To defer or not defer?

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May 16, 2013

Abstract

In this paper we show the optimal labour force regimes in the presence of pension income. In particular we focus on the option to defer ones pension or not. We show that the deferral option forms an important part of non labour or deferred income, and has an effect on the optimal labour supply regime. We then present an application of our general result assuming a quasilinear utility function, and supplement our results with simulations.

JEL classification: J14, J18, J22 & J26.

Key words: Retirement, Labour Supply, Ageing, UK State Pension.

1 Introduction.

Aging populations and increasing individual life expectancy raise issues of labour participation, savings and pensions especially amongst the elderly. There are also important issues for government fiscal balance since tax receipts obviously vary with labour and capital incomes, and benefits paid out for example via state pensions depend on age or work eligibility for receipt of a pension. The aim of state pension systems is to alleviate poverty in old age and in this sense is an open ended government commitment. Governments respond by encouraging later retirement and/or raising the age of eligibility for receipt of a state pension. Eligibility for receipt of a UK state pension only depends on age, although the amount received depends on lifetime work and tax (national insurance contribution) history.

A particular feature of the UK system since its inception has been the option to defer the date at which individuals start to receive their pension in exchange for an increase in their subsequent pension. This possibility has implications for the planned savings and work pattern of individuals through changing their lifetime pattern of nonlabour income. What implications will deferral have for

1This is a one shot choice and an individual can only defer their pension once.
their work and savings patterns? Can deferral induce individuals to stay on longer in paid work? Few papers have considered the role of pension deferral in trying to ascertain these effects. Disney and Smith (2002) formally analyse the effect of the abolishment of the Earnings Rule and as a side also consider pension deferral, their findings suggest after abolishment male weekly hours (above SPA) rose by approximately 4 hours, whilst for women it rose by 2 hours. However they do not explicitly consider the effects of pension deferral on labour supply or provide a theoretical framework by which to do so. Farrar et al (2012) compare the two deferral options available under current State Pension legislation and conclude under most simulations that the incremental option (additional weekly state pension) generally tended to more lucrative.

In section 2 we layout a general framework which encompasses the effects of pension deferral on optimal labour supply through the role of the present value of non labour income. In section 3 we show the effects of regime switches in the optimal labour supply using a form of preferences used widely in the literature. Importantly, the rate of return on the deferred non labour income and individuals taste for work through their marginal value of leisure, are both key components in determining the optimal labour force regime. Section 4 compares the two deferral options available under current UK State Pension legislation. Section 5 concludes.

2 The model.

With perfect capital markets and in a world of certainty, financial wealth can be transferred intertemporally by the consumer. So one would expect that the benefits of deferring a state pension will depend only on a comparison between the implicit interest rate used in the government set terms of deferral and the market interest rate. This intuition was brought out by Farrar et al. (2012) paper. Even with these strong assumptions there may still be effects of choosing to defer on the pattern of intertemporal labour supply and consumption, and obviously on savings. This is because individuals will only defer if it raises their disposable wealth at the date of deferral through raising the present value of nonlabour income in the form of pension receipts. For individuals who defer we would expect their savings to fall at deferral date as they intertemporally smooth but also there will be wealth effects on present and future labour supply and consumption. Disney & Smith (2002) point out that there may be labour participation effects of changes in the pension rules, especially they focus on the abolition of the earnings rule. If we add uncertainty about other future income sources and especially about the remaining length of life, the decision to defer or not is much less clear. Similarly individuals who face borrowing constraints now are less likely to defer now.

To see how a decision to defer impacts on current and future labour supply as individual leisure preferences and wage rates vary, needs a formal framework. We present this next. Individuals maximise a time additive concave utility function depending on consumption $c$ and leisure $L$ with respect to consumption
and labour supply subject to their lifetime budget constraint:

\[
\begin{align*}
\max_{c_{T-1},c_T,L_{T-1},L_T} & \quad u(c_{T-1},L_{T-1}) + \delta u(c_T,L_T) \\
\text{st} & \quad rc_{T-1} + c_T = rA_{T-1} + ry_{T-1} + y_T + rw_{T-1}(1 - L_{T-1}) + w_T(1 - L_T) = x \\
& \quad 0 \leq L_t \leq 1
\end{align*}
\]

Here \( r \) is the real interest rate, \( A_{T-1} \) is financial assets at the start of \( T-1 \), \( y_{T-1}, y_T, w_{T-1}, w_T, L_{T-1} \) and \( L_T \) denote non labour income, wages and leisure respectively in periods \( T-1 \) and \( T \). There is a fixed time endowment each period of one unit of time which can be used either for leisure or work. Nonlabour income includes any pension that is actually received in that period and so depends the deferral decision.

So should an individual defer his pension from \( T-1 \) to \( T \)? This just depends on the present value of the stream of pension payments over the two periods with and without deferral. The individual will choose the option which has the higher present value. The pension flow available at \( T-1 \) is \( p \) per period. Thus if the individual has non-pension,non-labour income of \( y^0_{T-1}, y^0_T \) then without deferral \( y_T = y^0_T + p, y_{T-1} = y^0_{T-1} + p \). With deferral \( y_T = y^0_T + r_g p, y_{T-1} = y^0_{T-1} \) where \( r_g \) is the implicit interest rate set by the government in the terms of deferral. Th deferral decision only impacts on achievable life cycle utility through affecting the present value of wealth \( x \) available from \( T-1 \) onwards. Deferral will be chosen iff it raises \( x \). Without deferral \( ry_{T-1} + y_T = r(y^0_{T-1} + p) + y^0_{T-1} + p \) while with deferral \( ry_{T-1} + y_T = ry^0_{T-1} + y^0_T + r_g p \). The individual is better off deferring if \( (1 + r) < r_g \). Since there is no uncertainty and no restrictions on borrowing or lending except that individuals cannot die in debt, only the present value of nonlabour income affects the maximum value, and optimal labour market decisions depend only on nonlabour income through it’s present value. The implicit interest rate factor \( r_g \) is common to all individuals so variation between individuals in the decision to defer must be due to variation in the market interest rate available to individuals and more generally to variation in borrowing constraints or other capital market imperfections, or to omitted issues like uncertainty over the length of life.

For an individual who does decide to defer, his life cycle wealth increases from the date of deferral. To explore the effects of this on intertemporal labour supply and consumption we have to go further with solving the maximisation problem. Consumption each period must be interior\(^2 \) so:

\[
\begin{align*}
\frac{\partial u_{T-1}}{\partial c_{T-1}} = r \frac{\partial u_T}{\partial c_T} \\
rc_{T-1} + c_T = x
\end{align*}
\]

\(^2\)Assuming that the marginal utility of consumption in any period becomes arbitrarily high as consumption in that period becomes very small
We have a ranking of the full incomes

\( v(L_{T-1}, L_T, x) \) which is increasing in all its arguments and also concave in the leisures of each period (needs to be shown in the appendix). The remaining problem for the individual is to choose optimal labour supply in each period:

\[
\max_{L_T, L_{T-1}} v(L_{T-1}, L_T, x) \text{ st } 0 \leq L_i \leq 1
\]

Our main focus is on the interaction between labour participation decisions, saving and pension deferral so we focus on just full time and zero work options for each time period. There are four possible configurations of labour participation over the final two periods of life: full time work in both periods, zero work in both periods or full time work in one period and zero work in the other.

Define the life cycle full incomes at the start of \( T-1 \) corresponding to each lifetime pattern of labour participation:

\[
\begin{align*}
X_{11} &= rA_{T-1} + ry_{T-1} + y_T = Z \\
X_{00} &= rA_{T-1} + ry_{T-1} + y_T + rw_{T-1} + w_T = Z + rw_{T-1} + w_T \\
X_{01} &= rA_{T-1} + ry_{T-1} + y_T + rw_{T-1} = Z + rw_{T-1} \\
X_{10} &= rA_{T-1} + ry_{T-1} + y_T + w_T = Z + w_T
\end{align*}
\]

We have a ranking of the full incomes \( X_{00} > X_{01} > X_{11}, X_{00} > X_{10} > X_{11} \).

The possible payoffs corresponding to these labour participation patterns are then \( v(1, 1, X_{11}), v(0, 1, X_{01}), v(1, 0, X_{10}) \) and \( v(0, 0, X_{00}) \). Note that if \( v(1, 1, X_{11}) > v(0, 1, X_{01}), v(1, 0, X_{10}) \) then \( v(1, 1, X_{11}) > v(0, 0, X_{00}) \) from the monotonicity of \( v() \) in all arguments.

The only differences between the full incomes between participation patterns are in the value of the time endowment which arises in periods of work and depends of course on the wages of those periods. A suitable idea of the time profile of reservation wages between any two alternative profiles of labour participation is a pair \( w_{T-1}, w_T \) giving indifference between the two patterns of labour participation. So with \( Z = rA_{T-1} + ry_{T-1} + y_T \), we can define:

\[
\begin{align*}
V_{11} &= v(1, 1, Z) = v(1, 0, Z + w_{T-1}^{11,10}) = V_{10} \\
V_{01} &= v(0, 1, Z + w_{T-1}^{01,10}) = v(1, 0, Z + w_{T-1}^{01,10}) = V_{10} \\
V_{11} &= v(1, 1, Z) = v(0, 0, Z + rw_{T-1}^{00,10} + w_{T-1}^{00,10}) = V_{00} \\
V_{11} &= v(1, 1, Z) = v(1, 0, Z + w_{T-1}^{11,01}) = V_{01} \\
&\Rightarrow v(0, 0, Z + rw_{T-1} + w_{T-1}^{11,01}) < v(1, 0, Z + w_{T-1}^{11,01})
\end{align*}
\]

If we included interior solutions for labour participation there would be 9 configurations. The way of getting the "reservation wages" above would be similar eg suppose \( 0 < L_{T-1} \) and \( L_T = 0 \). Let \( L_{T-1}^* \) solve

\[
\frac{dv(L_{T-1}^*, 0, x)}{dL_{T-1}} = 0 \text{ and then require } \frac{dv(L_{T-1}^*, 0, x)}{dL_T} < 0
\]
In general there may not exist finite positive wages ensuring these indifferences. But the general pattern of how life cycle labour participation is determined is clear. For the pattern $ij$ to be optimal (ie participation state $i$ in period $T-1$ and $j$ in $T$) to be optimal we require that $V_{ij} > V_{kl}$ for each other possible participation profile $kl$. How the optimal participation profile varies with $Z$ and current wages depends on the form of the utility. There are some basic results just from monotonicity of $v()$ in its arguments. Thus if $V_{11} = V_{10}$ then $V_{00} < V_{10}$. In general one would expect that for for given $Z$ and a given utility function, there will be a region of high wages in both periods where it is optimal to work full time in both periods (corresponding to $V_{00} > V_{10}, V_{01}, V_{11}$). Similarly there will be a region of low wages in both periods where it is not optimal to work in either period (corresponding to $V_{11} > V_{10}, V_{01}, V_{00}$). And finally there will be two regions: one with high wages in $T-1$ but low wages in $T$ (corresponding to $V_{01} > V_{10}, V_{00}, V_{11}$) where it is optimal to work full time in $T-1$ but not work at all at $T$; and conversely a region of high wages at $T$ but low wages at $T-1$ where it is optimal to stay out of the labour market at $T-1$ but work full time at $T$, (corresponding to $V_{10} > V_{00}, V_{01}, V_{11}$). For particular preferences and $Z$, some of these regions may be empty. With given preferences, $Z$ and wage rates of each period, the optimal profile of labour participation over the two periods is determined.

How will introduction of the deferral option affect the optimal participation profile? Deferral is only taken up if it raises the present value of nonlabour income including the pension stream changes. This change in wealth changes the demand for leisure in each period. If leisure is a normal good, an increase in wealth increases the demand for leisure in each period. So we would generally expect a drop in work hours in each period when an individual prefers to defer. If an individual was planning full time work in each period without the deferral option but chooses to defer, then if his wages rates were close to the reservation wage in one of the periods (as computed above), with deferral his optimal profile may switch into zero work in that period. Disney and Smith (2002) consider the effects of relaxation of the earnings rule on labour supply participation of older workers in the UK. Similar to our findings, their model indicates that increasing generosity of work incentives, such as reducing the marginal tax rate on earnings for older workers will cause a reduction in the number of hours worked.\footnote{This may not hold true for all workers depending on whether their income is above or below the earnings rule threshold.}

To see the impact of pension deferral (raising the present value of nonlabour income) on life cycle labour force participation we need to know more about the wage regions corresponding to different labour participation patterns and how these vary with $Z$. Then we can predict for which parts of the intertemporal wage rate distribution will introduction of the pension deferral option lead to a switch to zero hours of work in either or both of periods $T-1, T$. To determine this we have to resort to a specification of preferences which allows us to explicitly compute the labour participation areas and the ways in which they vary with $Z$. We can then also see how deferral will impact on consumption and savings.
in different parts of the wage rate distribution.

3 An application of our general framework using quasilinear utility.

In this section we take a commonly used specification for the utility function (Gustman and Steinmeier (2010), Blau (2012)). We are able to derive optimal saving and labour supply regimes in each case. We show the channels by which pension deferral affects the optimal labour supply. In this specification remaining lifetime preferences are given by

\[ u(c_{T-1}, L_{T-1}) + \delta u(c_T, L_T) = \frac{C^\alpha_{T-1}}{\alpha} + h_{T-1} L_{T-1} + \delta \left( \frac{C^\alpha_T}{\alpha} + h_T L_T \right) \]  

(4)

In the appendix we derive the optimal value of savings \( A_T \) and the value function as

\[ A_T = \frac{x_{T-1} - (\delta r)^{1/(\alpha-1)}(y_T + w_T(1 - L_T))}{1 + r(\delta r)^{1/(\alpha-1)}} \]

where \( x_{T-1} = rA_{T-1} + y_{T-1} + w_{T-1}(1 - L_{T-1}) \)

The resulting value function is

\[ v(K, w_{T-1}, w_T) = \left( \frac{K + rw_{T-1}(1 - L_{T-1}) + w_T(1 - L_T))}{\alpha} \right)^{\alpha} D + h_{T-1} L_{T-1} + \delta h_T L_T \]

where \( K = r(rA_{T-1} + y_{T-1}) + y_T, D = ((\delta r)^{\alpha/(\alpha-1)} + \delta) \)

We can then write the maximal utilities obtained from the various labour participation life cycle profiles as

\[ V_{00}(K, w_{T-1}, w_T) = \left( \frac{K + rw_{T-1} + w_T}{\alpha} \right)^{\alpha} D \]

\[ V_{01}(K, w_{T-1}) = \left( \frac{K + rw_{T-1}}{\alpha} \right)^{\alpha} D + \delta h_T \]

\[ V_{10}(K, w_T) = \left( \frac{K + w_T}{\alpha} \right)^{\alpha} D + h_{T-1} \]

\[ V_{11}(K) = \left( \frac{K}{\alpha} \right)^{\alpha} D + h_{T-1} + \delta h_T \]

This allows us to define six combinations of wages \( w_{T-1}^i, w_T^i, i = 1..6 \) which
Figure 1: Indifferences between participation profiles

give indifferences between pairs of maximal utility levels

\[ V_{00}(K, w_{T-1}^1, w_T^1) = V_{01}(K, w_{T-1}^1) \]
\[ V_{00}(K, w_{T-1}^2, w_T^2) = V_{10}(K, w_T^2) \]
\[ V_{00}(K, w_{T-1}^3, w_T^3) = V_{11}(K) \]
\[ V_{01}(K, w_{T-1}^4) = V_{10}(K, w_T^4) \]
\[ V_{01}(K, w_{T-1}^5) = V_{11}(K) \]
\[ V_{10}(K, w_T^6) = V_{11}(K) \]

Using the detailed expressions for the various value functions the appendix shows that the critical wage combinations are related as in the figure below, and that all the intersections of regions exist at finite positive wages.

Then using monotonicity of the value function expressions in the wage rates, we can deduce regions of wage space in which different intertemporal labour participation patterns are optimal as shown in Figure 2 below. The boundaries between the regions in Figure 2 correspond to the relevant parts of the lines 1, 2 giving lower bounds on full time work, 5, 6 giving upper bounds on the zero work region and 4 giving the division between working either just in \( T - 1 \) or just in \( T \).

3.1 The effect of pension deferral on labour force participation.

To examine the impact of pension deferral which raises the present value of non-labour income on life cycle labour participation we show how Figure 2 changes.
with $K$. The appendix shows that the effect on the optimal labour participation profile of an increase in $K$ depends on whether the utility value of leisure is higher in $T - 1$ or $T$. In both cases the wage region with zero work in both periods expands and that with f/t work in both periods contracts. But if the value of leisure is higher in period $T$ than $T - 1$, the wage region with f/t work only at $T - 1$ expands at the expense of the wage region with f/t work only in $T$. Conversely if the value of leisure is higher in $T - 1$ than $T$, the wage region with f/t work at $T$ expands at the expense of the wage region with f/t work only in $T - 1$.

If the option to defer is suddenly introduced or taken up, or is made more generous than previously (all of which cause the present value of non-labour income to rise), we can deduce the likely effects on life cycle participation profiles chosen. If leisure is more valuable in period $T - 1$, the increase in $K$ will tend
to reduce f/t work in $T - 1$. Some of those who were working f/t in both periods may switch to only working in period $T$ and some of those who previously only worked in $T - 1$ may switch to only working in $T$. But some who previously only worked in $T$ may switch into inactivity in both periods. Thus with leisure more valuable in $T - 1$, the increase in the value of the deferred pension unambiguously reduces f/t work in $T - 1$ but raise or lower it in period $T$. If the value of leisure is higher in period $T$, the opposite effects occur: f/t work in $T$ unambiguously falls while f/t work in $T - 1$ may fall or rise depending on the distribution of the life cycle wages $w_{T - 1}, w_t$ in the population.

This infers that pension deferral increases the likelihood of observing individuals being in full time leisure in both periods for those on lower wages, due to the increase in the PV of non labour income. Hence such a policy will only extend the working lives of those who are paid a sufficiently high wage. Below we demonstrate the effect of pension deferral using a numerical simulation assuming stylised parameter values.

### 3.1.1 Stylised simulation: defer or not defer?

We compare the effects of pension deferral under our framework and the implications it has on labour supply assuming stylised parameter values. We assume a relative risk parameter of -0.5 similar to the lifecycle model presented in Attanasio et al (2008), an annual wealth stock of £5000, weekly non labour income of £150 under no deferral and £180 under deferral, marginal value of leisure in the penultimate period and terminal period of 0.001 and 0.0015 respectively. We assume individuals consume 80% of their wage income and earn annual rate of return of 10% (similar to that available under deferral) and a discount rate of 0.9. In doing so we can replicate the effects of figure 3 more clearly i.e. assuming $h_{T - 1} < \delta h_T$ as shown figure 5 below:
Figure 5: Numerical simulation increase in PV of non labour income

By deferring one period the required wages to be in full time work increase in each period. This can be seen clearly in figure 5. Under the no deferral option whereby the individual claims non labour income in period T-1 the wage rate required to be in full time work at T-1 and T is (,), whilst under deferral it increases to (,) thus deferral raises the reservation wage required by around ...% in order for it to be optimal for the individual to work full time in both periods. The relative slope and shifting of the new and old slopes of the principally depends the difference between 1. the value of non labour income by deferring and 2. the difference in the marginal value of leisure in each period

4 UK State Pension & Deferral.

The purpose of State Pensions can be thought of as two fold: 1. To avoid poverty in old age (Beveridges 1948 original aim) and 2. To ensure a specified replacement rate for all eligible retired individuals. The UK defines a statutory State Retirement Age (SRA) which serves two purposes: it is the age up until which working individuals must pay national insurance contributions at a % rate of their earnings; it is also the age at which an individual first becomes eligible for receipt of a weekly state pension. The amount of the pension depends generally on past national insurance contributions (and so past earnings) although there is a guaranteed minimum state pension. As of April 2010 any man or women who reaches SRA on or after 6th April 2010, is eligible to receive a full state pension if they have made 30 years of NI contributions, and would pay about 15% of the average labour income in 2008 (Coleman at al, 2008). The 2013 White Paper policy announcement to introduce a flat rate pension from 2017 and for new

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5The description presented here draws from Bozio et al (2010).
retirees (post 2017) requires individuals to make 35 years of NI contributions. For individuals who make less contributions their state pension will reflect this, whilst those individuals who make less than 10 years contributions will not receive any state pension.\(^6\) The first date of eligibility for receipt of state pension depends only on age and not on current or future employment status. Until recently the SRA has been 60 years for women and 65 for men but since 2012 there are plans to bring the two closer together, by 2018 the female retirement age will be 65 equal to that of males, and by 2020 the SRA for both men and women will be 66.

Since April 2010 the coalition government has committed the State Pension to a triple lock upratings policy, which means State Pensions are uprated in line with whichever is highest of: (1) September-September CPI (2) average earnings or (3) 2.5\%. For those who defer their pension, at the date of undeferral the rate of return earned in lump sum option means the upratings which have taken place are accounted for in the lump sum itself. In addition all additional flows of the basic weekly SP are uprated each year. On the other hand under the deferred income option at the undeferral date, upratings are only applied to the initial amount of the SP the individual was due to receive before deferring. The additional income earned per week has not been uprated since April 2010 (Thurley 2010).\(^7\)

**Prevalence of pension deferral.** The prevalence of UK SP deferral has been documented in a recent Freedom Of Information (FOI) published by the DWP.\(^8\) Between September 2009-2010 approximately 66,300 individuals deferred their pension. Of this total roughly just over one third took the increment option, whilst nearly half took the lump sum option, the remainder took a mixture of the two.\(^9\) Of the total number of individuals eligible to claim their state pension, roughly 1 in 10 chose to defer their pension. Thus, the prevalence of pension deferral should not be understated. However Coleman et al (2008) surveyed individuals who were approaching or had reached SPA, and found a low level of respondents, 65\%, knew of the option to defer. This proportion only increased slightly after SPA. The main reasons cited were due time constraints and it being

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\(^6\)Bozio et al. (2010) pp 13. For men before April 1945 and females born before 1950, UK State Pension legislation requires these individuals to make the equivalent of 44 years and 39 years of full contributions respectively, in order to be eligible for the maximum State Weekly Pension. For these individuals men must make at least 11 years of contributions and females 10 years, in order to be eligible for any state pension at all.

\(^7\)This holds true since April 2010, prior to this, the additional income earned in the deferred income option was also uprated annually under the same rules as the BSP.

\(^8\)FoI (2773/2011)

\(^9\)FoI DWP (2011) pp.2 notes: New rules for deferral came into effect in April 2005 and lump payments became available from April 2006. A person who deferred their State Pension before April 2005 would qualify for increments for the period up to April 2005 and may have a choice of either a lump sum payment or an increment for the period of deferral from April 2005. This means some people may have both an increment and a lump sum payment. The lump sum option is only available to those who have deferred continuously for at least 12 months. The numbers do not include those who deferred for less than 12 months and opted for simple arrears instead of increments.
the ‘spouses responsibility’, lack of interest or confidence in financial matters. The 2013 White Paper acknowledges these findings and has proposed increased awareness of pension deferral, increased flexibility and to focus on the high rate of return available in exchange for older people extending their working lives.\(^\text{10}\)

### 4.1 Which choice is optimal?

Our general theoretical framework showed the option of whether to defer or not simply depended on the present value non labour income. In this section we show numerical simulations comparing the present value at date of undeferral of the two deferral options available.

On reaching SRA an individual can choose whether to take up the state pension or defer it from that date. They do not have to precommit to a length of deferral but at any future date can ask for their pension to start from that future date. If an individual chooses to defer their pension, then current rules mean that for every five weeks an individual defers, their weekly State Pension increases by 1%, alternatively this is equivalent to a 10.4% rate of return for each full year an individual defers their State Pension. Alternatively an individual may also defer their State Pension and receive a lump sum payment, conditional on them deferring for at least 12 months.\(^\text{11, 12}\) If an individual choose to take the latter option, the lump sum they receive is the value of their past deferred weekly pension payments accumulated at an interest rate of at least 2% above the Bank of England base rate. Depending on the life expectancy of the individual there is no clear answer as to which option is more lucrative, however given the increasing life expectancy observed in the past 30 years, it is generally considered that the first option (deferred pension income) offers a higher rate of return.

At the point of reinstatement of a deferred pension \(S\), the present value of the extra weekly payment coming from the deferral is \(x(1+1.01+1.01^2+\ldots+1.01^T)(1+(1+r)^{-1}+(1+r)^{-2}+\ldots+(1+r)^{-S})\) where \(\tau\) is the number of months for which the pension has been deferred between SRA and age at \(S\), \(x\) is the original weekly pension payable at SRA, \(r\) is a constant market interest rate and \(T\) is the date of death. On the other hand the lump sum payable at \(S\) is \(x(1+\rho+(1+\rho)^2+\ldots+(1+\rho)^T)\) where \(\rho\) is at least 2% above bank base rate.

We show the two deferral options in figures 6 and 7. In figure 6 we instead vary the length of time it takes to earn a 1% increase in an individuals weekly state pension under deferred income option. In figure 7 we vary the length of the period following the undeferral, that is to say, the life span of the individual from the date they start claiming their pension. It is these two factors which are main determinants of the PV of the deferred pension. To show this we set all

\(^{10}\)Options to allow increased flexibility of deferring and undefering multiple times are also being considered DWP (2013).

\(^{11}\)Extra State Pension and lump sum payment are both taxed. In addition if you choose to defer then this will impact means tested benefits, whereas if you choose to recieve a lump sum, this will not affect certain means tested benefits.

\(^{12}\)Since it’s inception there has been various changes to legislation regarding how the rate of return on the deferral option is formulated, and the introduction of the lump sum option in 2006. For a more detailed description of these changes see Bozio et al (2010).
other parameter values as follows: initial weekly state pension of £100, weekly interest rate on lump sum option equal to $0.05\frac{52}{52}$, post undeferral weekly net rate of return equal to $0.02\frac{52}{52}$, deferral period equal to two years.

(i) Varying rate of return on incremental option Figure 6 shows the effect of changing the rate of return or relative generosity, assuming an individual lives for 15 years following the date of undeferral. The sloping curve represents the deferred income option whilst the flat curve corresponds to the lump sum option.

The break even point for the PV of the pension is at a rate of return (under the deferral option) of about 1% for every 6.25 weeks deferred. The current rate of return is a 1% increment for every 5 weeks deferred, and therefore in this example it is approximately £3000 more lucrative for the individual to choose the deferred income option assuming an individual lives 15 years. Nonetheless if the individual is say credit constrained, then it could be the case they require the lump sum to clear some debt, eg remaining mortgage. What is also clear is that during the 1970’s when the contribution rate was approximately 700-800 (1% for every 7-8 weeks deferred) and individuals had a shorter life span (shown below), the lump sum option would have been more lucrative had it been available.

(ii) Varying life span from undeferral date Figure 7 shows the effect of increasing longevity under the incremental option (green) and lump sum option (red), assuming identical parameter values to those above.

As expected the PV for those who only live a short period after they undefer are much better off choosing the lump sum option. However it is clear that the deferred income option is more lucrative provided an individual lives for approximately 12 years or more after they undefer.
The Office for National Statistics (2010) published current and projected life expectancy tables by gender in the UK covering the period 1985 to 2035. Over this period it is quite clear life expectancy has increased substantially, for both cohort and period groups. ‘cohort life expectancy at birth is calculated using age-specific mortality rates which allow for known or projected changes in mortality throughout a person’s life’ (ONS, 2011). ‘Hence by 2035 the average period female is expected to live until 87 years of age. ‘In contrast, cohort life expectancy at birth is calculated using age-specific mortality rates which allow for known or projected changes in mortality throughout a person’s life’ (ONS, 2011), which implies that by 2035 a female on average will live to reach 97 years of age. Figure 8 implies that suppose an individual reaches their life expectancy then the deferred income option is more lucrative, and so long as policy is not changed such as an increase in the number of weeks to earn a 1% increase in the individual’s State Pension, then the deferred income option will only become more lucrative for future generations.

Source: ONS.

Farrar et al. (2012) compare the two undeferral options relative to not deferring and investing at the market rate, in most policy simulations deferral of any kind is preferred over non deferral. Similar to Disney and Smith (2002) and our own model they assume individuals face no borrowing constraints, deferral would not be optimal if individuals could not borrow against their future income. Assuming individuals lived to their life expectancy, then the incremental option tended to offer a higher rate of return in most simulated examples.

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13 In their paper the authors worked in continous time and do not consider a formal model of labour force participation.
including taking account of the tax rate on the post deferral SP income stream. Their results indicated the 10.4% interest payment substantially exceeded the break even interest rate required for the incremental and lump sum option to be of equal PV. Coleman et al (2008) analyse the characteristics of deferrers versus those who claim at SPA. Interestingly they find it was high earners who had good financial knowledge of the deferral option, and either or their partner tended to continue engaging with paid work post SPA. These individuals also reported they were financially comfortable during the deferral period. They also found that the majority of deferrers tended to favour the incremental income option due to the potentially high rate of return. Thus, it is unlikely deferrers are to be in credit constrained households.

5 Conclusion

- Develop a lifecycle framework with pension deferral and its effect on labour force participation, consumption and savings.

- Given increasing life expectancy the option to defer one’s pension is a useful policy tool but our model and data from the DWP (2008) suggest conditional on not being credit constrained, by raising the value of non labour income, pension deferral acts to increase the reservation wage, and hence those who are low paid are caused to drop out of the labour force, and only those who are paid a sufficiently high wage extend their working life.

- if policy remains unchanged is only going to become more lucrative.

Figure 8: Cohort and period life expectancy men and women.
References


A The Value Function for QuasiLinear-Isoclastic Preferences

Defining $A_T$ as the financial wealth carried forward from period $T-1$ to period $T$, we can substitute out the lifetime budget constraint to write $c_{T-1}$ in terms of initial wealth minus savings and leave the problem

$$U = \left( \frac{(rA_{T-1} + y_{T-1} + w_{T-1}(1 - L_{T-1}) - A_T)^\alpha}{\alpha} + h_{T-1}L_{T-1} \right) + \delta \left( \frac{(rA_T + y_T + w_T(1 - L_T))^\alpha}{\alpha} + h_T L_T \right)$$

16
Maximising $U$ wrt $A_T$ gives

$$A_T = \frac{x_{T-1} - (\delta r)^{1/(\alpha-1)}(y_T + w_T(1 - L_T))}{1 + r(\delta r)^{1/(\alpha-1)}}$$

where $x_{T-1} = rA_{T-1} + y_{T-1} + w_{T-1}(1 - L_{T-1})$ and putting this back into $U$ gives

$$U = \frac{(rA_{T-1} + y_{T-1} + w_{T-1}(1 - L_{T-1}) - \left[x_{T-1} - (\delta r)^{1/(\alpha-1)}(y_T + w_T(1 - L_T))\right]^{\alpha}}{1 + r(\delta r)^{1/(\alpha-1)}} + h_{T-1}L_{T-1}$$

The value function is then

$$v = \frac{(r(rA_{T-1} + y_{T-1} + w_{T-1}(1 - L_{T-1})) + y_T + w_T(1 - L_T)^{\alpha}}{\alpha}((\delta r)^{\alpha/(\alpha-1)} + \delta) + h_{T-1}L_{T-1} + \delta h_T L_T$$

which can be rewritten as

$$v = \frac{(K + rw_{T-1}(1 - L_{T-1})) + w_T(1 - L_T)^{\alpha}}{\alpha}D + h_{T-1}L_{T-1} + \delta h_T L_T$$

where:

$$K = r(rA_{T-1} + y_{T-1}) + y_T, D = ((\delta r)^{\alpha/(\alpha-1)} + \delta)$$

### A.1 The Wage Profiles Giving Indifferent Participation Profiles

Comparisons: all pairwise utility combinations are

(i) $v_{00} = v_{01}$

$$(K + rw_{T-1} + w_T)^{\alpha} = (K + rw_{T-1})^{\alpha} + \frac{\alpha}{\alpha} \delta h_T$$

$$w_T^1 = \left((K + rw_{T-1})^{\alpha} + \frac{\alpha}{\alpha} \delta h_T\right)^{1/\alpha} - K - rw_{T-1}$$

(ii) $v_{00} = v_{10}$

$$\frac{(K + rw_{T-1} + w_T)^{\alpha}}{\alpha}D = \frac{(K + w_T)^{\alpha}}{\alpha}D + h_{T-1}$$

$$rw_{T-1}^2 = \left((K + w_{T-1}^2)^{\alpha} + \frac{\alpha}{\alpha} h_T\right)^{1/\alpha} - K - w_{T-1}^2$$
(iii) \( v_{00} = v_{11} \)

\[
\frac{(K + rw_{T-1} + w_T)^\alpha}{\alpha} D = \frac{K^\alpha}{\alpha} D + h_{T-1} + \delta h_T
\]

\[
K + rw_{T-1}^3 + w_T^3 = (K^\alpha + \frac{\alpha}{D}(h_{T-1} + \delta h_T))^{1/\alpha}
\]

(iv) \( v_{01} = v_{10} \)

\[
(K + rw_{T-1}^2)^\alpha = (K + w_T^2)^\alpha + \frac{\alpha}{D}(h_{T-1} - \delta h_T)
\]

\[
 rw_{T-1}^4 = ((K + w_T^2)^\alpha + \frac{\alpha}{D}(h_{T-1} - \delta h_T))^{1/\alpha} - K
\]

(v) \( v_{01} = v_{11} \)

\[
 rw_{T-1}^5 = (K^\alpha + \frac{\alpha}{D}h_{T-1})^{1/\alpha} - K
\]

(vi) \( v_{10} = v_{11} \)

\[
w_T^6 = (K^\alpha + \frac{\alpha}{D}\delta h_T)^{1/\alpha} - K
\]

For convenience we repeat the indifference relations here: (intercepts- set \( \text{RHS} = 0 \) from above).

(1) \( V_{00} - V_{01} : w_T^1 = (K^\alpha + \frac{\alpha}{D}\delta h_T)^{1/\alpha} - K \)

(2) \( V_{00} - V_{10} : rw_{T-1}^2 = (K^\alpha + \frac{\alpha}{D}h_{T-1})^{1/\alpha} - K \)

(3) \( V_{00} - V_{11} : rw_{T-1}^3 + w_T^3 = (K^\alpha + \frac{\alpha}{D}(h_{T-1} + \delta h_T))^{1/\alpha} - K \)

(4) \( V_{10} - V_{01} : rw_{T-1}^4 = (K^\alpha + \frac{\alpha}{D}(h_{T-1} - \delta h_T))^{1/\alpha} - K \) (ref \( w_{T-1} \))

(5) \( V_{11} - V_{01} : rw_{T-1}^5 = (K^\alpha + \frac{\alpha}{D}h_{T-1})^{1/\alpha} - K \)

(6) \( V_{10} - V_{11} : w_T^6 = (K^\alpha + \frac{\alpha}{D}\delta h_T)^{1/\alpha} - K \)

Comparing the loci we see that for wages such that \( V_{01} = V_{10} \) and \( V_{00} = V_{01} \) we must also have \( V_{00} = V_{10}, \text{in terms of the diagram the loci (1),(2) must cross each other on the locus (4). Similarly the loci (5),(6) (V_{11} = V_{01} and V_{11} = V_{10}) must cross on the locus (4) (V_{01} = V_{10}). For similar reasons loci (1),(3),(5) must intersect at a common point; and so must loci (2),(3),(6).}

The indifference relations \( V_{11} = V_{01}, V_{11} = V_{10} \) and \( V_{00} = V_{11} \) are all linear in the wage rates with the last being negatively sloped and the other two respectively horizontal and vertical. Relation (4), \( V_{10} - V_{01} \), is positively sloped. In fact the remaining loci (1) and (2), respectively \( V_{00} = V_{01} \) and \( V_{00} = V_{10} \) are
also positively sloped although this is less obvious. For example differentiating $v_0 - v_0$ implicitly

$$\frac{d w_T}{d w_{T-1}} = r \frac{(K + r w_{T-1})^{\alpha-1} - (K + r w_{T-1} + w_T)^{\alpha-1}}{(K + r w_{T-1} + w_T)^{\alpha-1}}$$

$\alpha < 1$ so $(K + r w_{T-1})^{\alpha-1} > (K + r w_{T-1} + w_T)^{\alpha-1}$ and the slope of locus (1) is always positive at any $w$'s. The same logic applies to locus (2):

$$\frac{d w_T}{d w_{T-1}} = r \frac{(K + r w_{T-1})^{\alpha-1} - (K + r w_{T-1} + w_T)^{\alpha-1}}{(K + r w_{T-1} + w_T)^{\alpha-1}}$$

Comparing the intercept of the loci: those of (1) and (6) are equal, also those of (2) and (5). But the intercept of locus (1) is below that of locus (3) on the $w_T$ axis, and of locus (2) is below that of locus (3) on the $w_{T-1}$ axis.

Combining all this information gives Figure 1 in the text.

A.2 The Intersections of the Loci All Exist

Assets, $y$'s and $h$'s may be such that not all the intersections happen at $>0$ wages. But a finite positive solution must exist: both sides continuous in $w_T$, at $w_T = 0$ LHS greater than RHS

$$[K^\alpha + \frac{\alpha h_{T-1}}{DD}]^{1/\alpha} > \{K^\alpha + \frac{\alpha (h_{T-1} - \delta h_T)}{DD}\}^{1/\alpha}$$

and as $w_T \to \infty$

$$\lim_{w_T \to \infty} \{(K + w_T)^\alpha + \frac{\alpha h_{T-1}}{DD}\}^{1/\alpha} - [(K + w_T)^\alpha + \frac{\alpha (h_{T-1} - \delta h_T)}{DD}]^{1/\alpha} < \lim_{w_T \to \infty} w_T$$

A possible problem is that $w_{T-1}$ where $v_0 = v_1$ may not be positive: eg looking at (??) above if $\delta h_T$ is huge compared with $h_{T-1}$ may give $w_{T-1} < 0$ where they cross.

A.3 Comparative Statics of the Optimal Life Cycle Labour Participation Regimes

How the participation diagram shifts: looking at the critical wage expressions eg $w^1$ etc as a function of $K$ except for $w^4$ the relevant expressions in $K$ are all of the form

$$w = (K^\alpha + z)^{1/\alpha} - K$$

where $z > 0$. Differentiate wrt $K$
\[
\frac{dw}{dK} = (K^\alpha + z)^{(1-\alpha)/\alpha} K^{\alpha-1} - 1 = (1 + zK^{-\alpha})^{(1-\alpha)/\alpha} - 1 > 0 \text{ if } z > 0
\]

For \( w^4 z \) we have \( (h_{T-1} - \delta h_T) \) so if \( h_{T-1} > \delta h_T \) then \( dw/dK > 0 \) but if \( h_{T-1} < \delta h_T \) then \( dw/dK < 0 \). So if \( h_{T-1} > \delta h_T \) the wage region with f/t work at \( T \) expands at the expense of the wage region with f/t work only in \( T - 1 \). Or vice versa if \( h_{T-1} < \delta h_T \).