int_X b^m(x) d\Lambda_j = \tau^m \sum_{j=1}^{j*-1} \mu_j \int_X y_j(x) d\Lambda_j$$
$$\sum_{j=j*}^{J} \mu_j \int_X b^{ss}(x) d\Lambda_j = \tau^{ss} \sum_{j=1}^{j*-1} \mu_j \int_X min\{y_j(x), y_{\max}\} d\Lambda_j$$

7. the Government budget constraint is satisfied at every period:

$$T^{\text{inc}} + \Omega + \tau_c C + = G$$

8. goods market clears:

$$C + (1+g)(1+n)K + G = Y + (1-\delta)K$$

3 Calibration

This section details the parameters used in our model. We calibrate the benchmark model to the Australian economy. The key parameters are detailed in Table 1.

Demographics

Our model assumes individuals are born, or become economically active, at age 21 ($j = 1$) and live up to a maximum age of 85 ($j = 65$). The population growth rate is set to 1.2% which is the Australian average over the last 10 years. The conditional survival probabilities (v_j) of individuals are estimated using ABS data on death rates.

Labor productivity is given by a deterministic component ϵ_j (age efficiency) and by an idiosyncratic shock component $s_j = (s_j^1,\ s_j^2)$ which captures permanent and persistent sources of productivity differences. The permanent component s^1 stays fixed for an agent over the life-cycle. The persistent component s^2 follows an autoregressive process.

	Parameters	Model	Observation / Comment / Source
Demographics			
	Initial age	$j = 1$	Age 21
	Maximum age	$j = 65$	Age 85
	Retirement age	$j* = 55$	Age 65
	Annual Population Growth	$n = 0.012$	ABS data
	Survival probabilities	v_j	ABS data
	Age efficiency profile	ϵ_j	HILDA data
Preferences			
	Annual discount factor	$\beta = 0.99$	Match Australian saving behaviour
	Risk aversion parameter	$\rho = 2$	Tran & Woodland (2011)
	Frisch elasticity	$\gamma = 0.35$	Buddelmeyer *et. al* (2007)
Production			
	Capital share of GDP	$\alpha = 0.4$	Tran & Woodland (2014)
	Interest rate	$r = 0.0495$	Average10 year Treasury bond
Government			
	Government consumption	$G = 0.14$	Tran & Woodland (2014)
	Consumption tax	τ^c	Endogenously determined
	Income taxes	$\tau_j, T_j, \bar{y}_j$	2014-15 tax schedules
	Means-tested pension	$b^{\max}, t_y, t_a, \bar{y}_1, \bar{a}_1$	2014-15 pension rules
	PAYG pension		Huggett & Parra (2010)

Table 1: Parameters

The age efficiency profiles (ϵ_j) correspond to hourly wage rates by age. We have estimated the Australian age efficiency profile using the data from the Household, Income and Labour Dynamics in Australia (HILDA) survey[3], similar to Tran & Woodland (2014). To model permanent productivity differences, we follow Conesa et al. (2010) and assume two ability types with equal population mass i.e. $p^1 = \{0.5, 0.5\}$ and $s^1 = \{0.69, 1.45\}$. We estimate the persistent component s^2 using a five-point discrete Markov chain process as described by Tauchen & Hussey (1991). Similar to Cho & Sane (2011) we use the Gini coefficient as a measure of the variance, which is 0.34 taken from Greenville et. al. (2013). The shocks are calculated as $s^2 = \{0.2069, 0.4133, 0.7721, 1.4424, 2.8819\}$ and the probabilities for each shock are calculated as $p = \{0.0988, 0.2418, 0.3188, 0.2418, 0.0988\}$.

Preferences

We set $\rho = 2$ which is a standard assumption for Australia. We then set $\kappa = 1$ to normalise to unity. We calibrate φ to match the Frisch elasticity of $\gamma = 0.35$. We use $\beta = 0.99$ to match the Australian savings behaviour, which is also used by Tran & Woodland (2014).

Production sector

We use the capital share of GDP $\alpha = 0.4$ as calculated in Tran & Woodland (2014). As Australia is a small economy, we use a partial equilibrium model where factor prices are set exogenously. We set the interest rate $r = 0.0495$ which is the average of Australian Treasury bonds over the last 10 years.

[3]HILDA is a longitudinal household survey that collects data on income, work, and family / household formation. Similar to Tran & Woodland (2011) we use data from the first 7 waves of the survey for our age efficiency profiles.

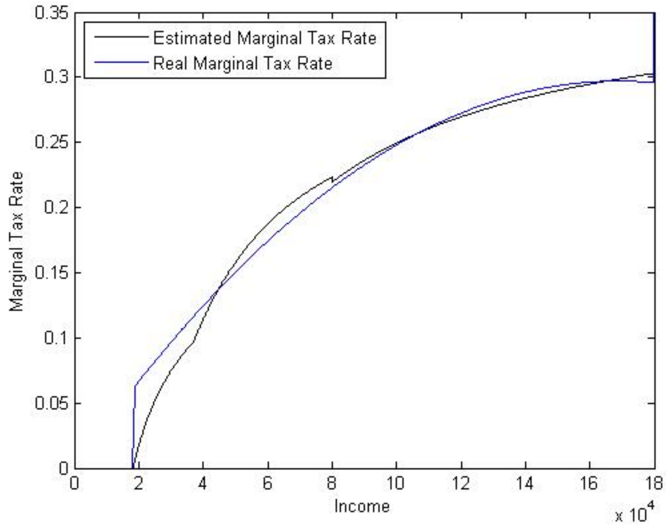

Figure 1: Marginal Tax Rates

Government sector

The consumption tax rate adjusts endogenously within the model to ensure the government budget is balanced. We use a quadratic function to approximate the marginal tax rates individuals face, similar to that used by Kumru & Piggott (2009) and Huggett & Parra (2010). The actual marginal tax rates versus the estimated marginal tax rates are shown in Figure 1, which verifies that the quadratic function matches real marginal tax rates fairly closely.

We use the means-tested pension rates as detailed by the Department of Human Services for 2014-15. This includes a taper rate on income of $t_y = 0.5$, a benefit reduction rate on assets of $t_a = 0.0015$, an income threshold of $\bar{y_1} = \$4,160$ per year, an asset threshold of $\bar{a_1} = \$348,500$ and a benefit payment of around $\$15,000$ per year. As our model does not adequately capture homeownership, we use the asset threshold for individuals who do not have a family home.

To compare the Australian means-tested pension system to a PAYG system, we use Huggett & Parra (2010) benefit payment parameters for the PAYG system. This is expressed as a benefit payment function in Figure 2. We set the social security tax such that the net present value of the system matches the benchmark Australian means-tested system, in this case $\tau_{ss} = 21.8\%$.

4 Simulation Results

This section first compares our benchmark model to the current Australian economy before exploring different policy changes. When discussing policy changes we focus on comparing means-tested pension system and PAYG pension systems before considering changes to taper rates and pension payment rates, holding the cost of the programme constant.

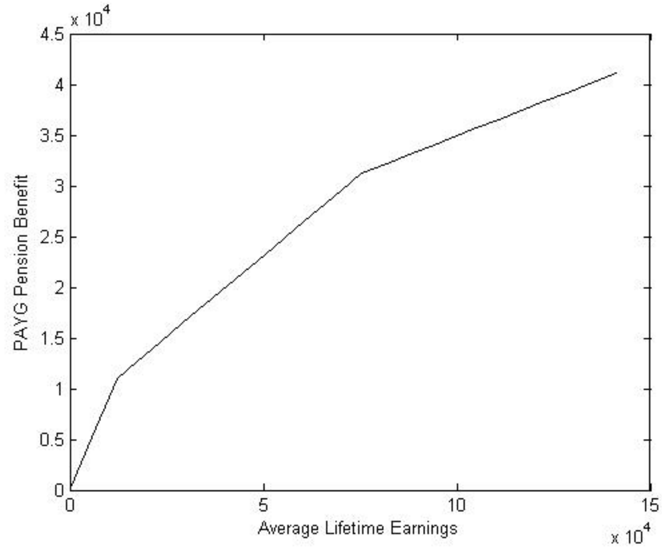

Figure 2: PAYG Benefit Function

4.1 Benchmark Model

Before considering changes to the Australian means-tested pension system, we first examine key outputs of our model to see that it matches features of the Australian economy.

Asset profile[4]

In order to compare our model output to real Australian data, we use the HILDA survey results on assets and wealth distribution. As can be seen in Figure 3, our model generates the same life-cycle asset accumulation whereby individuals accumulate assets early in their life before drawing down on them during retirement. We can see that assets are lower earlier in life, starting at 0 when $j = 1$, as we constrain our model such that individuals start their working life with no assets. We can also see that peak savings, while at the same stage of life in both sets of data, is much higher in the real data compared to our model output. Housing is often cited as a key incentive for saving in the Australian context, and while excluded from the data there may be flow on to other savings behaviour. So this difference in peak savings may be attributed to the fact that our model doesn't include housing.

Labour market

Our model matches the life cycle labour supply behaviour of individuals fairly well, as shown in Figure 4. A notable difference being that younger individuals work more than the observed data shows. This is primarily due to the assumption in our model that individuals enter their working life with no assets and cannot borrow. We also make the retirement decision exogenous in our modeling, meaning that individuals leave the workforce at 65.

[4] Assets in our model do not include compulsory superannuation or housing.

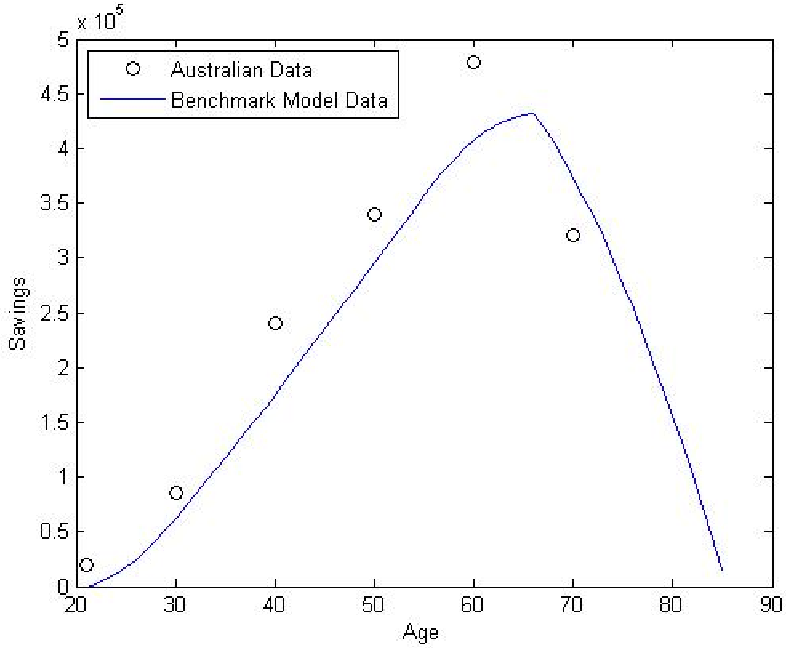

Figure 3: Asset Profile

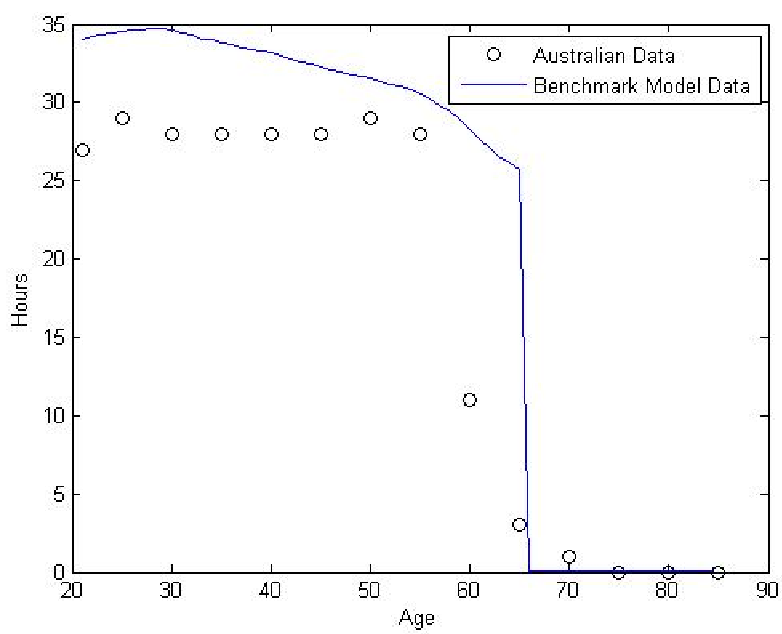

Figure 4: Labour Profile

System	Cost of Pension System	CEV (%)	Aggregate Labour	Aggregate Savings
No pension	NA	0	100	100
PAYG	-1.54	-23	117.2	60.1
Means-tested	-1.54	-22	116.5	61.1

Table 2: Results from Comparison of Pension Systems

4.2 Comparison of Pension Systems

In this section we compare the benchmark model and a stylised PAYG pension system with the Australian economy without a pension system in place. We focus on welfare differences and explore changes in savings and labour supply behaviour.

A pension system has two opposing impacts on individuals behaviour; it provides a form of risk-sharing but also distorts individuals labour supply and savings behaviour. We use the results in Table 2 to assess which of these is the dominant force in the PAYG pension system, means-tested pension system and an economy without a pension system.

To compare the models in terms of welfare we compute the consumption equivalent variation (CEV), which is a standard method following on from Conesa *et. al* (2009) and Kumru & Thanopoulos (2011)[5]. We use the model with no pension as the baseline for analysis in this section, meaning a positive CEV indicates a welfare gain compared to the model with no pension and a negative CEV indicates a welfare loss compared to the model with no pension. We also use the model with no pension as the baseline model for comparing relative changes in savings and labour supply.

As shown in Table 2, both the PAYG and means-tested pension systems are welfare reducing, with consumption levels at each age decreasing by 23% and 22% respectively. Individuals in both the means-tested and PAYG system have much lower savings over their life-span than under the model with no pension system. This aligns with the results from Tran & Woodland (2014), Auerbach & Kotlikoff (1987), and Imrohoroglu *et. al* (1995), which consistently find that pension systems are welfare reducing due to the dominant effect of incentive distortion. Figure 5 shows this distortion clearly through the savings behaviour of individuals under each of the systems.

Taking a closer look at the differences between the two pension systems, we can see that a PAYG system CEV is 1% lower compared to a means-tested system. This result indicates that the means-tested program is relatively better than the PAYG program. More precisely, individuals' consumption level at each age decreases by 1% less under the means-tested system compared to that of the PAYG.

In this model, as we explained in Section 2, individuals face two different idiosyncratic permanent productivity shocks that determine their productivity level. As the social security systems redistribute income from wealthier members of the society to poorer members, we compare the differences in savings behaviour and labour supply of the income groups under the two different social security systems.

[5] As described in Kumru & Thanopoulos (2011), CEV $= \left[\frac{V(x_0^*)}{V(x_1^*)}\right]^{1/(1-\rho)} - 1$, where x_0^* is the benchmark model allocation and x_1^* is the new system allocation.

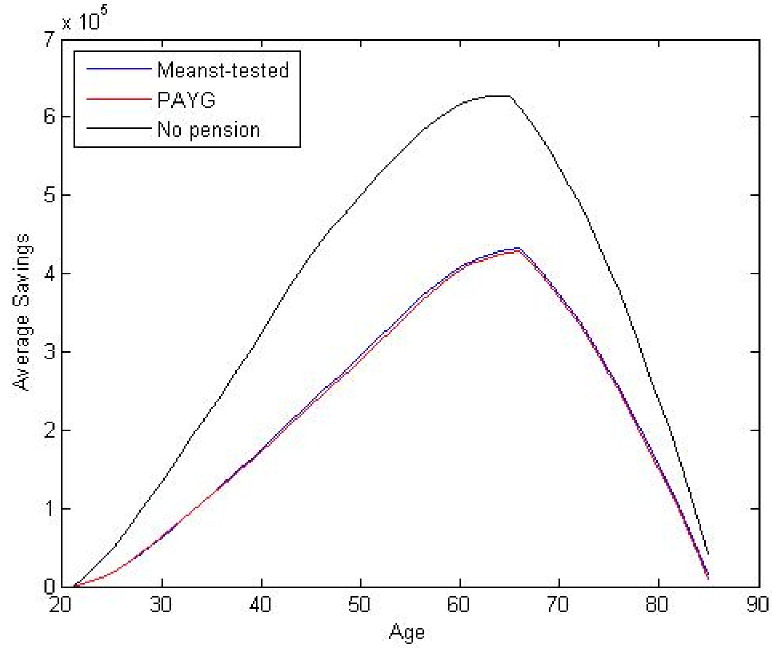

Figure 5: Average Asset Profiles

Let us first consider the lowest earners in the system, and examine their savings and labour supply behaviour. As can be seen by Figure 6, lowest earners do not change their savings or labour supply behaviour between the two systems. This is because they have no incentive to lower savings under a means-tested system, given they are already receiving the largest benefit. In the case of a PAYG system, they cannot increase their labour supply sufficiently to increase their benefit payment in retirement, hence they have lower utility under a PAYG system.

We can see in Figure 7 that the highest earners accumulate assets earlier in life in a PAYG system, reaching a much higher peak of savings than under a means-tested system. The disincentive to save under a means-tested system for wealthy individuals is due to the fact that their benefit in retirement reduces if their savings levels are too high. There is no such disincentive under a PAYG system, hence the higher savings and higher utility for wealthy individuals in a PAYG system.

We conclude that while the means-tested pension system is welfare reducing, the reduction in welfare is slightly lower than under the PAYG pension system. While the aggregate savings and labour supply under the two systems is only marginally different, the differences between the income groups is notable. Specifically, the means-tested system provides a disincentive for wealthier individuals to save which is not present under the PAYG system.

4.3 Changes to Means-tested Policy

In this section we explore changes to the income taper rate in the means-tested system. By varying the taper rate we are changing the effective marginal tax on income in retirement, with a higher taper rate increasing the effective marginal tax. Given savings are the single source of income in

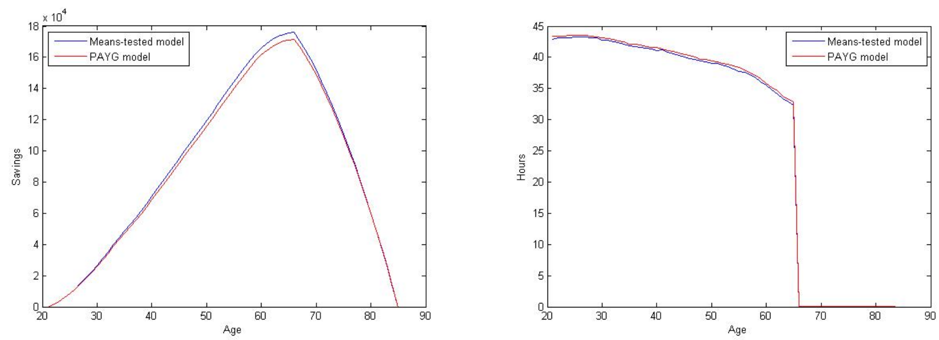

Figure 6: Labour Supply and Savings Behaviour of Lowest Earners

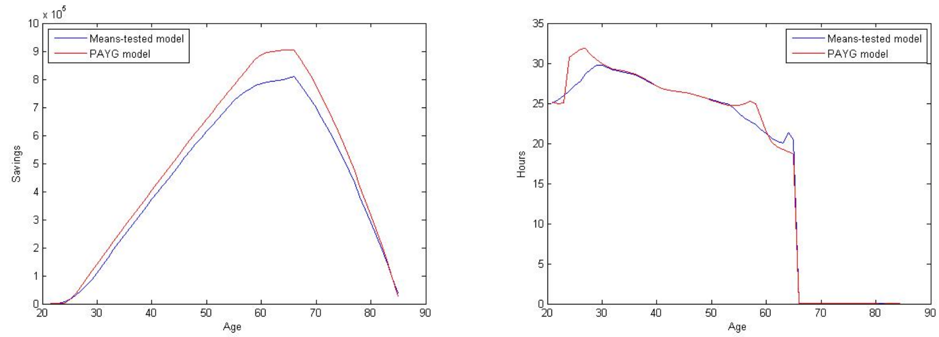

Figure 7: Labour Supply and Savings Behaviour of Highest Earners

retirements, by changing the taper rate we expect to see changes to savings behaviour. We first explore these effects in a model with varying cost, before examining how imposing a constant cost programme changes the results. In this section we use the benchmark model as the baseline for examining welfare gains with CEV and relative changes to savings and labour.

Variable system cost

We first simulate a number of alternative model economies where we vary the taper rate in the means-tested pension holding the income threshold, benefit payment, and asset testing constant. A different taper rate has two main effects; it changes the value of the benefit paid to retirees and simultaneously changes the number of retirees who receive benefit payments. Table 3 reports the welfare effects as well as the main aggregate variables we are interested in.

The results reported in Table 3 indicate that in our model economy a taper rate of 1.0 provides the greatest welfare gain, similar to the conclusion from Kumru & Piggott (2009) and Tran & Woodland (2014). At this taper rate, we are maximising the risk-sharing mechanism while minimising the distortionary impact on savings behaviour.

We can see the distortionary effects on savings increase as the taper rate decreases due to fact that individuals have a lower incentive to save for their retirement. As the taper rate decreases, more individuals become eligible for the pension programme, meaning they do not need to save as much for their retirement. Under a universal benefit (taper rate = 0.0), everyone receives a benefit

Taper Rate	Maximum Benefit	Cost of Pension System	CEV	Savings	Labour
0.0	15,000	-1.94	-7.550	92.4	98.8
0.1	15,000	-1.85	-4.429	96.1	101.1
0.2	15,000	-1.78	-3.027	97.7	100.7
0.3	15,000	-1.71	-3.004	96.8	100.8
0.4	15,000	-1.63	0.390	100.9	99.9
0.5	15,000	-1.54	0.000	100.0	100.0
0.6	15,000	-1.44	4.091	104.8	99.0
0.7	15,000	-1.38	5.130	105.9	98.7
0.8	15,000	-1.29	7.325	108.5	98.2
0.9	15,000	-1.22	8.599	109.6	97.9
1.0	15,000	-1.17	9.597	110.6	97.7

Table 3: Results from Changes to the Taper Rate

regardless of their income, meaning even the wealthiest individuals in the economy can reduce their savings and still maintain their consumption in retirement.

The impact on labour supply behaviour is much less significant, with a lower taper rate resulting in higher labour supply behaviour. Again, this result is due to the fact that a higher taper rate results in more individuals lowering their labour, and hence savings and income in retirement, to ensure their eligibility for the pension system.

The results in Table 3 show that the cost of the system increases as the taper rate decreases, as individuals who received very little or no pension benefit now receive a higher payment. This means our results cannot identify if the welfare gains under a higher taper rate are due to the optimal distribution of benefits or simply a lower costing pension programme. To explore this further, we fix the cost of the programme by varying the benefit amount, and compare the changes in welfare and savings behaviour.

Constant system cost

We now simulate a number of alternative model economies where we vary the taper rate and benefit amount in the means-tested pension, holding the cost of the programme constant. Again we hold the income threshold and asset testing constant. By keeping the cost of the programme constant we can ensure that changes in welfare are solely attributed to the distribution of benefit payments in the economy and exclude any welfare changes due to a change in the cost of the pension system.

The results in Table 4 show that when the cost of the system is held constant, the optimal taper rate is 0.0, a universal benefit scheme. This directly opposes the results from the variable cost system, indicating that the driver for welfare gains under a variable cost pension programme is lower cost, and hence lower tax on individuals.

Under the fixed cost economies, changes in the taper rate also produce opposing results for savings and labour supply behaviour. As the taper rate and benefit payment increase, the incentive to lower savings increases as individuals reduce their income in retirement to become eligible for the pension programme.

Taper Rate	Maximum Benefit	Cost of Pension System	CEV	Savings	Labour
0.0	9,000	-1.54	0.697	100.6	99.8
0.1	10,000	-1.54	0.496	100.2	99.9
0.2	12,000	-1.54	0.483	100.1	99.9
0.3	13,000	-1.54	0.363	100.1	99.9
0.4	14,000	-1.54	0.183	99.8	100.0
0.5	15,000	-1.54	0.000	100.0	100.0
0.6	16,000	-1.54	-0.007	100.0	100.0
0.7	17,000	-1.54	-0.096	99.9	100.1
0.8	17,000	-1.54	-0.126	99.8	100.1
0.9	18,000	-1.54	-0.191	99.7	100.1
1.0	19,000	-1.54	-0.292	99.6	100.1

Table 4: Results from Changes to the Taper Rate with Constant Cost

From this analysis, we conclude that under a system with a fixed benefit, a taper rate of 1.0 is preferred to all other taper rates. Lower taper rates distort the savings behaviour of individuals in the economy through the higher tax rate needed to fund the pension programme. However, when we hold the cost of the system the same, we find that a universal benefit is preferred. As the benefit payment is lower, the distortionary effects on savings behaviour are minimised. This is an important result as it highlights that the distortionary effects of changes to taper rates within a means-tested pension system are due to changes in tax rates on individuals. Changes to the taper rate under a fixed cost pension system produce the opposite effect, with a universal benefit providing the best welfare outcome. Again, this indicates that the results from a variable cost pension programme are driven by the cost of the system, rather than the distribution of benefits.

5 Sensitivity Analysis

In this section we analyse how changes to parameters in the model impacts the results. This provides evidence that our results are robust. We consider these changes to parameters; survival probabilities, age efficiencies, and risk aversion. Within our analysis we focus on our key findings from Section 4.3; optimal taper rates under fixed and variable cost pension systems.

5.1 Survival Probabilities

We consider the current Australian survival probabilities and lower survival probabilities[6] as pictured in Figure 8, and explore how changes to these probabilities impact our findings.

We can see from our results in Table 5 that survival probabilities have an impact on savings behaviour and welfare under a means-tested pension system. However, the results align with our findings in Section 4 in that a taper rate of 1.0 produces the largest welfare gain in a variable cost model due to lower tax rates. Under a fixed cost model we can see that a universal benefit provides

[6]For the lower survival probabilities we use U.K. values as calculated by Kumru & Piggott (2009).

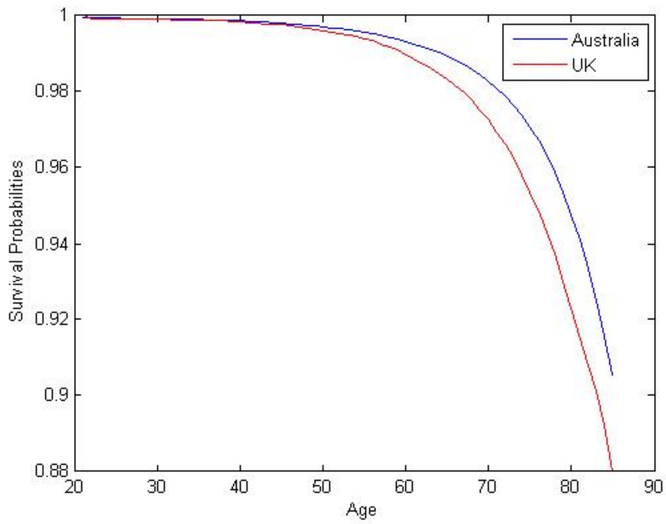

Figure 8: Conditional Survival Probabilities

	High survival rates			Low survival rates		
Taper Rate	CEV	Savings	Labour	CEV	Savings	Labour
Variable cost						
0.0	-7.550	92.4	98.8	-7.671	92.8	102.1
0.25	-1.969	98.5	100.4	-4.641	95.6	101.3
0.5	0.000	100.0	100.0	0.000	100.0	100.0
0.75	6.661	107.4	98.3	3.867	103.7	99.0
1.0	9.597	110.6	97.7	7.164	107.0	98.2
Fixed cost						
0.0	0.697	100.6	99.8	0.772	100.6	99.8
0.25	0.338	100.0	100.0	0.371	100.2	99.9
0.5	0.000	100.0	100.0	0.000	100.0	100.0
0.75	-0.083	99.8	100.1	-0.205	99.7	100.1
1.0	-0.292	99.6	100.1	-0.425	99.6	100.1

Table 5: Survival Probabilities with Changing Taper Rates

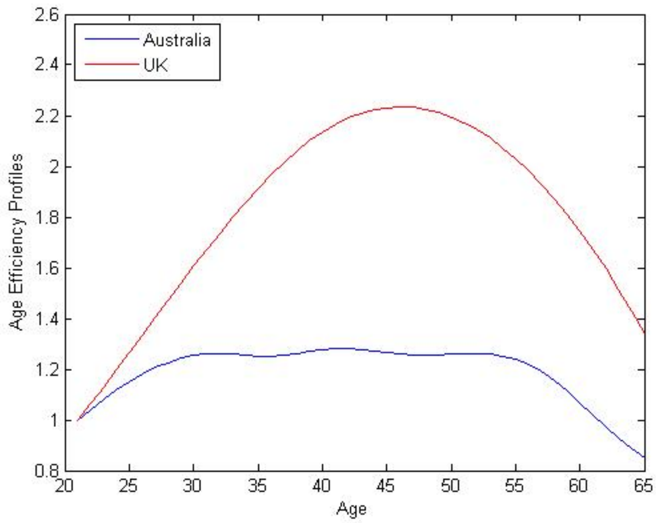

Figure 9: Age Efficiency Profile

the best welfare outcome, which aligns with our results from Section 4.3.

5.2 Age Efficiency Profiles

We consider the current flat efficiency profile used in Australia and a more concave age efficiency profile[7] shown in Figure 9. We examine if the distribution of age efficiency impact our findings, focusing on how larger differences in potential earnings across age groups impact welfare and savings.

Table 6 results show that under a variable cost programme with a concave distribution of age efficiencies, a taper rate of 1.0 produces the largest welfare gain. This result aligns with our conclusion in Section 4, indicating that while the distribution of age efficiencies will impact the magnitude of the welfare gain, it will not change the directional impact a change in the taper rate produces.

We can also see from Table 6, that a 0% taper rate means-tested program (universal benefit) maximizes the welfare under a fixed cost programme with a concave distribution of age efficiencies. Again, this is due to the fact that the welfare gains obtained by increasing taper rates under a variable cost programme are due to lower tax, not a better distribution of benefits.

We conclude that while different age efficiency profiles do impact the size of the welfare gain and changes in individuals labour supply behaviour under different taper rates within a means-tested pension system, the results are similar to those in Section 4. Our results come to the same conclusion as Section 4, that welfare gains under a variable cost programme are not present under a fixed cost model.

[7]For the concave age efficiency profile we use data on the U.K. as reported by Kumru & Piggott (2009).

	Flat distribution			Concave distribution.		
Taper Rate	CEV	Savings	Labour	CEV	Savings	Labour
Variable cost						
0.0	-7.550	92.4	98.8	-4.999	97.6	101.3
0.25	-1.969	98.5	100.5	-2.143	101.1	100.5
0.5	0.000	100.0	100.0	0.000	100.0	100.0
0.75	6.661	107.4	98.4	2.764	102.4	99.3
1.0	9.597	110.6	97.7	6.107	110.1	98.1
Fixed cost						
0.0	0.697	100.6	99.8	0.566	100.5	99.8
0.25	0.338	100.0	100.0	0.260	100.1	100.0
0.5	0.000	100.0	100.0	0.000	100.0	100.0
0.75	-0.083	99.8	100.1	-0.323	99.8	100.1
1.0	-0.292	99.6	100.1	-0.565	99.7	100.2

Table 6: Age Efficiencies with Changing Taper Rates

Taper Rate	Benefit	Cost	CEV	Savings	Labour
Variable cost					
0.0	15,000	-2.07	-8.433	94.3	102.1
0.25	15,000	-1.91	-3.982	97.4	101.0
0.5	**15,000**	**-1.65**	**0.000**	**100.0**	**100.0**
0.75	15,000	-1.38	6.445	105.1	98.65
1.0	15,000	-1.22	15.548	111.5	96.8
Fixed cost					
0.0	9,000	-1.65	0.915	100.6	99.8
0.25	12,000	-1.65	0.395	100.2	99.9
0.5	**15,000**	**-1.65**	**0.000**	**100.0**	**100.0**
0.75	16,000	-1.65	-0.154	100.0	100.0
1.0	18,000	-1.65	-0.551	99.6	100.2

Table 7: Risk Aversion with Changing Taper Rates

5.3 Risk Aversion

In this section we use a higher risk aversion parameter of 3 and explore whether this impacts our results. A higher risk aversion parameter is representative of a more risk averse economy.

Table 7 illustrates that in an economy with a higher risk aversion parameter, the results from Section 4 still hold; a taper rate of 1.0 maximises welfare under a variable cost pension system and a universal benefit maximises welfare under a fixed cost system.

6 Conclusion

Pension programmes play an important role in society by providing insurance against longevity risk. However, these pension programmes can distort labour supply and savings behaviour of individuals, resulting in welfare losses. In this paper we explore how changes to the current Australian pension system impact welfare.

The design of pension systems is a topic of many recent studies given their role in society. Our work builds on that by Kumru & Piggott (2009), using an overlapping-generations model to explore changes in savings and labour behaviour in response to changes in the means-tested taper rate. We also examine welfare differences between an economy with no pension system, and that with either a PAYG system or means-tested system.

Previous research focuses on changes to taper rates within the means-tested pension programme and the resulting change in welfare. However, there has been little consideration to how the change in the programme cost interplays with the change in welfare. Our work extends on the current body of research by changing both the taper rate and benefit payment to hold the cost of the programme constant, and then considering the impact on welfare.

We find, similar to Auerbach & Kotlikoff (1987) and Tran & Woodland (2011), that a means-tested system is welfare reducing. However, a means-tested system does provide a welfare gain compared to a similar costing PAYG system. We also find that, similar to previous work by Kumru & Piggott (2009) and Tran & Woodland (2011), a taper rate of 1.0 provides the best welfare outcome in a pension system with fixed benefit and variable cost. However, when we hold the cost of the programme constant, we find an opposing impact on welfare, with a universal benefit providing the maximum welfare. This is due to the fact that under a variable cost system lower taper rates result in higher costs, and these costs are financed through taxation of individuals during their working life which drives the welfare losses. Once the cost for the system is held constant, we see that lower benefits paid to all individuals provides the best welfare outcome.

Our model assumes evenly distributed income through the wage rate shocks. Given the results from our sensitivity analysis on age efficiency profiles, we would suggest that exploration of varying shock distribution would provide an interesting extension on our work. We also think that the inclusion of superannuation and endogenous retirement decision would be beneficial in future research. Finally, our model assumes constant population age distribution. Give that there is growing pressure on government financing of aged pension from an ageing population, inclusion of this phenomenon would provide an interesting extension to our work.

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