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ALTERNATIVE APPROACHES TO MODEL WITHDRAWALS FROM THE LABOUR MARKET

A LITERATURE REVIEW^{*}

by

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20th December, 2002

Abstract

The paper reviews large literature on retirement, keeping in mind the goal of finding a suitable model to the labour market of the older workers in Sweden. The review is divided into six sections. The first section explains the problems of defining retirement. The second section deals with a multitude of labour market exit channels. Specific features of modelling old-age retirement, disability, sick leave, and unemployment of the aged are explained. The third section is concerned with economic and non-economic incentives. Different definitions of economic incentives are described, and the importance of a correct health measure is discussed. The fourth section is concerned with the spousal decision-making, and the fifth with the labour demand effects on retirement. The final chapter goes through strengths and weaknesses of structural and reduced-form models.

Keywords: Retirement; Labour force participation of the older workers

JEL classification: J26; J14.

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1. Introduction

The purpose of this paper is to provide a plan and a discussion on how the old age labour market transitions should and could be modelled in Sweden. The paper is a background paper for a model that is to be constructed econometrically and used for policy simulations within a larger micro simulation model (SESIM) of the Ministry of Finance in Sweden. As such the paper includes no description of the Swedish old age labour market (to be included in the accompanying paper by Daniel Hallberg). Moreover, there are no estimations on this paper, but merely a literature review that attempts to focus on the Swedish case when possible.

Swedish literature on the topic consists mainly of a series of papers by Palme and Svensson (1997, 2002a and b). As the intention is to use the same data set as is used in their papers, most of the discussions rely rather heavily on these papers. Yet I try to add to the discussion in these papers by adding bits and pieces from the work of others as well as from my own work on Finland. Even if the ambitious goal of the future modelling is to largely replicate the existing models by Palme and Svensson, I will also try to discuss issues that might merit further consideration.

This paper proceeds by first discussing different definitions of retirement. The third chapter pays heed to the numerous ways that the aged work force can withdraw from the labour markets in Sweden. I'll try to highlight the issues that are important when modelling old-age retirement or the labour market withdrawals because of health or unemployment. The fourth chapter describes different measures of economic incentives and discusses the importance of the health controls. The fifth chapter takes up the issue of spousal interaction when making the retirement decisions. The sixth chapter focuses on the labour demand side that tends to be overlooked in largely supply-side retirement models. The seventh chapter is a mix of all things. It discusses different econometric models that could be used to model retirement, their feasibility given the main aim of the retirement model in this context. The eighth chapter concludes.

2. Defining Retirement

The definition of retirement is not clear-cut. In surveys retirees are identified from their response to the question on whether they are retired. Research (Takala 1999), however, tells us that, for example, part-time retirees can differ in their subjective feeling of retirement. Some of the part-time retirees in Finland felt that they were still working, whereas others defined themselves as retired. So, a yes-or-no definition on retirement can place the part-time retirees on either side.

Furthermore, a decision to stop work does not necessarily equal claiming the retirement benefits. Stopping to work can either precede a pension benefit application, or benefits can be collected while working (either in a different job, or the same job with full or reduced hours). Coile et al. (1999) investigate delays in claiming social security benefits. They show that delaying claiming in the US can sometimes be optimal even when the individuals stop work. Coile et al. also show that even if delayed claiming is not as common as their theoretical model would predict, it is still fairly important in the US.¹

In administrative data sets problems with subjective feeling of retirement are avoided. Yet there are a number of other issues that are specific to administrative data. Retirement in administrative data sets is generally defined through work hours, wage earnings and/or retirement benefits. The most stringent definition of retirement limits the work hours and the wage earnings to zero. Yet we know from the pension regulations that some of the common pension schemes do not require full withdrawal from the labour force for collection of the benefits. In Finland, there are specific yearly labour earnings limits on the collection of pensions (Hakola, 2002).² So when defining retirement, it would seem more natural to set some limit on the earnings or on the working hours rather than requiring them to be zero. The question then becomes what is the best candidate for this limit. The limit could be an absolute amount (crowns/ per hour per year or per month or one Basic Amount (BA)³ per year, as in Palme and Svensson, 2002a and b), or it could be a relative amount (pension benefits as a

¹ Coile et al show that about 10% of men retiring prior to their 62nd birthday delay claiming in the US. Moreover, they show that some of the theoretical implications on delayed claiming are born out by the data. Men with longer life expectancies have longer delays, delays follow an inverse u-shaped pattern as wealth increases, and men with younger spouses have longer delays.

² These yearly limits differ between different pension schemes.

³ Basic Amount (BA) is the sum that is decided each year by the government in Sweden. It is a basis for the calculation of all social security payments that year.

share of whole income per year). Yet another possibility is to rely on a relative fall in either income or the amount of work in consecutive years (used by, for example, Zabalza et al., 1980).

Palme and Svensson (2002a and b) use two definitions to measure full-time retirement. First, they define retirement through sources of income. They have classified all yearly income by its source (social security, pensions), and define a person to be fully retired when more than 80% of his income comes from various types of social security payments.⁴ The other definition that Palme and Svensson use relies on total labour earnings. If an individual earns less than one Basic Amount in labour income, Palme and Svensson consider him retired. On both definitions Palme and Svensson require that conditions hold until the last year of the data, that is, until 1997.

Palme and Svensson compare their two definitions of retirement by seeing how well the definitions match. They find that in almost all age groups, their two definitions are within one year's difference for at least 80% of their sample.⁵ Palme and Svensson mention two sub-groups where there seems to be a greater difference in the retirement age when using the different definitions. First, there is a group of younger workers (more often women) who receive labour earnings below one BA some years before their labour earnings fall below 20% of the total earnings. Second, there are older individuals (more often men) whose labour earnings are less than 20% of their total earnings, but their labour earnings are more than one BA. They explain both of these deviations by the fact that the decision to claim a benefit is separate from the decision to retire. Some people claim their benefits even when they are working (second group), whereas others can live on other household income or savings and delay their claims even when they have retired (first group). Even if Palme and Svensson state that the source of income definition (80% from social security) might be more appropriate for high-income workers⁶, they prefer (and use) the earnings definition based on the BA. In this way they catch those individuals (primarily women) who leave the labour market without any compensation. This approach also classifies most of the part-time retired as workers (assuming that most part-time retirees earn more than one BA in labour earnings).

⁴ These are state old-age pension, occupational pension, disability pension, survivor's pension, wife's supplement, severance payment from the employer, private pension, sickness insurance, unemployment insurance and partial retirement benefit.

⁵ For those in the age groups above 55, the two definitions yield the same year of retirement for more than half of the cases.

⁶ Earnings above one BA correspond to relatively few hours of work for the high-income workers.

The issue of how to treat the part-time retirees has been studied explicitly in the US by Gustman and Steinmeier (1984). They show that self-reported partial retirement is relatively common in the US. Most often partial retirement in the US implied work outside the main job that was defined as the job held at the age of 55. Gustman and Steinmeier show that ignoring the partial retirement leads to a misspecification of the retirement model. This misspecification in turn affects results of the retirement models. For example, they show that if partially retired are counted as retired, a higher wage in the main job reduces the probability of retirement. If the partially retired are not counted as retired, depending on age, a higher main-job wage either has little effect on, or increases the probability of full retirement.⁷ In Finland most of the part-time retirees resemble the full-time workers by their observable characteristics (Hakola (2002)).⁸ Therefore if one wants to classify retirement dichotomously (which itself might not be necessary), it would seem more natural to include the part-time retirees in the working category.

3. Different ways out of the labour market

A great share of retirements today happens through early retirement schemes. Some of the early retirement schemes have been devised for early retirement (for example, disability pensions), whereas others have developed into such without an explicit intention (for example, extended unemployment benefits). These alternative retirement schemes should be accounted for when modelling retirement. Mere lumping of the schemes together can yield erroneous conclusions on the effect of the explanatory variables (See Hakola, 2002).

3.1 Old-age pension

Retirement is traditionally defined as a withdrawal from the labour market because of old age. Most countries have an official old-age retirement age, indicating the age when a person becomes eligible for the full pension benefits. In most cases this is the age 65 (Sweden and most other European countries) or 67 (USA). Old age pension benefits can often be collected either early or late. If either of these options is exercised, then the pension benefits can be actuarially reduced or increased. As the actuarial rules are usually well specified, and the age

⁷ From this, we can deduce that part-time retirees in the US are low wage individuals.

⁸ In Finland, the average income of the part-time retirees is notably high. (See Hakola, 2002.)

limits of old age pension schemes are given in pension laws, both the economic incentives and the eligibility for the old age retirement can be well defined. Hence, the estimation of the effect of the incentives on the old age retirement is relatively easy to model.

In the US calculating the old-age pensions is somewhat more complicated because there are numerous private pension schemes, in addition to the general social security scheme. In Sweden, despite the increase in private pension savings, a great bulk of the individual pension wealth is concentrated in the public and occupational specific pension schemes. As there are only four major occupational pension schemes, old-age retirement that is supported through the public scheme and one of the occupational schemes, is relatively easy to define.⁹

The biggest problem in modelling old-age retirement is the fact that this scheme is most often not the scheme of the first instance. In other words, people withdraw from the labour market prior to their eligibility to the old-age pension scheme. Retirement is then not decided at the age of eligibility to the old-age pension scheme, but most of the transitions to this scheme are deterministic. Individuals that have derived income through an alternative source prior to qualifying for the old-age pension scheme are automatically transferred to the old-age pension scheme at the age of 65. As these transitions do not count if we are interested in the behavioural parameters, models of the old-age retirement should focus only on those who take up the old-age pension directly from work.¹⁰ This work to old-age retirement can take place early with actuarially reduced benefits, at the age of 65 with normal benefits, or after the age of 65 with increased benefits.

There exists a large literature on old-age retirement (See Lumsdaine and Mitchell, 1999, for the latest extensive review.) In the US retirement is defined as old-age retirement. Award of the pension benefits is not uncertain. Either the person qualifies for the benefits or he doesn't.¹¹ However, retirement decision is still not free from uncertainty. Rust and Phelan (1997) allowed uncertainty with respect to mortality, health status, health expenditures, marital status, employment, and income. This led them to estimate a complicated dynamic programming model. Other dynamic models on old-age retirement, such as Berkovec and

⁹ The major complication in defining economic incentives is to define the occupational pension scheme the individual belongs to (not observed in Linda), and the accumulated wealth in the private pensions.

¹⁰ If we are interested in the cost of each of the schemes, we would then be also interested in the behavioural parameters.

¹¹ Most often this is a function of age and vesting rules to the pension system.

Stern (1991) and Stock and Wise (1990) do not allow for uncertainty, but capture the consumption-leisure trade-off in a lifecycle context.

3.2 Disability Pension and Sick Allowance

Deteriorated health is usually the most common reason for early retirement. Reduction in health can prevent further work partially or totally. In order to prevent people from falling into poverty, countries have long standing insurance programmes for health. In Sweden, there are two such programmes, disability pension and sick allowance. Disability pension is an early pension scheme, and, to receive the disability pension in full, the work ability is classified as completely lost.¹² Traditionally, the individual was not expected to return to the work force after the disability pension. Sick allowance, in contrast, is targeted to temporary illnesses. Even if the duration of the sick allowance is not limited in Sweden, the recipients of the sick allowance are expected to return to the labour market. Otherwise they are transferred to the disability pension. Gun Alm Stenflo (2002) claims that sick allowance and disability pension have been used interchangeably.¹³ Until 1991, those who were at least 60 years of age could receive sick allowance for labour market reasons.

The major difficulty in modelling health related early retirement is discretion in the award of a pension. If the rules for the disability benefits could be strictly defined (and they would be constant over time), and the work ability of the individual could be perfectly observed, there would be no uncertainty in who is rewarded disability benefits, and there would be no rejected pension applications. Yet all applicants are not always awarded benefits. One of the reasons is that we cannot perfectly observe the health status of the applicants. Specially, the severity of the most common diseases leading to disability applications, psychological or musculoskeletal problems, is hard to assess. Also the rules of the disability pension system are not easy to define, nor do they stay constant over time. There are also numerous diseases that can prevent certain type of work but not another type. So even if all disability related benefits require a medical certificate, the award of the benefits undergoes subjective evaluation of the officials involved in the pension award decision. This evaluation is naturally based on the personal judgment of the officials.

¹² In Sweden, it is also possible to collect the disability pension in part (25%, 50% or 75%).

¹³ She finds that if the recipients of sick allowance and the recipients of the disability pension benefits are added up, there is little change in the share of social security payments made from either of the schemes over the years as a share of total income.

Some papers (e.g. Halpern and Hausman, 1986, Parsons, 1991, Kreider, 1999) claim that the stringency in disability screening actually affects the number of applications that are submitted. As we are generally interested in when an individual stops work, rather than when he is awarded the benefits, Bound (1989) looked at what happens to those disability applicants who were declined disability benefits. He found that 50 per cent of the rejected applicants actually stopped working after their application. Parsons (1991) pointed out that these individuals may face obstacles in getting back to the labour market,¹⁴ or they might receive disability benefits from some other scheme that Bound did not account for. Benitez-Silva et al. (1999) point out that there are several stages in the disability application that should be accounted for when estimating the true reciprocity of the disability benefits. They modelled the application procedure in four stages: first the candidate decides whether to apply, then the administrator decides on whether to accept, then the candidate decides on whether to appeal, and finally, the administrator decides whether to reverse its decision on the basis of the appeal.

Palme and Svensson (2002a and b) state that in Sweden an individual has to be classified to have lost totally his work ability in order to receive full disability pension. Strictly speaking, this would then imply that disability benefits are available only when there is no alternative, so the transition to the disability pension is not subject to choice. In this case, there would be little reason to specify a model where other variables (such as the economic incentives) are considered. Yet the incidence of disability is so high in Sweden that it is unlikely that all people in disability have totally lost their work capacity. Therefore, Palme and Svensson (and others in the NBER project) modify their economic incentive variable for disability by accounting for the eligibility probability for disability.¹⁵ Palme and Svensson run a probit equation for the disability take up on age, education, socio economic group, marital status and a region, and use these results to derive for each individual a probability of receiving the disability pension. In order to assess the size of the disability pension, they constructed a stylised disability path. Accordingly, they assumed that when the individual quits work he first receives either sick allowance or unemployment benefit (both assumed to be 80% of income). Then he transfers to the disability pension and receives this until the old age

¹⁴ In the US, the worker has to first quit work in order to be able to apply for disability benefits.

¹⁵ Palme and Svensson state that one could assume that everyone was eligible to the disability, or the only retirement alternative was the old age pension, or that only those who took up the disability were eligible for it. These would, however, lead to over and underestimates as well as endogeneity problems.

retirement. The time between the initial benefit (sick allowance or unemployment benefit) and the disability pension is a function of the individual's age.¹⁶ Finally they multiply the benefit eligibility probability by the reward from the stylised benefit path to yield the expected benefit. This expected benefit is used as an instrument for the true disability benefit.

A further difficulty in modelling the disability transitions is the consideration of the counterfactual. If the Swedish rules were taken literally, modelling the disability pension route would merely consist of a transition from the disability pension to the old-age pension. Traditionally, recovery from disability was not expected. Today, however, rules of the disability pension system allow for work for a limited period of time.¹⁷ Moreover, if we included the sickness benefits into the model¹⁸, the possibility of recovery should somehow be taken into consideration. The question is then how big is the probability of recovery for each individual. Would he still be entitled to the same wage that he had prior to falling ill? Palme and Svensson (2002a and b) ignore the chance of recovery in their model, and as this would considerably complicate the analysis, this simplification is highly practical. Yet there is no information on the frequency of recovery, so the importance of possible recovery is unclear.

3.3 Unemployment

Some of the issues that were discussed with the disability pensions apply also to modelling the labour force withdrawal through unemployment. With unemployment the problems of defining the counterfactual can be even more severe. Unemployment benefits in Sweden are restricted to 300 working days.¹⁹ If the unemployed do not find a job before the end of these 300 days, they will be subjected to active labour market programmes. The financial compensation of the active labour market programmes equals the unemployment benefit. After the end of the programme the individual can be entitled to the unemployment benefits if he is not permanently employed. Yet there is always the possibility that the individual finds a job. This possibility of finding a job is likely to be higher for some individuals than for others.

¹⁶ Palme and Svensson show that the transfer from other benefits to the disability pension fits nicely a quadratic function of age.

¹⁷ In the first three months of work while on the disability pension, the individual is still allowed to collect his pension even while he is working. In the first year, he can let the pension rest, but he does not lose the right for the pension. In the following two years, disability pension can still be activated if the reasons for stopping to work at this point are strong.

¹⁸ Most, but not all sickness benefits are converted to disability pensions after one or two years. See Palme and Svensson (2002a).

¹⁹ Prior to 2001, unemployed who were 57 years of age and older were entitled to unemployment for 450 workdays.

Yet it is hard to estimate, as it is hard to find variables that affect the probability of finding a job, but do not influence the economic incentives of the unemployed. Nevertheless, even if the probability of finding a job could be assessed, it is not clear what would be the expected wage. The wage prior to unemployment is likely to be too high, because long periods of unemployment are likely to depreciate human capital (and might have unwanted signalling effects on employers). Wage expectations might then actually be a function of the duration of unemployment.

It is also unclear whether an individual can reject a job offer without any penalty of losing unemployment benefits. It is also unclear whether individuals are forced to take up jobs that are worse compensated than their previous jobs.²⁰ Besides the treatment of the aged unemployed might be more relaxed, even if there are no age specific regulations on the quarantine rules.

If the lay-off decision is employer initiated, and if the individual had no desire to stop work, modelling the labour market transition in a traditional supply side model is wrong. If the individual did not have a choice, there was no counterfactual present for him to choose. Yet there are fairly rigid employment protection laws in Sweden. Last-in-first-out (LIFO) rule specifies the order of terminated contracts. This being the case, following Lazear (1986), we can argue that older workers can be “bought out” by generous pension arrangements. Then the lay-off might not be attributable to the firm decision only, but there would be supply side elements to it as well.

4. Economic and non-economic incentives to leave the labour market

This chapter takes up issues with the most important explanatory variables in retirement models; namely economic incentives and health. I will start with the economic incentives (discussed in section 4.1.), and finish with the health variable (section 4.2.). Leaving out discussions on other variables, such as education, gender or industry, does not suggest that they are un-important. Their inclusion to the models is considerably more straightforward.

²⁰ In Sweden, unemployed are allowed to reject two job offers without being penalised through the loss of the unemployment benefits.

4.1 Economic incentives

The most convincing evidence on the effect of the economic incentives on retirement (or the lack of the effect) comes from natural experiments. (See Krueger and Pischke, 1992, or Gruber, 1996). Most papers, however, calculate the incentives explicitly from the data. Below I will describe some of the most commonly calculated economic incentives. In the final section, I will also discuss strategies for income prediction and estimation of taxes and housing allowances.

WAGES AND PENSION BENEFITS (OR SOCIAL SECURITY COMPENSATION)

Higher wages encourage work and higher pension benefits encourage retirement. The most straightforward control for the economic incentives would then be the wage rate and/or the pension benefit (net of taxes). In Sweden, expected social security pension benefits for those who are still at work are “observable”, because they can be computed from centrally registered pension points at the National Social Insurance Board.²¹ Calculation of the occupational pension benefits, however, is trickier, as they are based on trade union agreements, and no public data is available on earned benefits for those who have not started to withdraw them. So, in order to predict occupational benefits in the future, assumptions are needed on how long people stay with the same or similar employer.

As discussed above many early retirements from the labour market start with some other form of social security benefit. Disability pension does not generally equal the person’s old-age pension. Moreover, the same individual might be on sick allowance for several years before he is transferred to the disability pension. Financially, this would be in the individual’s interest, as the sick allowance is higher than the disability pension. If these differences in the benefits are not taken into account when calculating the total economic incentive of quitting work, the incentive could be over- or under calculated. An over or under estimated incentive variable would, in turn, under or over estimate the effect of the incentive variable on the probability of retirement.²²

²¹ Pension benefits can naturally be observed for those who are retired.

²² Assuming that the variable has an effect on the probability of retirement, and there is no bias in estimating this effect.

As mentioned above, unemployment benefits are limited in duration.²³ An individual who considers his income alternatives by comparing his unemployment benefit to his pre-unemployment wage would then be rather myopic. It is expected that the benefits come to an end after certain time, and the individual should take this into account when he makes decisions. Mere comparison of the current unemployment benefit to the previous wage is false. Incentives are likely to be considered with a longer time perspective.

REPLACEMENT RATE

Replacement rate is just the ratio of the expected pension benefits and expected wages. This ratio is often used because it is believed that it is the ratio of the two income sources that matters rather than the levels themselves. In practise, constructed replacement rates tend to suffer from the problem of the short time horizon. This, however, is not necessarily so, as the replacement rates could be defined with a longer time horizon.

SOCIAL SECURITY WEALTH (SSW)

Social security wealth takes into account the dynamic aspect of economic incentives. In other words, it summarizes the whole time path of the incentive until the old age retirement, or the end of the life expectancy. Social security wealth is the sum of all expected pension benefits and other social security contributions if the worker quit work today. Gruber and Wise (1999) also account for the social security contributions in the definition of social security wealth. The social security wealth is then a difference between personal benefits and personal contributions. Personal benefits are all discounted benefits that the worker expects to get in his lifetime from the pension system. Personal contributions, in contrast, are the expected discounted contributions to the pension system. Discounted benefits and discounted contributions are first added up, and then the sum of the contributions is subtracted from the sum of the benefits.

The social security wealth normally accounts for conditional survival probability (conditional on surviving until that age). This survival probability can be constructed from gender and age specific life-tables. In Palme and Svensson (1997, 2002a and b), the social security benefit streams also account for the spousal benefits, spouse's survival probability, and the widow's benefits in the case the spouse is deceased.

²³ This is so at least in theory. It is not clear whether the benefits are limited in practise.

The formula for the social security wealth as it is given in Palme and Svensson (1997) is repeated below:

$$SSW(a, r) = SSB(a, r) - SSC(a, r)$$

$$SSB(a, r) = \sum_{a=r}^{a=T} \left[(p_s q_s PB_m) / (1+r)^{a-t} \right] + \left[(p_s (1-q_s) PB_s) / (1+r)^{a-t} \right] + \left[((1-p_s) q_s S) / (1+r)^{a-t} \right]$$

$$SSC(a, r) = \left(\sum_{a=t}^{a=r-1} p_s C(a) \right) / (1+r)^{a-t},$$

where SSW indicates social security wealth, SSB social security benefits, and SSC social security contributions. a is the current age, r the retirement age, t is the current time, and T is the maximum life length. p_s is the probability of survival and q_s is the probability of the survival for the spouse. PB_m are the pension benefits of a married individual, PB_s the pension benefits of a single individual, S are the spousal benefits, and C is the contribution rate for the individual. r indicates the individual discount rate.

As the social security wealth is expected to control for wealth rather than incentives, most papers include it in the models in addition to one of the incentive measures defined below. These differenced measures are expected to control for the substitution effect, whereas the social security wealth is expected to control for the wealth effect.

Social security wealth is calculated for all individuals who have not yet retired. It does not need to be calculated for the individuals who have retired, and they should be removed from the sample of the analysis after retirement. Hence, there is no need to impute wages for people whose wages are not observed. Yet if any of the following incentive variables that are explained below is included (accrual rate, peak value or the option value), it is also necessary to predict income.

ACCRUAL RATE

Social security wealth is a measure of public sector wealth that the individual has accumulated. In the models, it therefore controls for the wealth effect. As it is well known, the substitution effect is different from the wealth effect. An increase in wealth tends to increase the demand of the good, which in the retirement models is defined by leisure. The substitution effect, in contrast, compares the price of the good with the price of the alternative good. In the

retirement models, this comparison takes place between more leisure immediately (retire now) or less leisure with a lower opportunity cost (retire later with a higher pension benefit).

There are a number of measures that control for the substitution effect. The simplest one is the accrual rate. The accrual rate is the change in the Social security wealth (SSW) from one year to the next. In other words, it measures how much the individual gains from working one extra year. Accrual rate has been criticized for being too myopic. If there are discontinuities in the social security wealth further in the future than one year ahead, the accrual rate does not capture these discontinuities. It could be optimal for the individual to wait until the highest benefits further in the future are available. In Sweden such discontinuities exist because of the occupational pension benefits. In some cases they become available only at the age of 60 (or 65), and no early withdrawal is possible (See Palme and Svensson, 2002).

The formula for the accrual rate is given below:

$$ACC_t = (SSW_{t+2} - SSW_{t+1})$$

PEAK VALUE AND THE TAX/SUBSIDY RATE

To combat the assumption of a myopic individual, Coile and Gruber (2000) defined another incentive measure. They called it the peak value. The peak value is otherwise like the accrual rate, but it compares this year's social security wealth to the maximum social security wealth in the future. The future is defined until old age retirement, and it is possible to continue working until then.

Coile and Gruber (2000) furthermore restrict the peak value to be equal to the accrual rate, if the individual works beyond the highest value for his social security wealth. Coile and Gruber also normalize the peak value by the expected stream of wages over the period between the maximal year and the current year. Hence their actual measure measures the benefits of continued work relative to the earnings in the same period. Consistent with earlier papers (Diamond and Gruber, 1999), they call this relative measure the tax/subsidy rate. The same normalization can naturally be done for both the accrual rate and the option value.

The formula for the peak value is given below:

$$PEAK = \max(SSW_{t+1}, SSW_{t+2}, \dots, SSW_{65/67}) - SSW_t, \text{ if } \max(.) \text{ is the global max in the future}$$

$$= ACC \text{ otherwise}$$

OPTION VALUE

Lazear and Moore (1986) were the first to define the option value of retirement.²⁴ They pointed out non-linearities in the pension accrual. The biggest discontinuities in the US are created by private pension schemes, as they have vesting rules. One more year of work can make a huge difference in the pension entitlements of an individual.²⁵ By working the extra year, the individual would also retain the option of retiring later.

Stock and Wise (1990) “popularised” the option value in the retirement literature by constructing a structural model based on this measure. As this structural model is difficult to implement, numerous authors (e.g. Börsch-Supan, 1992, 1994, Samwick, 1998, Gruber and Wise, 1999, Hakola, 2002) have used the option value in reduced form models. The authors first construct this option value variable for each potential year of retirement, and then use it to explain the retirement propensity.

The option value is similar to the peak value, but the value is defined by a difference between the utility values of the earnings streams. To make this abstract concept operational, it is then necessary to assume a functional form for the utility function. Most papers in the literature use the constant relative risk aversion.²⁶ Option value models also assume that the difference between the financial reward from work and from retirement can be controlled by a constant.²⁷ In addition, assumptions need to be made on the discount factor last (and, as before, the maximum life length and the conditional probability of survival).

²⁴ Option value of retirement is somewhat a misleading concept, because the option value or retirement does not incorporate uncertainty in the concept. Uncertainty, in turn, is a key feature of the option value in the financial literature.

²⁵ He might not be vested in the scheme in one year, but would get the full rights in the next year, if he worked that year.

²⁶ A utility function with a constant relative risk aversion can take a form of $u(y)=y^{-g}$. Arrow-Pratt measure on the relative risk aversion would then be $r = -\left[\frac{u''(y)}{u'(y)} \times y\right] = g$. Higher the g , less risk averse is the individual (and less concave is his utility function.). A function with constant relative risk aversion implies that the relative risk aversion is constant over y . In other words, the person does not get less risk averse or have a higher utility over a specific fraction (say, 10%) of his income when his total income grows. Specific values for the parameter are usually searched by a grid search. Stock and Wise (1990) estimate g to equal 0.75.

²⁷ The constant controlling for the ratio of a reward from work to the reward from retirement shows us how much less individual values a crown from work than a crown from pension benefits.

The formula is given below:

$$OV = E_t[U_t(R^*)] - U_t(t)$$

$$U_t(R^*) = \max_r U_t(r) = \sum_{s=t}^{s=r-1} (p_s u(Y_s)) / (1+r)^{s-t} + \sum_{s=r}^{s=T} (p_s u(kB_s)) / (1+r)^{s-t},$$

$$U_t(t) = \sum_{s=t}^{s=T} (p_s u(kB_s)) / (1+r)^{s-t}$$

$$u(Y_s) = Y_s^\gamma$$

$$u(kB_s) = kB_s^\gamma,$$

where OV is the option value, E is the expectations operator, and U_t is the total utility at time t . R^* is the optimal retirement age, r is the age of retirement, and T is the maximum life length. p_s is the probability of survival, $u(\cdot)$ is the period specific utility function, and Y_s and B_s are the labour income and pension benefits, respectively, in period s . k reflects the relative value of pension income to the labour income. r is the discount factor, and γ is the coefficient of relative risk aversion.

Most of the variation in the option value variable is driven by the variation in wages rather than variation in the pension formula (Coile and Gruber, 2000). Even if there is a leisure control k that should control for unobserved tastes, this is only true if the particular utility structure is correct. This is why Coile and Gruber suggested that wages should be controlled for separately, and rather than including them within the option value variable, Coile and Gruber favour their own measure, the peak value.

LIFETIME EARNINGS

Palme and Svensson (2002a) also have an additional income control that is not in most other retirement models. They call this the lifetime earnings. They construct the lifetime earnings by first regressing the labour earnings on age and year controls and the individual fixed effects. Predicted lifetime earnings are obtained by adding up the constant and the fixed effects. Presumably the hypothesis is that higher lifetime earnings imply higher private wealth²⁸, and the wealth effects on retirement are generally positive. This, however, does not seem to hold in their results.

²⁸ Social security wealth, in turn, controls for the public wealth.

STRATEGIES FOR WAGE PREDICTIONS

As stated above, all of the forward-looking measures require predicted wages for those individuals who are not working.²⁹ Wages are also needed far in the future for those individuals who are working. There are numerous ways to go about predicting wages. Here, I will describe a few.

The simplest method is to assume real earnings growth of say, one per cent per annum (Coile and Gruber, 2000). One can also use the previous wage observations to impute a value to the later observations and index these to the current year (Palme and Svensson, 1999). If, however, we assume that the wages grow differentially for different types of people, we might want to take this into account in the predictions. Therefore many people have first used regression models to get regression coefficients of the wage models. These coefficients are then used with the original data to predict wage development that differs between different types of individuals. There are, of course, a number of models that can be used to get the coefficients.

The simplest model is a model where wage levels are explained by a set of explanatory variables. If one has only cross-section data at hand, then the identifying variation would come from the differences between individuals. In panel data, time variance for the same individual can also be used. If there were enough observations, it might be preferable to limit the sample only to the aged individuals, as the age effect might not be sufficiently captured by a control variable for age (whichever its functional form). An age-restricted sample is likely to produce a better fit for the prediction of wages for older individuals.

Panel data models include fixed effects and random effects models. Fixed effects models insert an individual specific dummy for each individual in the sample. These dummy variables pick up the effect of all time-invariant explanatory variables. Fixed effects models are recommended when we are interested in the specific sample only, whereas random effects models produce results that are more easily generalized to larger samples (Hsiao, 1986). Yet the random effects models make a problematic assumption of independence of errors from the explanatory variables.

²⁹ In the interest of not introducing a systematic bias in the regressions, it is better to predict wages for all individuals, also for those whose wages are observed.

Wage regressions can naturally use wage information only when it is observed. As in all wage models, individuals who have missing wage information are likely to be a selective subgroup. Therefore, one might want to correct for this selectivity. (As is done, for example, by Heyma, 1996.)

One of the best predictors of this year's wage is last year's wage. Therefore, it might be appropriate to include the lagged wage rate among the explanatory variables. If the model assumes that there is a time-invariant error term, there is correlation between this error term and the lagged wage (i.e. one of the explanatory variables). The bias in the estimations caused by this correlation can be removed by differencing all of the variables, and using lagged wages as instruments for these wage differences (Arellano-Bond, 1991). Regression can then be run on the differenced variables. A Hausman-Taylor type of a transformation can then be used to obtain regression coefficients on time-invariant variables. (As was done in Hakola, 1999).

In the final estimations, it is probably best to use predicted income for all individuals rather than to use the observed values for those whose wages are observed. This would ensure that everybody's earnings are calculated in a similar manner, and the error in the calculations is the same for all. Moreover, the intention of the wage prediction exercise is to predict wage expectations rather than the actual wages.

Yet one way to assess the ability of the model to predict wages is to compare wage predictions to wage observations for those who have both. This comparison can be a simple eyeball test on the means and the variances on predictions and observations. One can also look at some composite measure, for example, the root mean squared error. (As in Hakola, 1999.)

Income predictions are necessary if one wants to use forward-looking incentive measures. Yet the identification of these models is problematic. The simplest expectation models (percentage growth or imputation that is based on the lagged values) can be too simplistic for capturing the true wage dynamics. Yet it is hard, if not impossible, to find variables that would affect the wage expectations, but not retirement.³⁰ Moreover, wage models that use

³⁰ The hypothesis is that wages, among other things, affect retirement. If the same variable, say schooling, affects both wages and retirement at the same time, we cannot first predict wages by the schooling variable and then

information on the previous year's wages are cumbersome and seem unnecessarily complicated for a task that is only a small share of the retirement models. Therefore, even if it is theoretically difficult to find a satisfactory model, it is better to keep the predictive models relatively simple.

TAXES AND HOUSING ALLOWANCES

Sweden has both national income taxes and local municipal taxes. In the 1980s and 1990s there were several year-to-year changes in the tax system. Therefore, they found tax calculations from income data highly cumbersome. In addition, low-income pensioners are entitled to housing allowances. The amount of housing allowance depends on housing costs. These are generally not in the data. Therefore, Palme and Svensson (2002a) chose to approximate both taxes and housing allowances from the data. They regressed the amount of taxes on taxable income separately for workers and retirees. As there was a major tax reform in 1991³¹, they used two different functional forms. Pre-reform tax estimation was a third degree polynomial, and the post-reform estimation was based on three linear segments. Estimated functions were then used to calculate individual taxes.³² Palme and Svensson (2002a) note that a similar procedure is applied to calculating the housing allowances.

4.2 Health

Health is often cited as the most common reason for retirement. A particularly severe health shock can lead to total inability to work. Then the individual has no option but to retire, and nothing else matters in the decision to stop work. Retirements could then be fully explained by the health shocks. Most health shocks, however, are not totally debilitating, and health status of an old individual tends to worsen gradually. This then leaves the individual some choice in the timing of retirement. If there is some choice in the timing of retirement, other factors, such as economic incentives, may influence the decision. To determine the extent of choice in the retirement decision, it is important to control properly for the health of the individual.

estimate the effect of wages on retirement. Wage predictions that use only schooling as a predictor for wages, bring no new information to the retirement model.

³¹ Taxation of labour and capital income was separated.

³² Palme and Svensson (2002a) do not explain why these functional forms were chosen.

Lumsdaine and Mitchell (1999) divide claim that health has an effect both on the individual's preference for leisure and on his budget constraint. A sudden health shock or a gradually declining health endowment is likely to alter individual's work ability, and therefore affect his willingness to work. Health can affect the budget constraint, because individual's earning capacity falls, and/or because individual with deteriorated health can qualify for health-related transfer programmes.

Whichever is the channel of influence of health on retirement, it is undisputable that health is very important in retirement models. The measurement of health, however, is difficult. In retirement models, we would really like to control for work ability rather than the general health level of an individual. Yet data sets with an assessment of work ability are very rare.³³ Because of imperfect health measures, Currie and Madrian (1999) claim that the problem of assessing work ability is analogous to the problem of assessing general ability in schooling models.

In order to assess the health bias, it is good to go through most common health controls. Currie and Madrian (1999) categorize available health measures into eight categories: 1) self-reported health status in surveys, 2) observed or self-reported health limitations on the ability to work, 3) measure of functional limitation (can also be an "index measure" of several limitations³⁴), 4) presence of an acute or a chronic health condition, 5) utilization of medical care (including hospital nights or the use of medication), 6) clinical assessment of health (usually assessed mental health or alcoholism), 7) nutritional status (height, weight, or Body-Mass-Index), and 8) expected mortality.

Most of these measures can be used either as a control for the health level as they can be differenced in time to control for a health shock. For example, Coile (2002) uses changes in the respondent's own and spouse's health status. She groups the health shocks (following McClellan, 1998) into three categories: 1) acute health events (heart attack, stroke, new cancer), 2) onset of a new chronic illness (diabetes, lung cancer, heart failure, or arthritis), and 3) accidental injuries or falls.

³³ Some exceptions are the Nagi commission study in the US (See Nagi 1969) and the Mini-Finland Survey in Finland (See Luoma 1995). Both of these projects involved massive medical efforts (specially designed medical tests) to determine the "true health level" of a sample of population in the respective countries. Yet neither of the studies evaluated the health level with respect to the job held by the individual.

³⁴ Information in the Health and Retirement Study has been used to formulate two indices: ADL=activities of daily living or IADL=instrumental activities of daily living

Even with this wide array of options, there are a number of problems that remain with most (if not all) of the health controls. If the information is obtained in a survey, Bound (1991) and Bound et al. (2001) point out that: 1) Respondents in surveys are asked to make subjective judgments on health, and these judgments need not to be comparable across respondents, 2) Responses to the questions on health may not be independent of the labour market outcomes, 3) Retired individuals may choose (consciously or unconsciously) to rationalize their retirement for health reasons, and 4) Early retirement benefits may be available only for those incapable of work, so individuals may have financial reasons to identify themselves as disabled. This last effect might be strongest for those whose relative reward of disability is particularly high. If the health information is more “objective” (based on administrative records, medical examination, subsequent mortality, or a narrower health question), there tends to be a problem that these measures measure overall health rather than work capacity. Moreover, all measures of health tend to be correlated with a number of other variables, which in themselves are important determinants of retirement (economic incentives, education, age, business cycle effects, marital status, occupation, race).

Currently the Swedish data set LINDA has no exogenous controls for health. Yet it is possible to link the Swedish Hospital Discharge Register (Patientregistret) of the National Board of Health and Welfare (Socialstyrelse) to the base data. The register covers all public in-patient care. Principal diagnosis³⁵ is available for all people who have been discharged from hospital care.³⁶ As there are naturally numerous diseases, it would be preferable to classify the disease diagnosis into those that reduce the work ability and those that don't.³⁷

All health conditions that reduce work capacity do not necessarily require hospital care. Therefore, it is possible to construct additional health control from frequent and/or long sickness spells in the prime age of the individual (assuming that the data go sufficiently far back). Even if sickness spells are obviously endogenous if we consider them as a form of

³⁵ Most observations are diseases, but also injuries and poisonings are included.

³⁶ In validity studies, about 10 per cent of the diagnosis were later considered erroneous. For a control variable in retirement models, however, it is better to have a diagnosis at the time, as this can influence the retirement decisions.

³⁷ This would obviously require help by a medical professional.

exit³⁸, a control for a long history of sickness absence might suffer less from endogeneity while controlling for health (or worker motivation).

Bound (1991) and Bound et al. (2001) construct simple models to structure the expectation of the health bias. The outcomes of their models are repeated below.

First, we turn to the model where health is proxied by a subjective measure on health. This is presented below as model 1.³⁹

$$\begin{aligned}
 \text{Model 1: } \quad & \text{labour force particip (lfp)} = \mathbf{b}_1 \times \text{wage} + \mathbf{I}_1 \times \text{health} + \mathbf{e}_1 \\
 & \text{subj. measure of health (sh)} = \mathbf{b}_2 \times \text{wage} + \mathbf{I}_2 \times \text{health} + \mathbf{e}_2 \\
 & \text{Corr}(\mathbf{e}_1, \mathbf{e}_2) > 0 \\
 & p \lim \hat{\mathbf{I}} = \mathbf{I}_1 \left[\mathbf{s}_h^2 (1 - r_{h,w}^2) + \mathbf{s}_{e_1}^2 \mathbf{s}_{e_2}^2 \mathbf{r} \right] / \left[\mathbf{s}_h^2 (1 - r_{h,w}^2) + \mathbf{s}_{e_2}^2 \right] \\
 & p \lim \hat{\mathbf{b}}_1 = \mathbf{b}_1 + (\mathbf{I}_1 - p \lim \mathbf{I}_1) (\mathbf{s}_{h,w} / \mathbf{s}_w^2) - p \lim \mathbf{I}_1 \mathbf{b}_2 \\
 & , \text{ where } \mathbf{r} = \text{corr}(\mathbf{e}_1, \mathbf{e}_2) \text{ and } r_{h,w}^2 = \text{corr}(\text{health}, \text{wage})
 \end{aligned}$$

If we inspect the probability limit estimates for both the wage and the health coefficient, we observe three types of bias. Correlation between the error terms (\mathbf{r}) of the two equations yields simultaneity bias for the health coefficient. Assuming that the correlation between the errors is positive, the simultaneity bias in the health coefficient is also positive. The second cause of bias comes from the variance in measuring health ($\mathbf{s}_{e_2}^2$). This variance introduces errors-in-variables bias to the health coefficient. This bias works in the opposite direction of the simultaneity bias. Both the simultaneity bias and the errors-in-variables bias are transferred to the wage coefficient by the health coefficient. Finally, there is additional bias in the wage coefficient. This third source of bias is due to the fact that the subjective health measure is dependent on wage (\mathbf{b}_2), and this in turn is a major determinant of the labour force participation equation. This third bias attenuates the wage coefficient on the participation equation. Because the simultaneity bias and the errors-in-variables bias work in the opposite directions, the direction of the total estimation error, when using subjective information on health, in both the health and the wage coefficients is indeterminate.

³⁸ This is less of a problem when they are past sickness spells.

³⁹ Wage is assumed to affect reported health, because lower wages encourage earlier retirement, and bad health report can be used as a justification for early retirement.

Then we turn to the model where health is measured more objectively. This is presented as model 2 (again following Bound et al., 2001).

$$\text{Model 2: } \textit{labour force particip}(lfp) = \mathbf{b}_1 \times \textit{wage} + \mathbf{I}_1 \times \textit{health} + \mathbf{e}_1$$

$$\textit{obj. measure on health (oh)} = \mathbf{I}_3 \times \textit{longevity}(l) + \mathbf{e}_3$$

$$\textit{wage} = \mathbf{I}_4 \times \textit{health} + \mathbf{e}_4$$

$$\textit{health} = \textit{longevity}(l) + \textit{work capacity (wc)}$$

$$\text{Corr}(\mathbf{e}_1, \mathbf{e}_3) = 0$$

$$p \lim \hat{\mathbf{I}}_1 = \mathbf{I}_1 [\mathbf{s}_1^2 (1 - r_{l,w}^2)] / [\mathbf{s}_1^2 (1 - r_{l,w}^2) + \mathbf{s}_{e_3}^2]$$

$$p \lim \hat{\mathbf{b}}_1 = \mathbf{b}_1 + (\mathbf{I}_1 - p \lim \mathbf{I}_1) (\mathbf{s}_{l,w}^2 / \mathbf{s}_w^2) + \mathbf{I}_1 (\mathbf{s}_{wc,w}^2 / \mathbf{s}_w^2)$$

$$, \text{ where } r_{l,w}^2 = \text{corr}(\textit{longevity}, \textit{wage})$$

Now the objective health measure is longevity⁴⁰, which is correlated imperfectly with the work ability. With this more objective measure on health, two sources of bias are removed. There is no simultaneity bias, as the error terms are independent in the participation and the health equation. Moreover, even if the wage is influenced by health, the determination of the health status is independent of wage. So the “third” source of bias in the previous case is not a problem in this case. Yet there is still errors-in-variable bias in both the health and the wage coefficient. As before, this bias tends to attenuate the estimated coefficients. Moreover, now there is yet another source of bias that is attributable to the objective health measure - namely, the omitted variable bias. As stated above, the objective health measure (longevity) and work ability are only partially correlated. There are illnesses that affect the work ability, but are not life threatening. Controlling merely for those that are life threatening leaves out a part of the control variable from the labour force participation equation. This will tend to overestimate the wage coefficient.

Summarizing the results above, it is claimed that objective measures tend to underestimate the effect of health, and overestimate the effect of economic incentives on the labour force

⁴⁰ This could be, for example, subsequent mortality (assuming that the data period is long enough).

participation. Subjective health information can yield either positive or negative bias on both of the coefficients.

If there is positive correlation between economic incentives and health, leaving out the health coefficient altogether (see, for example, Palme and Svensson, 2002a) will overestimate the effect of the economic incentives. The correlation between economic incentives and health is very likely. It can take a number of different forms. For example, bad health reduces earnings, reduced health provides access to certain social security programmes that affect incentives, higher income enables higher expenditure on health, and finally, if the economic incentive variable is defined as a life-cycle incentive, there will be correlation between health and the life-expectancy (which is part of the economic incentive). It is therefore very likely that the omitted variable bias in the economic incentive variable is a serious issue when the health variable is totally excluded.

Health status of other family members might also be important while making labour force participation decisions. As stated in Johnson and Favreault (2001), the health problem of the spouse may induce the partner to work longer to compensate for the loss of income, or to retire earlier to take care of the spouse. Some studies (see Currie and Madrian, 1999) find that, in the US, women increase, and men reduce market work when their spouse falls ill. Blau and Riphahn (1999) assess this effect by spouse's current labour market status. With German data, they confirm the previous claim that wives are less likely to exit and more likely to enter the labour force, if their husbands have a chronic condition and are still working. In contrast, however, if the husbands have a condition and have left the labour force, the wives are more likely to exit, and less likely to enter the labour force. This effect seems to be asymmetric for men. They are less likely to stop employment and less likely to re-enter the labour market, if their wives have a chronic condition. This effect for men is independent of wife's labour force status.

Some researchers find no effect of spouse's health status on retirement (e.g. Parsons, 1977), or a symmetric effect for both genders (Coile, 2002). Coile's results on US data show that there is an increase in the labour supply of an individual when the spouse has an acute shock to his/her health, but a decrease in the labour supply when this acute health shock is accompanied by severe impairments. So she claims that the labour force response is dependent on the nature of the health problem of the spouse.

5. Dependence between spouses

Spouse's effect on retirement is naturally not limited to his/her health status. There are a number of theoretical labour supply models that account for the labour supply decision of the whole household (See Blundell and MaCurdy, 1999, for a survey). Less formally it has been suggested (e.g. Hurd, 1988, Blau, 1997 among others) that it is important to model retirement of both spouses because there can be i) complementarity of leisure between spouses, ii) cross-spouse effects of covariates, and covariate effects differing by the spouse's employment status (e.g. the effect of health), iii) assortative mating on unobservables or correlation across spouses in unobserved tastes, and/or iv) cross-spousal financial effects.

Gustman and Steinmeier (2000) give examples of bias if the spousal structure is ignored or badly modelled. Say, the wife suggests that both spouses retire at the same time. If they do so, a study of the retirement of the wife would then conclude that the husband's retirement affected the wife's retirement. Yet the causality was actually the reverse, or the leisure preferences were correlated. Coile (2000) shows that estimated effects of the policy changes on retirement are biased if the spousal spillover effects are omitted.

Empirical models that have been used to estimate the spousal retirement behaviour range from simple probits or logits (e.g. Coile, 2000) to differences-in-differences estimates (Baker, 1999), or to rather complicated structural models (Blau, 1998, Blau and Riphahn, 1999, Gustman and Steinmeier, 2000 and 2002).

Of the structural models, Blau (1998) and Blau and Riphahn (1999) estimate dynamic multinomial probit equations. Transitions between four discrete states classified by the employment status of both of the spouses are modelled.⁴¹ This model then shows automatically the effect of the covariates depending on the spouse's employment status. The model is, however, not only difficult to implement, but the results are also hard to interpret. Blau (1998) and Blau and Riphahn (1999) show the effect of each of the covariates by

⁴¹ The labour market categories are the following: i) both spouses are employed, ii) husband is employed, wife is not employed, iii) husband is not employed, wife is employed, and iv) both spouses are out of the labour force.

calculating the difference in the estimated probability between the current state and the transfer into one of the three alternative states.

Gustman and Steinmeier (2000, 2002) estimate another structural model. Their model is a simultaneous probit model with truncated endogenous variables. Gustman and Steinmeier focus on two types of spousal effects: correlation in the tastes for leisure, and a value of retirement once the other spouse has also retired. They conclude that both effects are significant, but simulations reveal that the positive correlation in spousal retirement dates has more to do with joint value of leisure than correlation in the tastes for leisure. In other words, even if the spouses might prefer similar retirement ages, because they value free-time as much, it is still far more important to be able to spend the time in retirement together, and coordinate retirement accordingly.

Perhaps the most original model with an easy interpretation of the variables is in An et al. (1999). An et al. construct a bivariate proportional hazard model with three hazard functions. These are a baseline hazard for both the husband and another for the wife, and additionally a third baseline hazard for the incidence of joint retirement.⁴² The model endorses a conditional independence assumption. Hence, conditional on observables, all three hazard functions are mutually independent. Yet it is difficult to imagine that all joint variables that are driving the individual hazard functions can be controlled for, so the assumption of conditional independence is not easily defended. Nevertheless, the model with three separate baseline hazards is interesting. All the three hazard functions are allowed to depend on all of the observed individual characteristics.

The way the influence of the spouse is taken into account through the explanatory variables also varies. Some models (e.g. Coile, 2000) include all of the spouse's explanatory variables in the retirement model, but exclude an explicit indicator of the spouse's retirement status. Others (Gustman and Steinmeier 2000, 2002) include an indicator on the spouse's labour market status explicitly. Economic incentives are often calculated separately for both spouses, using estimations from men and women sub-samples (for example, Blau, Blau and Riphahn, 1999). A good predictor for spouse's retirement is found in the age difference between the

⁴² An et al. claim that the correlation between the two individual hazard functions is driven by the additional joint hazard, rather than the joint unobserved heterogeneity term.

spouses (Hurd, 1990, An et al., 1999) and in the indicator on whether the spouse qualifies for early retirement.

Coile (2000) constructs from the Retirement History Study of the US a control variable from a question on whether the individual particularly enjoys spending time with the spouse. She argues that this could be viewed as some kind of a control for the complementarity of leisure. The interaction of this leisure complementarity variable with the incentive variable does indeed produce plausible results in her models.

Palme and Svensson (2002) do not include spousal employment explicitly in their retirement models, but they account for the spouse in calculating the economic incentives. Pension benefits are different if the individual is married compared to if he is single. Furthermore, Palme and Svensson account for the probability of survival for both of the spouses and the survivor's benefits.⁴³ In the models, Palme and Svensson also control for the lifetime earnings of the spouse (as well as of the individual itself), its square and the net social security wealth of the spouse. All of these variables are statistically significant in their models. So, in Sweden, both the lifetime earnings of the spouse and the social security wealth of the spouse increase the retirement propensity of the other spouse.

In the view of the earlier literature, Palme and Svensson control for the cross-spousal economic effects. Yet their model does not account for the complementarity of leisure, or the correlation between the unobservables. It could be argued that an indicator of the spousal labour market status might be a control for the complementarity of leisure.⁴⁴ Correlation between the unobservables would require some kind of a bivariate structure to the model and this is harder to implement in traditional models.

6. Demand side

It is even more difficult to incorporate the demand side into traditional retirement models. Retirement models tend to be based on the utility maximisation of an individual. Moreover,

⁴³ It is, however, not clear what is done (or what could be done, for that matter) in the calculations of the option value. To be theoretically consistent, one would need to account also for the spouse's wages (as well as for the structural parameters).

⁴⁴ Undoubtedly spouse's labour market status is an unsatisfactory control in the case of simultaneous decision-making, but arguably it is better than nothing.

firm level data and information on the work conditions have been in short supply.⁴⁵

Therefore, most retirement models leave out the demand side altogether, or just use a control variable for the local unemployment rates.

If labour demand controls were available in the data sets, they could well be used in the models, although the models focus on the supply side. Hutchens (2001) notes that flexibility of the work arrangements can be more important for older workers.⁴⁶ In the US, it seems that flexible work arrangements are more common in specific industries (health, education and services) as well as in small firms. Therefore controls for occupation, industry, and firm size can capture some of the demand side effects. Yet these controls are likely to have a direct effect on retirement that might not be attributable to labour demand only. Hence, they are unlikely to be sufficient control for the whole of the labour demand.

The most credible labour demand side story on retirement so far is that of Lazear (1979, 1986). In his view employment relationships are based on long-term, implicit contracts. Accordingly, compensation over the work life equals the expected marginal product over the work life in expected present value terms. Wage profiles by age are steeper than the productivity profiles. Consequently, the pay at the end of the career is higher than the productivity, and firms have an interest to terminate employment contracts at this point, while the workers have an interest to stay. Certain institutional structures, such as mandatory retirement, non-actuarial pension arrangements, help to overcome these contradicting incentives. Ideally, one would then like to control for the difference in productivity and the cost of labour per time unit (which is not equal to the wage rate). Productivity measures on individuals, however, are rare.

Existing productivity controls tend to be occupation or task specific. Employer-employee data allow formation of firm specific controls. It is then possible to create controls for firm specific productivity. Additionally, a number of other firm specific variables can affect retirement. Some examples are a change in firm's sales, experience-rating of the firm, full cost of the

⁴⁵ Information on the work conditions is rare in administrative data sets. Survey data, such as the HRS, include some information on the work place characteristics. It has, however, been less used. Some exceptions are Hurd and McGarry (1993) and Friedberg (2001).

⁴⁶ He is therefore interested in the extent the aged workers can re-negotiate their work arrangements and the employer willingness to provide part-time work opportunities.

specific type of labour, labour share of the value added of the firm, R&D intensity of work⁴⁷, and share of exports. (See Huttunen (2002) and Hakola and Uusitalo in Hakola (2002).)

Finally, there are a number of papers trying to estimate the effect of the cohort size on the relative wages of a specific cohort. As a baby boom generation approaches retirement in most industrialized countries, the size of different cohorts and their possible substitutability (between each other and with capital) is an issue that can affect the demand for older workers. Large cohorts can depress the wages of the cohort within the same skill cluster, and increase their demand and labour market opportunities. If a particular skill-age cohort is substitutable with another skill-age cohort, this effect is dissipated across several cohorts. Hence, the expected effect of the cohort size on the wages is not easy to determine and the results differ greatly between different studies.

7. Modelling issues

Decisions about labour force participation of the aged resemble other labour force participation decisions. Therefore standard structural or reduced form (discrete choice models or duration models) labour market models provide a good start in choosing the model to analyse retirement.

Labour market behaviour of the aged is also a process that has specific features that might not be as important for other age groups. First, withdrawal from the labour market can take place through a number of routes. Second, decisions can be made in a certain age interval. Third, retirement tends to be an absorbing state, as reverse transitions out of retirement are rather rare. Fourth, multiple transitions might be an issue also for the aged. And fifth, decisions are sometimes made with uncertainty.

There exists a multitude of exit routes that are available to an old worker. Within certain age limits, partial and full-time retirement options are available for all individuals. Additionally, unemployment and health related social security benefits (disability pension and sickness

⁴⁷ Skill biased technological change is presumed to affect the demand for different skill groups differently. Some of the skills can be age specific. Two competing/overlapping stories explaining the change in the demand structure of labour, rely on technical progress (measured by R&D intensity) and internationalisation (measured by the share of exports). See Huttunen (2002).

insurance) have been available for a large number of individuals. If the extent of the use of the different schemes matters, but the schemes are not separated in the estimation, the impact of the explanatory variables can also be confounded. For example, Hakola (2002) showed that reduced work capacity increased the probability of taking the disability pension, but reduced the probability of falling into unemployment.

Traditionally, retirement has also equalled final withdrawal from the labour force. Even if there is a tendency today to reform the pension systems in such a way that encourages work while retired or facilitates return to work from retirement⁴⁸, most retirement decisions are still absorbing. Before the final retirement, however, there can be multiple spells of non-employment. Unemployment of the aged has increased in the 1990s, and this can occur in several spells, being interrupted by spells of employment or of active labour market programmes. Similarly, transitions to sick allowance are assumed to be temporary absences from work. They may or may not end in employment before the disability or the old age pension.

Finally, retirement decisions have to be made in an uncertain environment. Even if aged workers in Sweden are shielded by special labour market protection (last-in-first-out principle), these regulations have been relaxed in recent years and employers have found ways to go around the employment protection legislation (OECD, 2002). Uncertainty is also an inherent feature of the early retirement options, as health related programmes are subject to an apply-award/reject –procedure.⁴⁹ Finally, in old age, there is an increased chance to suffer from unforeseen health shocks or loss of the spouse.

All structural and reduced-form models work well in discrete time. The assumption of multiple retirement channels, however, can be more problematic. Reduced form models (multinomial logit and competing risks duration model) can effectively deal with a multitude of end states, but they generally, with some exceptions, make a problematic assumption of independent channel choices. Due to the complexity in estimation, structural models so far have limited the retirement decision to a yes or no option.

⁴⁸ See, for example, the disability pension provisions in Sweden since 2000.

⁴⁹ Uncertainty in the disability benefit schemes in the US is more important as the applicants have to quit work before they can apply for the scheme. This is not so in Sweden.

The fact that retirement tends to be absorbing favours the duration model and makes the solution to a structural model more tractable (finite horizon model). Multiple transitions can, at least in theory, be handled in a multi-spell duration model.⁵⁰ Different types of uncertainty and big reforms in the pension system, in contrast, can properly be handled only in structural models.

The assumption of independence of the channels is rather prevalent in multi-channel models. In a multinomial logit model, this is the independence of the irrelevant alternatives assumption (IIA), whereas in the competing risks duration model, it is similarly assumed that the probability of an exit through one channel is independent of the existence of the alternative. Nested logit models relax the IIA assumption of the multinomial logit model, and allow for the correlation of the unobservables between different exit channels. Similarly, competing risks duration models with correlated unobserved heterogeneity terms between different channels have been developed (For an application see Jensen et al. (1999)). These models, however, have so far been rather hard to implement, and results of existing applications have been unstable.

The assumption of independence between different exit channels can be partially relaxed through additional explanatory variables. Hakola and Lindeboom in Hakola (2002) use indicators for whether an alternative exit channel is available in order to control for the potential channel substitution. So when considering the unemployment hazard, they included an eligibility indicator for the individual early retirement scheme (a disability pension scheme in Finland that has a minimum age limit). Other possibilities are to include incentive variables for different retirement alternatives (if they differ for the same individual), indicators for which of the alternatives yields the maximum retirement benefit, or times-to-the-eligibility-for-the-alternative-channel indicators.⁵¹

As the main purpose of the models is to predict behaviour, the main selection criterion of the models should be their ability to predict retirement. Several papers (Lumsdaine et al., 1990, Spataro, 2002 and Butler et al., 2002) have tried to assess and compare the predictive

⁵⁰ If duration is defined as time at work after the age of 55, multi-spells would then refer to work spells after this age. Even if this a possible construct, it seems somewhat unnatural as duration in more general labour market models is defined through spells of unemployment.

⁵¹ This and the eligibility to the alternative channel indicator require a change in the eligibility criteria in order to be identified from the pure age effect.

behaviour of structural and reduced form models on retirement. Comparisons between the predictive capabilities of the models have been made both in- and out-sample.

Lumsdaine et al. (1990) consider the in-sample and out-of-sample predictive power of three models, namely, a dynamic programming model, an option value model and a probit model. They argue rather convincingly that the predictive power of the dynamic programming and option value models is much better than the predictive power of a much simpler, reduced form probit model. The probit model can match the performance of the other two models only within sample if age dummies are included. Yet even this specification performs poorly when tested on a window plan.⁵² Lumsdaine et al. (1990), however, use data on one big company only, and assess the effect of one specific pension scheme without any knowledge on the successive labour market status. Amy Redher Harris (2001) tried to apply the option value model to the entire Health and Retirement Survey. The performance of the option value model was considerably more disappointing in the data set on the whole population than in the firm specific data set of Lumsdaine et al. (1990). As neither the Lumsdaine et al. (1990) model nor the Redher Harris (2001) model included explanatory variables, it is possible (and even likely) that the model worked better in a more homogeneous sample.⁵³

Butler et al. (2002) managed to include a number of explanatory variables in their structural models of disability pension. (They control for education, married, black, accommodation by the employer, white collar and some health conditions.) They compared the applying decision of SSDI (Social Security Disability Insurance in the US) after the individuals had fallen ill. The predictive capability of an option value model, a dynamic programming model and a duration model was assessed both in- and out-of-sample. Predicted application rates were underestimated in the first period in both of the structural models, and overestimated consequently. The duration model predicted the first period relatively well, but overestimated the application rates in all other periods. Butler et al. (2002) compared the fitted distributions of the estimated models to the original distribution of the data, and calculated the multinomial likelihood ratio test based on discrete periods. Using this test statistic, they found that the option value model provided best predictions both in- and out-of-sample. Even if the

⁵² Window plan is an unexpected change in the pension regulations that allows earlier withdrawal of the pension benefits than stipulated in the original rules. Window plans have been used to scale down the labour force of a company in recession.

⁵³ Lumsdaine et al. (1990) worked with a sample of sales people from one firm only. They were all facing the same pension scheme, were likely to have similar education levels, and their distribution in wages was almost certainly smaller than the distribution in the whole population.

difference between the dynamic programming model and the option value model seemed small, like Lumsdaine et al. (1990) Butler et al (2002) also preferred the computationally simpler option value model.

Spataro (2002) is the only one who seems to find a reduced-form model (duration model in this case) preferable to the structural option value model. He, however, based this claim on the log-likelihood values of the respective models. As Butler et al. (2002) noted there are better ways to compare non-nested hypothesis than to compare the log-likelihood values. Specially, because Spataro's option value model had no explanatory variables, unlike the duration model that controlled for, for example, different aspects of the family and the regional unemployment rates.⁵⁴ Finally, Butler et al. (2002) also noted that the duration model fits the data well in the first period, because it imposes less assumptions than the structural model, but the duration models are suspect when one wants to make policy simulations of substantial changes in the programme rules. Hence, structural models would clearly be preferable to the reduced-form if it were not for the complexity in their application.

7. Conclusion

This paper provided an overview of issues to be considered when modelling retirement. These issues were divided into six sub-categories, and they were all treated in turn. The categories referred to 1) defining retirement, 2) different ways out of the labour market, 3) main incentives for leaving the labour market (economic incentives and health), 4) dependence between spouses, 5) demand side issues, and 6) modelling issues.

In the first chapter it was pointed out that the definition of retirement is far from being clear-cut. Decisions on the hours of work and the claim on benefits are separate, even if related. It is possible to delay pension claiming even when the individual stops working, and it is also possible to claim pensions while still working. Earlier work on Sweden (Palme and Svensson, 1997) has defined retirement with an absolute limit on labour earnings (less than one basic amount).

⁵⁴ Spataro estimates the models separately for private and public sector workers.

Retirement has long ceased to be a simple decision to withdraw from the labour markets because of old age. The second chapter undertook issues that are specific to the withdrawals because of old age, disability or the unemployment at the advanced age. Old-age pension rules are generally well defined in law, so modelling the old age retirement tends to be rather straightforward. Yet when retirement starts with one of the health related social security schemes (sick allowance or the disability pension) or with unemployment, the assessment of the counterfactual is far more complicated. Moreover, disability pensions introduce extra uncertainty as not all applicants are awarded disability benefits.

The effect of the economic incentives has probably been the most studied aspect of the retirement behaviour. In chapter four, I defined a number of different economic incentives. Simple definitions consist of one period comparisons between work-related or retirement-related financial compensations, whereas more complex definitions are based on the whole life cycle of the individual. The more complex incentive definitions try to model more carefully the real incentives faced by individuals, but also require laborious wage imputations.⁵⁵

Economic theory tends to take it as given that people are forward-looking. Therefore, the complex definitions of the incentives would seem preferable at the first sight. In practise, however, it is unclear whether people base their labour market decisions on long-term considerations, or merely look at the short-term replacement rates. Researchers have only limited tools to judge the “correct” definitions on incentives. Some light on this issue can be obtained from surveys that ask people on their decision-making, from traditional econometric analysis (the variable with the highest explanatory power is likely to be the most “correct”), or from experiments – whether natural or laboratory-like. As different people, however, have different ways to make decisions, it is probably the best to use alternative definitions to support one another.

In order to assess the effect of the economic incentives it is important to control for the health of an individual. Yet the true work ability of an individual is very hard to measure. Imprecise measures give rise to numerous types of biases. If the health is imperfectly measured and the health is correlated with any other explanatory variable (such as economic incentives), the

⁵⁵ These wage imputations are also hard to identify properly.

problems in measuring health also contaminate the coefficients of the other explanatory variables.

Retirement research has made some headway on spouse's effect on the timing of retirement. This was reviewed in chapter 5. Spouse is likely to have an effect on the preferences for leisure as well as on the economic incentives. As people often find spouses that are alike, spousal papers also talk about assortative mating and correlation of the unobservables between couples.

Advances on the labour demand side effects on retirement have been scarce. Lazear's model of a mandatory retirement provides a plausible labour demand story. Tying up this story with the existing body of labour supply retirement models has, however, so far proved problematic. Supply side models on retirement and the relatively few attempts to account for the demand side have lived separate lives.

The final chapter dealt with modelling issues. Standard labour market models provide a good starting point for the retirement modelling. Both structural and reduced-form models have been extensively used in the literature. Specific features of retirement might favour one type of a model over another type. For example, retirement tends to be an absorbing state, and this has led to an extensive use of the duration model. Better predictive capability of the structural models tends to overpower the reduced-form models, and the latter should not be used to predict behavioural changes after comprehensive pension reforms. If it were not for their complexity in estimations and the difficulties to incorporate explanatory variables in the models, structural models should always be used when trying to infer future behaviour of the individuals.

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