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Working Paper

Time use and options for retirement in Europe

ETLA Discussion Papers, No. 868

Provided in Cooperation with:

The Research Institute of the Finnish Economy (ETLA), Helsinki

Suggested Citation: Piekkola, Hannu; Harmoinen, Liisa (2003) : Time use and options for retirement in Europe, ETLA Discussion Papers, No. 868, The Research Institute of the Finnish Economy (ETLA), Helsinki

This Version is available at:

<https://hdl.handle.net/10419/63972>

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Keskusteluaiheita – Discussion papers

No. 868

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TIME USE AND OPTIONS FOR RETIREMENT IN EUROPE** ***

First version: 25.09.2003

This version: 19.05.2006

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** We would like to thank Julie Mestdagh, Frank Pellikaan and Erica Schultz for comments on an earlier draft and Kimberley Fischer for delivering to us the international time use data. The usual disclaimer applies.

*** This paper is part of the "Ageing, Health and Retirement" AGIR Project financed by the EU fifth framework programme. A project report Piekkola and Leijola (2003) is published in www.enepri.org.

PIEKKOLA, Hannu – HARMOINEN, Liisa, TIME USE AND OPTIONS FOR RETIREMENT IN EUROPE. Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2006, 32 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; No. 868).

ABSTRACT: This paper examines the incentive effects of market and household work on retirement. This is accomplished by documenting the time use in market and household work in selected European countries. The assignment of an economic value to household work assumes substitutability of market and household work of some degree. With continuous lifetime patterns, household work may also replace market work after retirement. We construct replacement rates and option values that include the value of household work for 7 European countries. It is shown that the inclusion of household work in calculations on incentives makes the prospect of retiring more attractive, and that the calculation results correlate with actual retirement ages in Europe. Replacement rates are close to or exceed 100% when household work is accounted for. For men the increase in household work after withdrawing from the labour market is larger in relative terms (double on average). Therefore the effect of accounting for household work in the financial incentive to retire is greater for men.

JEL-codes: J26, J14, J22, J11

Keywords 1: Retirement, Option value, Time use, Leisure

Keywords 2: Household work, Option Value

1 INTRODUCTION

Europe is ageing and European inhabitants live longer and retire earlier than in other developed countries. OECD (2003a) shows that for continuing to work, the implicit tax rates embedded in the old-age pension and early retirement schemes are high in most Continental European Countries, but less so in the English-speaking and Nordic countries and that these influence retirement behaviour. OECD (2001a) finds that in most of the 9 countries examined in this study, the standard of living is the same for the employed and the non-employed when work-related expenditures and the popularity of owner-occupied housing are taken into account. On the other hand, the report suggests that retired people would prefer to continue to work if appropriate jobs were available. A natural policy response to the problem of funding social security in the future is not only to create new jobs but also to use financial tools to postpone retirement. In fact, the European Community member states are committed to raising the retirement age (European Commission 2002). Concerns have been expressed that the increasing wealth of the population is increasing the demand for early retirement (OECD 2000). The baby-boom generation, who are nearing retirement age at present, may also have different preferences for leisure: work life is no longer considered as a value in itself or as a necessary element of active ageing. In Finland those who choose voluntary early retirement generally enjoy financial, mental and physical wellbeing (Gould and Saurama 2003, 30). Gustman and Steinmeier (2002) estimate with US data that about two-fifths of those workers retiring now at 62 years of age would not defer their retirement to 64 even if it were the pensionable age.

Time-use patterns covering retirement decisions are complex. Time use can be categorised into market work, household work, personal needs (sleeping) and leisure. It is shown that household work substantially increases after early retirement. Hence, the time previously allocated to market work is used for other economically beneficial purposes, and this should be reflected in the calculations on financial retirement incentives. We elaborate three methods on how household work can be integrated into economic incentives. The first clear alternative is to consider retirement as a substitute for market work: thus these two time-use options should be added together in a consistent manner. Alternatively, with continuous time-use patterns, household work simply replaces market work after retirement. Finally, our analysis may be less relevant if household work is perceived as comparable to only active use of leisure time.

The economic value of household work is included in two measures of the financial retirement incentives presented in this paper. *The replacement rate* (RR) expresses as a percentage an individual's net pension that accrues from his net income from labour. RR is corrected for the value of household work by accounting for its different quantities during periods of employment and retirement. Traditional figures for RR are shown to be well below those that reflect the value of household work. The replacement rates including the value of household work are close to 100% in most of the countries considered: Belgium, Denmark, Finland, Germany, the Netherlands, Portugal and the United Kingdom. To calculate the *option values*, we use replacement rates comparable to Stock and Wise (1990) and more recently to Gruber and Wise (1999). These take into account both the annual pension accrual and the expected duration of receiving these benefits.

Section 2 considers the theoretical background. Section 3 shows the data, methods and time use at age 45-64. Section 4 examines the main results and Section 5 concludes the paper.

2. Theoretical background

2.1 Time Use and Option Values for Retirement

Gary S. Becker first presented an economic theory of the allocation of time (1965). It treats households as active producers of non-marketable commodities such as different leisure activities and household services. It is assumed that an individual's decision on the mix of market and non-market goods to be consumed lays the framework for the allocation of time between work, leisure and home production. Let wE = the (net of tax) wage income with wages w and market work time E , $PW_t \equiv P(a, w_{a-1} E_{a-1})$ = the level of pension available at age t on retirement at age a , depending on wages w and duration of market work time E before retirement. Pension wealth is the lump-sum equivalent of the total pension income a worker can expect to receive, and takes into account pension level, retirement age and life expectancy in each respective country. In time use, let L = the hours of leisure, H = the hours of household work. The time endowment is normalised to unity, so that labour supply is $E \equiv 1 - L - H$.

First, it is useful to consider the decisions concerning the optimal leisure L and household work H . Wages can have an effect on the pension wealth PW , while the retirement age is fixed. Household decisions today relate to respective time use after retirement through μ_H . If positive, it shows the fixed costs so that household work before retirement is linked to household work after retirement. This is the case with gardening, for instance, as a garden requires upkeep before and after retirement. Household work may also require skills that need constant investment. If you have not learnt to clean the house properly during your work career, you may not be able to do it satisfactorily after retirement either. If μ_H is negative, household work is qualitatively different before and after retirement. An example is post-retirement household work that becomes a substitute for market work in order to give some meaning to the day. Individuals, when working, might consider household work to be an extra obligation. This gives (suppressing time indicator and ignoring time preference)

$$(1) \quad V = u(x(w(1-L-H)+I), L, H, PW(w), \mu_H H),$$

where x = the quantity of goods consumed. Most of the studies starting from Gronau (1977) and Solberg and Wong (1991) model household production $Z(H, x_z)$, which combines auxiliary goods x_z with home production time, and assume this as a substitute for consumption good $x(w(1-L-H)+I)$. Household good production rather than household work time enters the utility function, which as such implies that leisure time and household work time cannot be aggregated.

$$(1') \quad V = u\{x(w(1-L-H)+I) + Z(H, x_z), L, PW(w)\},$$

It is easy to see from (1') that optimal household work supply is such that $\partial Z / \partial H = \partial Z / \partial x_z w$, where $\partial Z / \partial x_z = 1$. Household work time should be dependent on the return to market work w only, and not on the allocation of time to other activities. Graham and Green (1984) and Kerkhofs and Kooreman (2003) further include here additional joint leisure $g(H)$, $g'(H) \leq 1$, which modifies the optimal marginal productivity of household work to $\partial Z / \partial H = w(1 - g'(H))$. Here, it is worthwhile to study the impact of an increase in wages on time use to see the optimal decision making in a more general setting. The optimal allocation of time between leisure, market work and household work is determined from (1) and budget constraint $x = I + wE$:

$$(2) \quad V_L: -wU_x + U_L = 0 ;$$

$$(3) \quad V_H: -wU_x + U_H + \mu_H U_{\mu H} = 0.$$

Leisure or household work before retirement linked to post-retirement leisure or household work, $\mu_H > 0$, lowers the opportunity cost of household work. This is similar to the household production model, where household work that gives leisure lowers the productivity requirement in household good production. Assuming homothetic preferences $xU_x + LU_L + HU_H + \mu_H HU_{\mu H} = 0$ and $xU_{xx} + LU_{Lx} + HU_{Hx} + \mu_H HU_{\mu Hx} = 0$, the relation between the demand for leisure and wages can be written after some manipulation as (see appendix A for details)

$$(4) \quad \frac{dL}{dw} = L_w^c \left(1 - \frac{(\partial PW / \partial w + wE)U_x}{xU} A \right) ;$$

$$(5) \quad \frac{dH}{dw} = H_w^c \left(1 - \frac{(\partial PW / \partial w + wE)U_x}{xU} A \right) ;$$

$$\text{where } A \equiv \frac{LwU_x}{\sigma_L} + \frac{H(wU_x - \mu_H U_{\mu H})}{\sigma_H} + \frac{\mu_H HU_{\mu H}}{\sigma_{\mu H}} ;$$

$$L_w^c \equiv \Delta^{-1} U_x \{V_{HH} - V_{LH}\} < 0, \quad H_w^c \equiv \Delta^{-1} U_x \{V_{LL} - V_{HL}\} < 0; \quad \Delta \equiv V_{LL}V_{HH} - V_{LH}V_{HL} > 0,$$

where V_{HH}, V_{LL}, V_{LH} and V_{HL} are the partial derivatives of the first order conditions V_H and V_L with respect to H and L . Here, σ_L is the elasticity of substitution between leisure and market work along an indifference curve, if household work is held as fixed. The derivation uses Hicks proof that in holding the other decision variables as fixed and in a constant-returns-to-scale function, the elasticity of substitution between consumption and leisure may be written in the simplified form $\sigma_L = U_x U_L / U_{xL} U$. For household work and time allocation after retirement this is $\sigma_H = U_x U_H / U_{xH} U$, $\sigma_{\mu H} = U_x U_{\mu H} / U_{x\mu H} U$. The term A is positive under the natural assumption that the second derivative of utility from consumption is negative. This means that in (4) and (5) the substitution and income effects are of the opposite sign, but the relative strength of these depends on the household work and leisure substitution.

Household work during retirement may provide three functions. First, it is ‘work’ that needs to be done and men and women share these necessary chores. Household work, in the extreme,

may be perceived to be similar to market work. Second, household work provides structure and purpose to the day, which might otherwise be passive and beyond the control of the person. After retirement, household work becomes a substitution for the earlier market work, which may or may not have the case when the individual was still actively employed. Third, some household work is enjoyable leisure – cooking, gardening and is thus comparable to active leisure. We consider each alternative interpretation in turn.

Household and Market Work as Substitutes

In the household production model by Gronau (1977) household work produces a good that is a perfect substitute for a composite good that may be purchased on the market. This takes us back to the traditional model (1'), where wages alone determine the optimal household work supply. Becker (1981) proposes a theory on the division of labour based on comparative advantage to explain why men 'specialise' in market work and women in household work. Becker's notion is based on the idea of partnership and concentrates on the quantities of 'total work', while other time, including leisure, is used to preserve the capital necessary for market and household work. Men have the comparative advantage in market work and/or the hours spent in household work are more valuable for women.¹ In the extreme case, individuals can maintain the desired amount of leisure through specialization $\sigma_L = \infty$ and (5) simplifies to

$$(6) \quad \frac{dH}{dw} = H_w^c \left(1 - \frac{H(\partial PW / \partial w + wE)U_x}{xU} \left[\frac{wU_x - \mu_H U_{\mu H}}{\sigma_H} + \frac{\mu_H U_{\mu H}}{\sigma_{\mu H}} \right] \right)$$

Traditional competitive markets imply that high-income earners specialise in market work when the substitution effect H_w^c is large and is not offset by income effects, i.e. σ_H is large, indicating low substitution between household work and leisure. (We ignore throughout the analysis the potentially large effects of pension wealth through $\partial PW / \partial w$.) If an individual is time constrained and the level of household work after retirement is based on earlier household production, $\mu_H > 0$, low substitution in the post-retirement period between

¹ Bittman and Wajcman (1999) argue that specialisation is not a sign of discrimination against women, as the leisure activities of the spouses can still be the same.

household work and leisure $\sigma_H < \sigma_{\mu H}$ also lowers the relative significance of the income effect. These are the cases where we expect the change in the household supply to be most appropriate to include in the replacement rates.

Household Work gives a Meaning to the Day of Retired

Household work can also provide meaning to the day, especially after retirement when market work is no more done. Many people consider household work to give purpose to the day and more pronounced so after retirement. An OECD report discusses the tendency of people to continue to utilise their leisure time as they had done in the past (OECD 2000). We can thus assume an insignificant effect on leisure (L_w^c is close to zero) and consider the alternative where market work and the wage level have little effect on current household work, since the substitution effect H_w^c is close to zero. The alternative is that the income effects in (6) are high enough to offset the substitution effect. This is true if $\sigma_H = U_x U_H / U_{xH} U$ is small and $\sigma_H < \sigma_{\mu H}$ for $\mu_H = 0$ and $\sigma_H > \sigma_{\mu H}$ for large and negative μ_H . The latter states that the retirement-period household work is a strong substitute for leisure and the linkage between pre- and post-retirement household work is negative. The more one is already engaged in household work when employed the fewer are the household work opportunities after retirement.

Household Work as Active Leisure

Graham and Green (1984) show empirical evidence that home production and leisure should be at least partly considered as joint activities. The dichotomy between household production and leisure decisions is still maintained, since the substitutability between household work and leisure is not explicit. The third approach is rather to consider household work as valuable time similar to active leisure throughout the individual's lifetime. Household work can then be considered as one form of leisure. Thus the desire to retire is associated with the high level of existing household work, rather than changes in it. Since active leisure and household work are similar activities, after retirement an individual could also increase the time devoted to active leisure instead of household work. It would, therefore, be rather appropriate to give an economic value to the total household work and leisure, i.e. on the combined active non-market time.

In the analysis below, an economic value is assigned to household work. In order to determine the optimal retirement age, we assume a simple utility function, namely that the utility is equal to income: $u_1(x, L, H) = wL + w_H H$ and $u_2[kP(a, wL_{a-1}), H] = kP(a, w_{a-1}L_{a-1}) + w_H H$, where w_H is the value of household work (assumed to be the same for retired and non-retired), k is the value of total non-market time gained through retirement. The measures of the value of household work have varied according to the production or welfare orientation of the system (Juster and Stafford 1991). The two alternative measures for assigning a value to household work are the cost of buying the service from the market or choosing to assign a monetary value to the time based on the financial gain achieved by doing the job oneself. Assuming household work and market work to be close substitutes, or the specialisation of spouses to be important, it may be more appropriate to use the cost of buying the service from the market. In Becker's terminology, this indicates the marginal utility of capital invested in the production of home goods. This also implies that the value of household work is relatively lower for high-income individuals. In the alternative interpretation that household work gives a meaning to the day of retired, it could also have been appropriate to give an economic value only to the household activity after retirement or to measure additional household work gained in retirement period. Here, the value of household work can also be independent of wages. It is the habitual daily content of some quantity of market and household work that counts. If, instead, household work is compared to active leisure time, then market work is time away from this valuable activity. It is the level of current household work, assessed at the net wage level that can give an indication of high retirement propensity. Without further knowledge on how to value active leisure such as hobbies, sports and cultural life, we are, however, hesitant to proceed on these lines and give an economic value only to household work and not to active leisure (when these are close substitutes).

Previous OECD research shows that retirement decisions can be strongly influenced by fiscal incentives (Blöndal and Scarpetta, 1998, OECD, 2003a), which can be separated into two components. The first is the replacement rate — i.e. the proportion of the pre-retirement income that will be received as pension. The higher the replacement rate, the greater the incentive to retire. The second component is the change in pension wealth by working an additional year and thereby contributing to the scheme for the year while forgoing pension benefits for that period. If the pension wealth remains constant in spite of the additional year of employment, then the system is neutral, but if it falls, then the system imposes an implicit tax on working. Let T = the expected age of death at age i , s = the current period, a = the period of retirement, τ = the discount factor (set at 0.03), and z = wage growth. We assume a

steady annual wage growth z at three percent (thus $\tau - z = 0$). We assume that k is economically insignificant and receives the value of one. Using normalised values, the lifetime utility function V_s at time s can be expressed as follows:

$$(7) \quad v_s(a) = \sum_{t=s}^{a-1} (1 + \tau - z)^{-(t-s)} + pw_t(a) ,$$

where $pw_s^1(a) = \sum_{t=a}^T (1 + \tau)^{-(t-s)} nrr$ is pension wealth and $nrr = \frac{P(a, w_{a-1} L_{a-1}) + w_H H(a)}{w_{a-1} L_{a-1} + w_H H_{a-1}}$ is the

replacement rate, where $P(a, w_{a-1} L_{a-1})$ represents pensions. The first term is the period-specific utility for continuing employment divided by the value of market and household work. Second term is the normalised periodic utility after retirement. In each period the replacement rate expresses the ratio of the individual's pension and value of household work in retirement to his net earnings and household work if employed. Thus, it indicates in percentage terms the level of the person's income in retirement compared to his income if he continued to work. This receives a value of zero until the minimum entitlement age. The wealth accrual relating to pension wealth is

$$(8) \quad \Delta pw(a) = pw_{t+1}(a) - pw_t(a) .$$

Following Stock and Wise (1990), the option value for an individual is the difference between the expected lifetime utility if he defers his retirement decision until the optimal retirement age and the expected value if he were to retire immediately. If the individual retires immediately, he loses some years' income and higher pension benefits. If he retires later, he loses the forgone leisure time and household work. The option value, giving the opportunity cost of retiring today, is

$$(9) \quad OV_t(a^*) = E_t[v(a^*)] - v_t(t) ,$$

where E is the expectation operator and a^* is the optimal age of retirement if the individual decides not to retire at time t . Optimal retirement should occur before the age when the option value is no longer positive. Next, we introduce taxes so that the income during employment at an hourly after-tax wage rate is $w \equiv W(1 - q)$, where W = earnings per unit of work and q = the tax wedge:

$$(10) \quad q = \frac{(1-\alpha)y + m + (1-m)c/(1+c)}{1 + (1-\alpha)y} .$$

Standard tax wedge calculations, inclusive of all taxes, and, assuming that share α of the employer's social security payments is also paid by individuals in the form of lower wages, are applied in this analysis. In the tax wedge formulas, y = employer's social security tax, m = average wage tax rate, c = average consumption tax rate based on pre-tax price of consumption. In contrast to the approach used in Blöndall and Scarpetta (1998), we consider the social security contributions of the employed individuals to affect gross wages in such a way that all taxes are borne by the individual. Thus we have no separate assessment of the present value of future social security payments, since they are already reflected in the level of wages. The most important consequence of this is that social security payments by employers affect not only the cost of employment but also accrued pensions (based on the gross wage level before retirement).

In the empirical analysis different pension systems and the yearly accruals of pensions are accounted for, as are tax treatment and social security payments regarding both wage and pension income. Pension accrual figures for each country are obtained from the statistics service of the United States Social Security Administration (SSA 1999). Descriptions by OECD of the tax systems of its member countries are utilised to account for the effects of taxes on wage and pension income (OECD 2001b). Detailed descriptions of tax treatments and pension accruals are available on request from authors.

3. Data and Time Use of 45-64 Year-Olds

We apply original time-use surveys used to construct the Multinational Time Use Study (MTUS) database (for documentation, see Gauthier et al. 2002). The data have been gathered by administering time-use diary surveys and linking the results to background information on the respondents. We utilize complete data from five countries (Denmark 1987 survey, Finland 2000, Germany 1991, the Netherlands 1995, and the UK 1999), and cross tabulations by employment status, gender, and time-use categories from different sources in Belgium and Portugal.

National statistical offices, or corresponding organisations, have conducted the surveys. For the most part, the respondents to the surveys have kept records of their activities during the day in ten- or fifteen-minute intervals. Individuals usually kept the diary for one weekday and for one weekend day. Weights to correct for the weekday as well as sampling weights are provided with the data and applied in the analyses. From the data sets, individuals aged between 45 and 64 years were selected for the analysis, because they are considered to be the group relevant for examining retirement decisions. The sample sizes vary between 573 diary days for Great Britain and 3 643 diary days in the case of Germany.

The time used for household work has been calculated separately for the employed and the non-employed at 50-64 years of age, with the difference between the two groups serving as a proxy for the change in time use after retirement. Among the older workers, the household work supply stays relatively similar from one age cohort to another, with the major distinction being the employment status. We do not account for the reduction in household work at the very end of one's lifespan. According to evidence by Piekkola (2006) household work stays at the same level from the age of 65 to 74. The non-employed group includes both the unemployed and those taking care of their own household, i.e. individuals not necessarily retired. It would be difficult in a cross-national comparison to have a homogeneous definition of the early retired, since most of the older unemployed workers are in many countries in an unemployment pension pipeline. There is also little re-entry into employment. (For evidence on the production of household work independent of age cohorts in Finland, see Piekkola, 2006, for evidence on employment re-entry in Finland, Belgium and Germany, see Piekkola and Deschryvere, 2005).

In this study, *household work* is defined as the activity that is performed without pay, and which is related to the upkeep of the household and the provision of its members. It includes cooking, cleaning, laundry, childcare, gardening, shopping, maintenance-related odd jobs, and related travel. Shopping and gardening could also be considered as leisure activities, constituting on average around 22% of total household work. We ignore neighbourhood help. In Huovinen and Piekkola (2002), retired men appear to spend more time in voluntary or neighbourhood help related work. We use the similarly broad concept for time in market work. This includes 10% of total working time as travel time to and from work, as well as time for any breaks or errands during the workday.

The economic value of an hour devoted to household work is the net hourly wage for similar type of work in each country. Public sector involvement in providing household help to the elderly or handicapped differs substantially across countries, and hiring private help is more common in some countries. Therefore we apply either a wage on household help or the minimum wage (Portugal), whichever is more illustrative of the system.

Table 1: Wage rates for household work (euro per hour) in each country.

	Belgium	France	Finland	Germany	Netherlands	Portugal	UK
Wage cost to employer	9.0	11.1	12.8	9.6	7.4	2.1	6.3
Gross wage	7.1	8.4	9.8	8.0	7.0	1.9	6.3
Net wage	3.0	6.8	7.8	6.4	5.9	1.5	6.3

In France if the employer constitutes a household, a tax deduction equivalent to approximately equal to 3 € per hour can be made, while the employee can have a premium or around 0.3 (in order to compensate for the negative utility of working because he is close to the welfare eligibility limit). In the Netherlands employer receives a wage cost subsidy of 0.89 € (7.43 - 1.32 + 0.89 = 7.00). In Germany the figures correspond to a full-time worker. For the UK calculations are based on an individual who works 20 hours per week and 48 weeks per year and that they have no children under 16 years living in the same household, which disqualifies them from the Working Families Tax Credit. It is also assumed that the person has no other income apart from this work, and thus represents the lower quartile of the pay scale for part-time female workers found in the New Earnings Survey for 2000.

We evaluate the replacement rate as the average of three different income levels. These levels are derived from OECD's statistical perception of the average production worker (APW): individuals earning APW wages are fulltime production workers in the manufacturing sector whose earnings represent the average for such employees in the economy (OECD 2001). Here the manufacturing worker is considered to represent the middle-income earner. A worker with higher income is considered to earn 4/3 of the APW wages while a low-income worker earns 2/3 of the APW wage. The income of women is corrected for their lower supply of market work in all the countries, and they are assigned the corresponding share of the three wage levels. Female working hours, and thus their incomes, are on average 23% lower than men's. Tables 4 and 5 also report the average annual earnings and value of household work once the average household work of the employed and non-employed has been taken into account. Life expectancy by gender is fixed at the expected values in each country at 55 years of age (United Nations 1995).

Table 2, based on the time-use data, presents a breakdown, of the hours of market work and total work (including household work) per week.

Table 2: Total Work by Gender and Employment Status, 45-64 year-olds (hours per week).

	Market work		Total work			
	Employed		Employed		Non-employed	
	Male	Female	Male	Female	Male	Female
Belgium	35.4	30.0	42.9	41.3	23.3	37.6
Denmark	35.4	29.1	46.4	44.9	23.1	25.0
Finland	38.5	30.0	54.8	56.8	26.5	38.5
Germany	27.8	21.4	44.5	45.0	31.9	39.0
Netherlands	42.1	25.5	53.6	51.5	26.8	36.2
Portugal	44.9	35.8	51.2	63.5	14.9	41.8
United Kingdom	46.9	35.4	60.7	57.5	30.4	34.0
Average	38.7	29.6	50.6	51.5	25.3	36.0

Employed men work on average 9.1 hours a week longer at market work than women. Total work hours, however, are almost equal among the employed men and women, with women supplying 0.9 hours more total work. This lends support to the gender division of work. Also Bittman and Wajcman (1999) find in a cross-section of countries that men and women have similar quantities of total work and leisure time, although the quality of leisure seems to differ. In a Eurostat (2003) comparison of time use in 13 countries, the market work hours are also longer for men while women supply more household work. Eurostat (2003) also finds that among the employed, women in several countries supply more total work than men. For the 45-64 year olds, we find evidence of this only for Finland, Germany and Portugal, and the difference is significant only in Portugal, 12.3 hours. The obvious reason is that children for this age category have already grown up.

Furthermore, there are differences in total work times across the countries: Belgium, Germany and Denmark have the shortest total work hours per week for the employed, while the longest total working hours are among the male workers in Britain and among the female workers in Portugal. Table 3 shows the hours of household work per week.

Table 3: Household work and female share of household work by employment status, 45-64 year-olds

	Employed		Non-employed		Female share %	
	Male	Female	Male	Female	Employed	Non-employed
Belgium	7.5	11.3	23.3	37.6	60.1 %	61.8 %
Denmark	11.0	15.8	19.1	23.0	59.0 %	54.6 %
Finland	16.4	26.8	25.6	38.0	62.1 %	59.7 %
Germany	16.7	23.6	22.7	26.4	58.6 %	53.7 %
Netherlands	11.5	26.0	26.1	35.7	69.3 %	57.8 %
Portugal	6.3	27.7	14.9	41.8	81.4 %	73.7 %
United Kingdom	13.8	22.1	27.0	31.7	61.5 %	54.0 %
Average	11.9	21.9	22.7	33.5	64.6 %	59.3 %

It is seen that in almost all countries, men on average supply 10 hours less household work a week than women. On average, employed men supply 26.8 hours less household work than market work, whereas for employed women the difference is 7.7 hours. For the employed individuals, household work hours are short for men in Belgium and Portugal, but long for the males in Finland and Germany. The most household work is performed by women in Portugal, and the hours in similar tasks are also long for Dutch women. Shortest household work hours for employed women are found in Belgium and Denmark. A similar pattern is seen among the non-employed, but differences among countries and genders are less pronounced. According to Eurostat (2003), for women the hours spent in household work exceed the market work hours in

most European countries. In our data covering older workers, this is true among the employed in only Germany and the Netherlands, and the differences are small (2.2 and 0.5 hours, respectively). The picture is similar in the Eurostat study if one restricts the analysis to employed individuals aged between 45 and 64 and to just the countries included in our study: only employed women living in partnerships in Belgium, the Netherlands and Portugal spend more time in domestic tasks than market work.

Gauthier and Smeeding (2003) find that time use in the early years after retiring is rather similar to the pre-retirement period. Piekkola (2006) and Hamermesh (2006), on the other hand, argue that most of the extra time after withdrawal from the labour market is spent on leisure, a fact that is largely ignored here. Women are found to be less orientated to retire early and, hence, tend to continue with the same daily routine as before. (For Finnish studies, see Elovainio et al., 2001, Gould et al., 1991.) As proposed, continuity of lifetime patterns may also include the substitution of household work for market work after retirement. Non-employed women supply 66% more household work than the employed. For men the respective average figure is even higher 105%, with the exception of Belgium. One explanation for the greater difference for men, as discussed in Section 2, is the specialisation of genders that develops when individuals are still active in the work life.

The continental European countries and Portugal seem to exhibit greater specialisation by women in household work, and by men in market work. In the Scandinavian countries and the UK, work is more equally shared. Based on the Eurostat report, it is evident that more traditional gender roles with respect to work are exhibited in the eastern European countries undergoing economic and political transition, and the specialisation in market work by men and household work by women is more pronounced there than in the countries included in this study. Specialisation becomes more distinct when younger individuals are included. However, the presence of children in the household increases the total working time for both men and women (Eurostat 2003, 7). We also ignore the bias created through specialisation. This leads potentially to overstatement of the increase in household work of men. We simply do not have survey data done on household level from all the countries.

4. Incentives to Retire

Similarly to the base analysis in Blöndall and Scarpetta (1998), retirement income from the second and third pillars of pension systems is omitted. Retirement benefits depend on the legal retirement age, and country-specific early retirement benefit systems such as disability or unemployment pensions are ignored here. The replacement rates for each successive year of potential working time until the official retirement age are calculated from the age 55 onwards assuming the pension rules and taxes in effect in the year 2000. The exception is Finland, where the new pension rules becoming valid from 2005 onwards are applied (but not in the correlations of retirement incentive to actual retirement behaviour later). The benefit level also depends on the length of the contribution period, the rate at which an individual earns his pension through contributions, and the minimum and maximum pension levels. A 55-year old individual is assumed to have been working for 25 years so that replacement rates have not yet reached the upper bounds². The following tables show the replacement rates for men and women, which are simply the net pension income of the retiree versus his net income if continuing to work. Taxes on wages and consumption as well as social security payments (those paid by employers assumed to lower wages) are taken into account following (10). An additional element is the value of household work before and after retirement. Since reliable cross-country data for household work at different income levels are hard to obtain and not used here, we rely on average household work for the employed and the retired separately in each country, and these are not assessed at the three income levels. The replacement rate is also shown before the pensionable age, i.e. at the age when the individual is not yet entitled to pension benefits. Various early retirement pipelines are not considered here, so the replacement rates are usually lower as they only include accumulation of old age pensions. Option values take into account pension wealth from the age of pension eligibility (i.e. the replacement rate is set at zero until pensionable age).

The first column in Tables 4 and 5, captioned *Full*, includes the effects of the value of household work for each country, while the second column, *Partial*, excludes these effects. The last two rows of each table show net earnings and the value of household work according to employment status and market and household work supply. The last columns on the right show the unweighted average of the figures across the countries. Although these are rough approximations of replacements rates, they are sufficient to show the potentially large impacts of household work

² The pension system of each of the seven countries is given in Appendix B. Tax formulas and more detailed description of the pension systems are available upon request from the authors.

on retirement incentives (the pension wealth for each age group and country is shown in Appendix B).

Table 4: Option values and replacement rates for men across the countries, ages 55–70 (thousand €).

Last year of work	Belgium				Denmark				Finland, new				Germany			
	Full		Partial		Full		Partial		Full		Partial		Full		Partial	
	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV
55	94 %	6.8	75 %	8.2	72 %	11.9	48 %	11.8	93 %	12.4	40 %	19.9	93 %	12.4	40 %	19.9
56	94 %	13.6	75 %	16.5	77 %	23.8	48 %	30.4	95 %	24.8	44 %	39.8	95 %	24.8	44 %	39.8
57	94 %	20.4	75 %	24.7	77 %	35.7	48 %	45.7	97 %	37.2	47 %	59.7	97 %	37.2	47 %	59.7
58	94 %	27.2	75 %	33.0	77 %	47.6	48 %	60.9	99 %	49.6	51 %	79.6	99 %	49.6	51 %	79.6
59	94 %	33.9	75 %	41.2	77 %	59.5	48 %	76.1	102 %	62.0	54 %	99.5	102 %	62.0	54 %	99.5
60	94 %	21.1	75 %	33.5	77 %	71.4	48 %	91.3	104 %	74.4	58 %	119.4	104 %	74.4	58 %	119.4
61	94 %	8.8	75 %	26.2	77 %	73.0	48 %	100.4	106 %	86.9	61 %	139.3	106 %	86.9	61 %	139.3
62	94 %	-2.9	75 %	19.4	77 %	74.9	48 %	109.6	108 %	94.5	65 %	170.4	108 %	94.5	65 %	170.4
63	94 %	-14.1	75 %	13.0	77 %	77.0	48 %	118.9	116 %	89.4	78 %	180.5	116 %	89.4	78 %	180.5
64	94 %	-24.7	75 %	7.1	77 %	89.3	48 %	141.3	120 %	83.7	85 %	188.9	120 %	83.7	85 %	188.9
65	94 %	-34.9	75 %	1.5	85 %	91.0	58 %	149.8	124 %	77.1	91 %	195.6	124 %	77.1	91 %	195.6
66	94 %	-44.5	75 %	-3.6	85 %	93.1	58 %	158.4	128 %	69.9	97 %	200.6	128 %	69.9	97 %	200.6
67	94 %	-53.7	75 %	-8.4	85 %	95.4	58 %	167.3	131 %	62.1	103 %	204.1	131 %	62.1	103 %	204.1
68	94 %	-62.4	75 %	-12.7	85 %	98.0	58 %	176.3	135 %	53.6	109 %	206.2	135 %	53.6	109 %	206.2
69	94 %	-70.6	75 %	-16.7	85 %	101.5	58 %	186.3	139 %	41.1	116 %	201.3	139 %	41.1	116 %	201.3
70	94 %	-78.5	75 %	-20.4	86 %	104.6	59 %	195.6	140 %	28.9	117 %	196.4	140 %	28.9	117 %	196.4
Average	94 %	-15.9	75 %	10.2	80 %	71.7	52 %	113.7	115 %	59.2	76 %	143.8	115 %	59.2	76 %	143.8
	Y	w _H H			Y	w _H H			Y	w _H H			Y	w _H H		
Employed	8.2	2.3			15.2	4.6			8.7	5.7			18.1	4.6		
Retired	3.8	6.2			6.7	7.9			3.6	9.8			9.3	5.4		

Last year of work	Netherlands				Portugal				United Kingdom				Average			
	Full		Partial		Full		Partial		Full		Partial		Full		Partial	
	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV
55	71 %	24.4	52 %	32.0	97 %	5.0	79 %	5.9	58 %	17.1	23 %	19.2	83 %	12.9	51 %	16.7
56	77 %	41.5	62 %	51.7	99 %	10.1	82 %	11.8	58 %	34.2	23 %	38.3	85 %	24.7	54 %	32.6
57	79 %	58.8	64 %	71.7	101 %	15.1	84 %	17.8	59 %	51.2	24 %	57.5	86 %	36.5	55 %	48.1
58	81 %	76.2	66 %	91.9	104 %	20.2	87 %	23.7	59 %	68.3	25 %	76.6	88 %	48.4	57 %	63.6
59	82 %	93.9	69 %	112.3	106 %	25.2	89 %	29.6	60 %	85.4	25 %	95.8	89 %	60.3	59 %	79.1
60	84 %	111.7	71 %	133.0	108 %	24.7	92 %	30.8	60 %	87.5	26 %	106.4	90 %	66.5	61 %	90.5
61	86 %	129.6	74 %	154.0	111 %	24.2	95 %	31.8	61 %	89.8	26 %	117.0	91 %	71.3	63 %	101.1
62	88 %	147.8	77 %	175.2	113 %	23.6	97 %	32.7	61 %	92.3	27 %	127.5	93 %	74.9	65 %	115.0
63	90 %	145.6	80 %	178.4	115 %	22.9	100 %	33.6	62 %	94.9	27 %	137.8	96 %	72.2	69 %	120.4
64	92 %	143.3	82 %	181.1	118 %	22.2	103 %	34.3	62 %	165.4	28 %	231.9	98 %	80.4	72 %	139.1
65	94 %	143.4	86 %	187.0	120 %	20.4	105 %	33.8	94 %	162.2	68 %	234.5	105 %	76.6	82 %	142.5
66	97 %	143.0	91 %	191.9	120 %	18.8	105 %	33.5	94 %	159.4	68 %	237.2	107 %	72.8	84 %	145.5
67	101 %	142.0	96 %	195.7	120 %	17.4	105 %	33.3	95 %	156.9	69 %	240.1	108 %	68.9	87 %	148.0
68	105 %	140.4	102 %	198.3	120 %	16.0	105 %	33.2	95 %	154.7	70 %	243.1	110 %	64.9	90 %	150.1
69	109 %	138.0	108 %	199.6	120 %	14.8	105 %	33.2	96 %	152.9	70 %	246.3	112 %	59.8	92 %	150.2
70	114 %	134.9	115 %	199.5	120 %	13.8	105 %	33.4	96 %	151.4	71 %	249.6	113 %	54.9	94 %	150.1
Average	91 %	113.4	81 %	147.1	112 %	18.4	96 %	28.3	73 %	107.7	42 %	153.7	97 %	59.1	71 %	105.8
	Y	w _H H			Y	w _H H			Y	w _H H			Y	w _H H		
Employed	12.6	3.6			4.1	0.5			22.2	4.4			12.7	3.7		
Retired	6.2	7.7			3.2	1.2			5.2	8.8			5.4	6.7		

Full includes household work. Y = annual net earnings (employed) or pension income (retired). w_HH = value of household work (in thousand euros).

Table 5: Replacement rates and option values for women across the countries, ages 55–70 (thousand €).

Last year of work	Belgium				Denmark				Finland, new				Germany			
	Full		Partial		Full		Partial		Full		Partial		Full		Partial	
	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV
55	124 %	3.6	87 %	6.9	87 %	10.0	57 %	12.9	104 %	11.6	36 %	15.8	104 %	11.6	36 %	15.8
56	124 %	7.2	87 %	13.7	87 %	20.0	57 %	25.9	106 %	23.1	39 %	31.6	106 %	23.1	39 %	31.6
57	124 %	10.8	87 %	20.6	87 %	30.0	57 %	38.8	107 %	34.7	42 %	47.5	107 %	34.7	42 %	47.5
58	124 %	14.4	87 %	27.4	87 %	40.0	57 %	51.7	109 %	46.2	46 %	63.3	109 %	46.2	46 %	63.3
59	124 %	18.0	87 %	34.3	87 %	50.0	57 %	64.6	110 %	57.8	49 %	79.1	110 %	57.8	49 %	79.1
60	124 %	-2.4	87 %	23.3	87 %	59.9	57 %	77.6	111 %	69.3	52 %	94.9	111 %	69.3	52 %	94.9
61	124 %	-22.1	87 %	12.8	87 %	63.5	57 %	85.1	113 %	80.9	55 %	110.8	113 %	80.9	55 %	110.8
62	124 %	-41.1	87 %	2.9	87 %	67.2	57 %	92.7	114 %	104.7	58 %	137.4	114 %	104.7	58 %	137.4
63	124 %	-59.5	87 %	-6.6	87 %	71.1	57 %	100.5	120 %	110.2	71 %	147.8	120 %	110.2	71 %	147.8
64	124 %	-77.2	87 %	-15.6	87 %	86.0	57 %	122.1	122 %	114.3	76 %	157.1	122 %	114.3	76 %	157.1
65	124 %	-94.3	87 %	-24.1	94 %	89.4	69 %	129.1	124 %	117.1	82 %	165.2	124 %	117.1	82 %	165.2
66	124 %	-110.8	87 %	-32.2	94 %	93.1	69 %	136.9	127 %	118.8	87 %	172.3	127 %	118.8	87 %	172.3
67	124 %	-126.7	87 %	-39.8	95 %	96.9	70 %	144.2	129 %	119.3	93 %	178.4	129 %	119.3	93 %	178.4
68	124 %	-142.1	87 %	-47.0	95 %	100.8	70 %	151.7	132 %	118.8	99 %	183.5	132 %	118.8	99 %	183.5
69	124 %	-156.9	87 %	-53.8	95 %	105.6	70 %	159.6	134 %	111.2	104 %	182.5	134 %	111.2	104 %	182.5
70	124 %	-171.2	87 %	-60.3	70 %	109.8	55 %	167.4	135 %	103.7	106 %	181.5	135 %	103.7	106 %	181.5
Average	124 %	-59.4	87 %	-8.6	88 %	68.3	61 %	97.5	119 %	83.9	68 %	121.8	119 %	83.9	68 %	121.8
	Y	w _H H			Y	w _H H			Y	w _H H			Y	w _H H		
Employed	6.9	2.8			12.9	7.0			7.2	9.2			12.7	6.5		
Retired	5.7	6.1			6.7	9.9			2.6	14.4			6.7	7.3		

Last year of work	Netherlands				Portugal				United Kingdom				Average			
	Full		Partial		Full		Partial		Full		Partial		Full		Partial	
	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV	RR	OV
55	74 %	30.2	54 %	31.2	103 %	3.8	77 %	5.0	60 %	15.7	22 %	18.3	94 %	12.4	53 %	15.1
56	80 %	47.2	64 %	49.2	104 %	7.7	80 %	10.0	60 %	31.5	22 %	36.5	95 %	22.8	56 %	28.4
57	82 %	64.4	66 %	67.5	106 %	11.5	83 %	15.0	60 %	47.2	23 %	54.8	96 %	33.3	57 %	41.6
58	83 %	81.9	68 %	85.9	108 %	15.3	85 %	20.0	61 %	62.9	23 %	73.0	97 %	43.9	59 %	54.9
59	85 %	99.5	71 %	104.6	110 %	19.2	88 %	25.0	61 %	78.7	24 %	91.3	98 %	54.4	61 %	68.3
60	86 %	117.3	74 %	123.4	112 %	19.2	90 %	26.1	61 %	163.9	25 %	220.2	99 %	71.0	62 %	94.4
61	88 %	135.4	76 %	142.5	114 %	19.2	93 %	27.1	92 %	162.5	62 %	223.0	104 %	74.3	69 %	101.7
62	90 %	153.7	79 %	161.9	115 %	19.1	95 %	28.0	92 %	161.3	62 %	225.9	105 %	81.4	71 %	112.3
63	92 %	159.6	82 %	168.4	117 %	18.8	98 %	28.8	92 %	160.5	63 %	229.0	107 %	81.5	76 %	116.5
64	94 %	165.3	85 %	174.6	119 %	18.5	101 %	29.6	93 %	160.0	63 %	232.2	109 %	83.0	78 %	122.4
65	96 %	174.1	89 %	184.1	121 %	17.0	103 %	29.1	93 %	159.8	72 %	235.6	111 %	82.9	83 %	126.3
66	99 %	182.3	94 %	193.0	121 %	15.6	103 %	28.7	94 %	160.0	73 %	239.1	112 %	82.5	86 %	130.0
67	103 %	190.0	99 %	201.3	121 %	14.3	103 %	28.4	94 %	160.4	73 %	242.8	114 %	81.9	88 %	133.4
68	107 %	197.0	105 %	208.9	121 %	13.1	103 %	28.2	94 %	161.2	74 %	246.6	115 %	81.1	91 %	136.5
69	111 %	203.3	112 %	215.8	121 %	12.0	103 %	28.1	95 %	162.2	74 %	250.6	116 %	78.4	94 %	137.9
70	115 %	208.8	118 %	221.8	121 %	11.0	103 %	28.1	95 %	163.5	75 %	254.7	114 %	75.6	93 %	139.3
Average	93 %	138.1	84 %	145.9	115 %	14.7	94 %	24.1	81 %	125.7	52 %	179.6	105 %	65.0	74 %	97.4
	Y	w _H H			Y	w _H H			Y	w _H H			Y	w _H H		
Employed	8.3	8.0			3.2	2.2			17.5	7.3			9.8	6.1		
Retired	3.0	10.9			3.2	1.2			3.9	10.4			4.6	8.6		

See note for table 4.

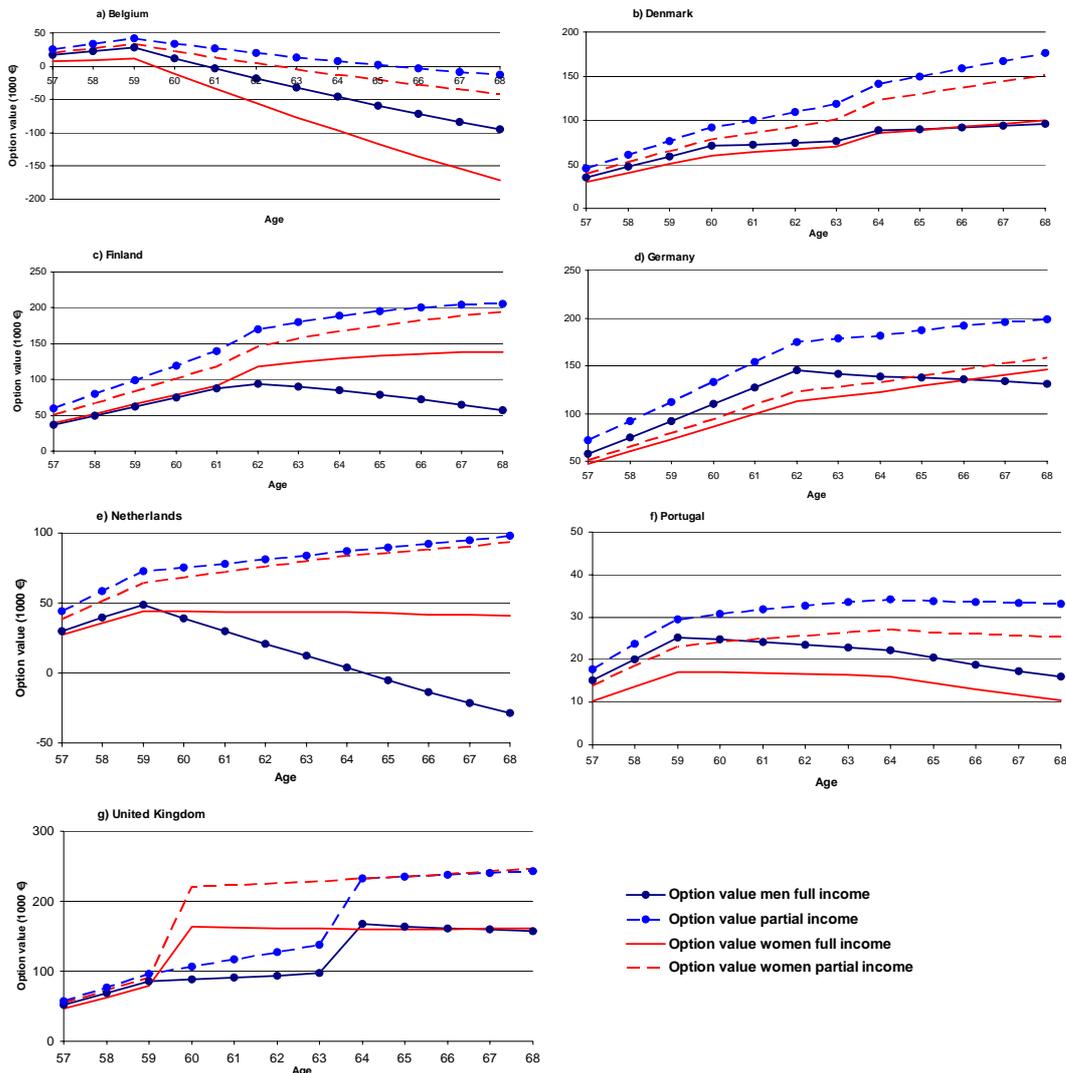
It is seen from Tables 4 and 5 that the average partial replacement rate with the exclusion of household work is 71-74 percent for both genders. With the exclusion of household work, these are slightly lower for men than for women. Replacement rates, hence, tend to decrease somewhat with the higher income levels. Recall that women's incomes are lower, since

corrected for their lower supply of market work. Greater share of women work part-time and regular working hours are shorter. Replacement rates decreasing with income level are also evident in the OECD estimates. Furthermore, the OECD estimates are somewhat higher with the inclusion of early retirement schemes, see OECD (2005). It is seen that full replacement rates with the inclusion of household work are much higher. Household work increases the replacement rate, because irrespective of gender, there is some addition to household work in all countries after withdrawal from the labour market. In absolute terms replacement rates are 30 percentage points higher and hence close to 100% for both genders.

One should, however, note that as indicated by our theoretical approach, the high figures would not be accurate if household work were a substitute for leisure instead of market work. In this case the level of household work, rather than changes in it, affects the economic incentives. However, we have shown evidence of considerable changes in time spent on household work after retirement and the relative value of household work can in some case even exceed annual pension income. The value of household work doubles for men after retirement (Table 3), who tend to reallocate more of their time towards household work than women. Furthermore, men, while still active in the labour market, contribute ten hours less a week towards household work. Thus, replacement rates for men, on average, become relatively greater. This also explains why the option value calculations indicate that in spite of the higher replacement rate for women, it is more attractive for men to retire.

Next, consider the option values and respective curves for retirement at age 55 shown in Figure 1. The future retirement age is compared with the advantage of retiring at 55. It is noteworthy that the optimal time for retirement would not substantially change with a different base year; the most important change is the maximal option value that is based on the number of years during which earnings are accumulated before retiring.

Figure 1: Option Values



The pattern of option values is again shown in Figure 1 with and without household work for each country separately. The peak option value shows the point of maximum benefit of not retiring today (at age 55). With the exception of Denmark, UK and Finland and Germany on the part of females, the full option value starts to recede at some point at the age of 60-65 and reaches a zero value – the point of indifference between retirement or non-retirement – in some countries before the legal retirement age. In the partial approach, retirement deferment is less attractive, as the implied higher pension level is not offset by the fewer years available for drawing the benefits. It is seen from Tables 4 and 5 and Figure 1 that the economic incentives in the partial approach, which overlooks household work, explain the reasons for the actual average retirement before the legal retirement age rather poorly. The partial approach that totally omits the value of non-paid work time does not support retirement before the age of 70 in any of the countries. Figure 1 clearly shows that with the

exception of high-income earners in Belgium, option values are positive until the age of 70 (and beyond). Although the goal of the system frequently is to postpone retirement beyond the pensionable age, the low average retirement ages do not appear to support this finding (see OECD, 2005).

The following tables show the correlation between retirement incentives and the average retirement age (Table 6) and the employment rates at 55-64 years at the three education levels (Table 7). The retirement incentives include the full and partial replacement rates at the legal 65-year retirement age, the age at which the option value is zero (point of indifference) and the age at which the option value is the highest. The age at which the option value takes the value of zero is the point of indifference whether to retire at age 55 or the current age. If the optimal retirement age is higher than 70 years, we set it at this limit (as was the case in 29 instances out of a total of 42). We apply the old (existing) pension scheme for Finland. The retirement incentives considered here are assessed for three income levels, which also yield the average retirement incentives shown in Tables 4 and 5.

Table 6: Correlation of average retirement age and retirement incentives

	Replacement Rate at 65 years		Point of indifference	Max Option Value
	Full	Partial	Full	Full
Men 0.67APW	0.625	0.501	-0.368	-0.305
Men APW	0.651	0.685	-0.340	-0.074
Men 1.67APW	0.080	0.241	-0.167	0.108
Women 0.67APW	0.484	0.467	-0.118	-0.456
Women APW	0.126	0.459	-0.208	0.028
Women 1.67APW	-0.073	0.119	-0.225	0.014
Men+women 0.67APW	0.512	0.473	-0.200	-0.379
Men+women APW	0.390	0.572	-0.289	-0.036
Men+women 1.67APW	-0.038	0.158	-0.165	0.061

Optimal age of retirement is set at 70 years if higher (in 29 cases of total 42). Using the old (existing) pension scheme in Finland. Point of indifference is the age at which option value is zero.

As can be seen from Table 6, the average retirement age is clearly correlated to full and partial replacement rates at the middle (APW) and low-income levels (0.67APW). Middle-income and low-income earners also form the majority of the retirees in determining the average age of retirement. The partial and full approaches yield fairly similar correlations, albeit Figure 1 showed that the full approach relates better to the age of retirement. It is also seen here that at the middle and low income levels, the full replacement rate is a somewhat better measure for men than the

partial replacement rate. It is seen that the age of point of difference or the age for maximal option value are mostly negatively related to average retirement age. The optimal retirement age implied by option values does not well explain the actual retirement behaviour.

In Table 7 we examine the correlations to the employment rate at various income levels for the 55-64 year-olds rather than the correlation to the average retirement age. Employment rates at three education levels from OECD (2003b) proxy employment rates at three income categories. This makes use of the fact that the education level and incomes are strongly positively correlated.

Table 7: Correlation of retirement incentives and employment rate by education level and OLS estimates

	Replacement Rate at 65 years		Point of Indifference	Max Option Value
	Full	Partial	Full	Full
Men <upr.sec.	0.656	0.473	-0.096	-0.037
Men upr.sec&post-sec.	-0.262	-0.126	0.020	0.334
Men tert.	-0.406	-0.266	-0.160	0.400
Women <upr.sec.	0.271	0.342	0.530	0.188
Women upr.sec&post-sec.	-0.725	-0.263	0.729	0.856
Women tert.	-0.783	-0.770	0.491	0.747
M+W <upr. sec.	0.254	0.290	0.212	0.121
M+W upr.sec&post.sec.	-0.614	-0.243	0.529	0.599
M+W tert.	-0.674	-0.568	0.303	0.568
Mean	1.02	0.73	67.70	67.70
Coefficient (replacement rate or optimal age of retirement)	-28.4 (2.76)	-8.3 (0.95)	1.59 (3.00)	0.07 (2.23)
Secondary education	8.6 (4.89)	10.3 (5.26)	10.4 (2.19)	9.1 (5.51)
Tertiary education	21.5 (4.37)	24.1 (5.23)	23.0 (4.81)	18.9 (1.87)
Constant	68.9 (5.95)	44.6 (5.95)	-69.0 (1.92)	34.8 (10.1)
R²	0.46	0.37	0.43	0.42

Optimal age of retirement is set at 70 years if higher (in 29 cases of total 42). Using the old (existing) pension scheme in Finland. Mean employment rate is 50%. In regression primary education is the reference group. Point of indifference is the age at which option value is zero.

It can be seen that the employment rate is negatively correlated with full and partial replacement rates for individuals with at least upper secondary education. However, for the low educated individuals, the economic incentives become the opposite. The age for point of difference or the age for maximal option value did not explain very well the country differences in the average retirement age. Figure 7 shows that these are associated more clearly to employment rates by educational (income) levels. Clearly, the age for maximal option value and partly the age for point of difference are associated positively with employment rates for individuals other than the low

educated. It is likely that the poor labour market situation with the highest replacement rate is a better explanation for the low employment rate than the incentive to retire.

We have also used OLS regression to explain employment rates with retirement incentives using retirement incentive observations for all three income levels (yielding 42 observations) and including in the estimation education dummies. It can be seen from the lower part of Table 7 that a 30 percent decrease in the full replacement rate (from an average of 1 to 0.7) induces a 10 percent increase in the employment rate of the 55-64 year age bracket. The employment effects of option values are also significant but not very large. Reforming the pension system so as to postpone by one year the point at which the option value reaches zero induces a higher employment rate of 1.6. Similarly, a 30 percent increase in the maximal option value (80 thousand euros on average) raises the employment rate by 1.7.

It can be seen from our analysis that countries with a low replacement rate such as Denmark and the UK have the best possibility of achieving the objective of retirement deferment. But even in these countries, private pension schemes are important (the UK) or private pension savings are heavily tax subsidised (Denmark), thus the inclusion of private sector financial incentives can alter the results.

5. Conclusion

This analysis started with the question of how does household work affect the labour supply and the demand for leisure with specific application to retirement. Life-long allocation of time between market work and household work is examined across seven countries. An important finding of the study is that older employed men and women in most countries contribute equally to the total work. This shows the relevance of considering the reallocation of total work between market work and household work between spouses over a lifetime, although specialisation by gender is largely ignored here. We also offer an alternative explanation based on habitual behaviour of replacing market work with household work after retirement. This approach is also in line with the continuity of lifetime patterns with regard to leisure.

Accounting for the value of household work yields on average 40 percent higher replacement rates (almost 100%), and respectively lower option values for retirement. A 30 percent

decrease in the full replacement rate induces an increase in the employment rate of the 55-64 age group by 10 percent. The analysis shows that the domestic situation is as important in the retirement decision for men as for women. For men the increase in household work after withdrawal from the labour market is larger in relative terms (double on average). The effect of accounting for household work in the financial incentive to retire is greater for men as they initially start from a situation of 10 hours less household work. Spillovers between genders occur through the substitutability of household and market work. Recent studies find that male retirement decisions are most sensitive to the labour market decisions of their spouses (Coile and Gruber, 2001, Dahl et al., 2002, Johnson and Favreault, 2001). The increase in household work for men and the small increase for women show that time allocation between genders becomes more homogenous during terms of non-employment.

In countries where the *relative* increase in the supply of household work after retirement is larger for men than for women, earlier retirement is more attractive to men. This is, in fact, evident in all the countries except in the UK. It is also clear that retirement policies should adapt to country characteristics:

- 1) Central Europe, characterised with relatively short market work hours (Germany, Belgium) and average household work hours (Germany), does not have similar difficulties in combining work and domestic life. However, the replacement rates are usually high and labour force participation of older German women is strikingly low (OECD, 2003a).
- 2) In small countries (such as Finland, Netherlands, Portugal) and the UK, men have long market as well as domestic work hours (except for household work in Portugal) while women have long household work hours. It is clear that wellbeing at work and the successful combining of the work and domestic life are very important. The pension system in the Netherlands is not very incentive compatible.
- 3) Household work supply is low in Denmark, otherwise its regime is similar to the other Nordic countries, and to Belgium. Combining working and domestic life is easier and household work does not influence the retirement incentives to the same degree. The pension system in Belgium is, however, generous, but household work does not exert pressure on individuals to withdraw from the labour force, as it stays relatively at the same level after retirement.

It seems clear that in making retirement decisions people consider other incentives in addition to its financial aspects. Although significant, these do not predict the very early average retirement age. In addition to household work, individual characteristics, such as the individual's health and his own perception of life expectancy, arguably also have a strong effect

on the retirement behaviour of the elderly. Human capital also explains a large portion of time-use patterns, and the better education level of the current older workers seems to be related to the rise since 2000 in the labour force participation rate among older cohorts. At a minimum, this study indicates that incentive calculations may fail seriously if the value of non-work time is not properly taken into account.

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Appendix A. Household Work, Market Work and Leisure

The effect of an increase in pension wealth and substitution effect of wages on leisure demand are from the first-order conditions (2) and (3)

$$(a.1) \quad \frac{\partial L}{\partial w} = L_w^c \left(1 + \frac{(\partial PW / \partial w + wE)U_{xx}}{U_x} \right);$$

$$(a.2) \quad \frac{\partial H}{\partial w} = H_w^c \left(1 + \frac{(\partial PW / \partial w + wE)U_{xx}}{U_x} \right),$$

where $L_w^c \equiv \Delta^{-1} U_x (V_{HH} - V_{LH})$, $H_w^c \equiv \Delta^{-1} U_x (V_{LL} - V_{LH})$, V_{HH}, V_{LL}, V_{LH} and V_{HH} are the partial derivatives of the first order conditions V_H and V_L with respect to H and L . Using the homothetic preference property $xU_x + LU_L + HU_H + \mu_H HU_{\mu H} = 0$ and $xU_{xx} + LU_{Lx} + HU_{Hx} + \mu_H HU_{\mu Hx} = 0$, homothetic properties $1/\sigma_L \equiv U_{xL}U/U_xU_L$, $1/\sigma_H \equiv U_{xH}U/U_xU_H$, $1/\sigma_{\mu H} \equiv U_{x\mu H}U/U_xU_{\mu H}$ and the first-order-conditions $wU_x = U_L = U_H + \mu_H U_{\mu H}$, the term in the brackets can be written as

$$(a.3) \quad \frac{(\partial PW / \partial w + wE)U_{xx}}{U_x} = - \frac{(\partial PW / \partial w + wE)U_x}{xU} \left[\frac{LwU_x}{\sigma_L} + \frac{H(wU_x - \mu_H U_{\mu H})}{\sigma_H} + \frac{\mu_H H}{\sigma_{\mu H}} \right].$$

(a.1), (a.2) and (a.3) give (4) and (5) in the text.

Appendix B. Country-Specific Analysis and Pension Wealth

Belgium

The eligibility requirement for social security benefits from early retirement was raised in 1997 from a minimum of 20 years of contributions to 35 years to become effect in 2005 (European Commission 2002). The age at which a private sector worker is entitled to an occupational pension was raised from the 50 to 60 in 2002, which is the pensionable age assumed in this study (i.e., the required 26 years of work experience in 2000 is also fulfilled). (Reid 2002).

In Belgium, the additional household work after withdrawal from the labour market is estimated to be worth 5000 € a year for men and 4250 € a year for women (Tables 5, 6). Excluding household work yields replacement rates comparable to those in Gruber and Wise (1999). It is noteworthy that the somewhat lower replacement rates in our study are explained by the social security payments of employers, which are assumed to lower the gross wage and, hence, pension income. The incentives for accumulating pension wealth appear small and the optimal retirement age (the intersection point to the horizontal axis) is achieved at the age of 59.5 years for women and 61 years for men. Individuals, therefore, are indifferent to retiring at 55 years or at the optimal age. This matches the average age of 59 years for withdrawing from the labour force.

Average replacement rates between the ages of 55 and 70 inclusive of the value of household work are 94% for men and 124% for women (Tables 5 and 6), which are considerably higher than those with no household income. The retirement incentive becomes strong after the eligible age of 60. The inclusion of the value of household work advances the optimal retirement age by four years for men and by three years for women.

Denmark

In Denmark, the universal flat-rate old age pension benefit, which is financed from general tax revenue, is available at the age of 65. The minimum age for receiving tax-favoured pension benefits is 67, but other programs facilitate early retirement. A private pension scheme is gradually taking over the public pension system, and roughly one half of workers are currently enrolled in the new system. In both the old and new systems,

pensions independent of income levels appear to have helped Denmark to face the future demographic transition. The previous early-retirement plan that facilitated the withdrawal of the unemployed is being phased out, and is omitted from this analysis. From 2018 on, the pensionable age for women, currently 56.6, will be raised gradually to 61.5, to match that of men. In our calculations the pensionable age is fixed at 61 years for both genders.

In Denmark, the change in household work after retirement is, on average, worth around 3400 € per annum for men and 3000 € for women. Figure 2 shows that there still is not much deviation in the option value curves regardless whether or not household work is included. The replacement rates before the legal age of retirement of 65 years are lower than in other countries (63 percent for men and 77 percent for women). It is clearly more optimal to retire at 68 years than at 61 years despite Denmark's shorter-than-average life expectancy. Thus, in economic terms, the optimal retirement age is after 68 years. The system also includes the option of additional pension income if retirement is deferred until 68 years. In fact, calculations presume the possibility of working indefinitely and the optimal option is never to retire. The average retirement age is indeed one of the highest in Europe, 62.4 years for men and 61.5 years for women. This can well be explained by the public pension system, which encourages delayed withdrawal from work. Reallocation of household work after retirement is also sufficiently low not to change the incentives dramatically.

Finland

A new pension system has been launched in Finland, and will gradually start to affect pensions in 2005. In this study, it is assumed to have been fully operational since 2000. Pension accrual starts at the age of 18. Pension is based on the entire working career and not merely the last ten years of each employment relationship, as is the case in the current system (duration of work experience is still fixed at 25 years at the age of 55, as in other countries). The annual accrual rate is 1.5 for the 18-53 year age bracket, 1.9 for the 53-62 age group and 4.5 for the age group 63-68. The new system is partly financed by a 30% increase in the social security payment of employees from the age of 54 onwards. The unemployment pipeline at the age of 60 still enables effective retirement at that age. Here, the pensionable age is set at 62 years. The new system also allows the pension level to be corrected for changes in the life expectancy of the population, but this option is not taken into account in our study. Estimates suggest that the pension reform would lead to an average 15 per cent increase in their levels (Central Pension Security Institute, 2002). The

possible longer working careers are included in this estimate, but no correction for life expectancy adjustment is made.

It is noteworthy that household work has the important effect of lowering option values, especially for men. The increase in household work in Finland after withdrawal from the labour market is 9 hours for men and 11 hours for women, and its marginal value is one of the highest of the countries studied, as the hourly net wage is 7.8 €. The difference between the net earned income and pension income is around 5000 €. This is almost totally compensated for by an equal increase in the value of household work. Thus, it is not surprising that the curves for optimal retirement differ widely, depending on the value of household work.

It is optimal for men to postpone retirement until 68 years, compared to only 55 years when household work is excluded. The incentives based on the high accrual rate of 7.5 percent from 62 to 63 years and 4.5 percent per year from 63 to 68 years keep the option-value curve relatively flat. However, with full income the curves slope downwards. In addition, pension wealth at 62 years is approximately 13,000 € higher for men and 14,800 € for women in the new system which is to become effective in 2005 than in the previous regime, as replacement rates based on full incomes are 5 percentage points higher. But it is by no means clear that individuals plan to defer retirement later, since the initial level of pension wealth may be even higher in the reformed system.

Germany

Workers in Germany may retire at the age of 60, 63 or 65, depending on the fulfilment of certain qualifying conditions (see www.bfa.de for a general description of the pension system). Legislation enacted in 1989 and effective in 1992 increased the pensionable age from the 60-year cut-off for females and 63 for males to 65, starting from the 2001. In our calculations, the pensionable age is taken to be 63 years for both genders.

Similarly to other countries, German workers lose approximately half of their net wage income after retirement. Household work does not substantially increase after retirement, and is valued at only 1300 € for men and 700 € for women. This explains the similarity of the curvatures with and without household work. The replacement rate at the age of 62 for the year 2000 is calculated by authorities to be 70.8% with an average annual pension of 17,457 € (Federal Statistical Office of Germany; Federal Ministry of Labour). In our calculations, the average replacement rate is somewhat higher: 77-86% at the age of 62 or around 10 percentage points higher with the inclusion of household work. It is seen that, if the

unemployment pension pipeline is not taken into account, the German system can encourage postponing retirement until 65 years of age or beyond for women. The major factor is to keep working until the age of 63 as pensions cannot be withdrawn earlier. Viewed only in terms of the economic incentive, retirement can occur for men at any time between 62-67 years, but is delayed further for women who gain the least from additional household income. The main reason for retirement deferment is the pension reduction of 3.6% per year if retirement occurs before 65 and the 6% increase per year generated by the postponement.

The Netherlands

In the Netherlands, the basic Social Security old age pension is available at the age of 65. However, the early retirement VUT program was developed in the early 1980s to allow the option of earlier retirement. A 60-year old worker with at least 10 years of uninterrupted employment can retire with a very high replacement rate. The 60-year age limit inhibits retirement earlier, albeit the disability pension scheme is often available at an earlier age. The government plans to phase out the present system gradually. In our calculations the pensionable age is assumed to be 60. The replacement rate is set at 70 percent for middle incomes and above, while it is assumed that the public flat pension rate is more favourable to women at average wage levels and for those at low incomes, perceived to be 67 percent of the average.

The value for additional household work after retirement is relatively low, 4400 € for men and 2900 € for women. Still, given the low initial level of household work, it has quite a large effect on option values. The public pension system with a flat pension implies a replacement rate of around 87 percent (46 percent for men and 48 percent for women if household work excluded, see Tables 5 and 6). It is clear that the incentives to postpone retirement are relatively high for low-income earners, particularly women who, due to lower earnings, are assumed to draw pensions from the public system. The optimal retirement age is close to the pensionable age.

Portugal

Portugal has raised the pensionable age for women from 62 to 65 over the period 1994 to 1999. In reality, an early retirement scheme enables the withdrawal from the labour market at 62 years, which is assumed to be the pensionable age here. The country's replacement rate is one of the highest in this study exceeding unity at 63 even without household work.

In addition, household work is greatly increased after withdrawal from work. On the other hand, the hourly value of household work, 1.5 €, is very low compared with the average 5 € for all countries. The wage rate applied here is the mandatory minimum wage for domestic services; these, however, may, be lower than actual wages paid to domestic help. The additional household work after withdrawal from work is valued at 680 € for men and 1100 € for women. Despite high replacement rates, the overall effect induces the individual to continue working throughout his or her career, since the expected value for additional household work after retirement remains low. Again, these findings support the country's average pattern of later withdrawal at 66 years.

The United Kingdom

The pensionable age in the UK is currently 65 for men and 60 for women. Through legislation enacted in 1995, the minimum for women will be raised gradually for over a ten-year period to 65, starting with those who reach 60 years in 2010, until it is uniform for all in 2020 (O'Connell 2002). In our calculations we have assumed the pensionable age to be 60 years, because the existence of various early retirement arrangements is promoting the average retirement age at 62 for men and 61 for women.

In the United Kingdom, the value for additional household work after retirement is 4300 € for men and 3200 € for women. We consider for the UK only the State Earnings Related Pension Scheme (SERPS), covering about 25% of the labour force. Private pension schemes constitute over half of the total retirement income in the country (Gruber and Wise 1999, 415). SERPS is currently being remodelled, and the original replacement rate target of 25% of the average earnings of the 20 best employment years is gradually being changed to 20% of the lifetime average. The pension accrual rates are determined according to these target replacements, and we assume here the accrual rate applicable under the new scheme.

It is seen that the low *full* replacement rates, 73% for men and 81% for women, offer incentive to postpone retirement. With a low level on any tax difference, an individual is relatively indifferent with respect to the timing of optimal retirement, given the pensionable age of 60 for women and 65 for men.

Table B1. Pension wealth for men across the countries, ages 55–70 (thousand €)

Last year of work	Belgium		Denmark		Finland		Germany		Netherlands		Portugal		UK		Average	
	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial
	55	295.84	216.66	134.64	80.23	217.86	101.99	194.83	140.17	263.92	151.57	45.40	35.99	199.63	86.48	193.16
56	295.84	216.66	134.64	80.23	223.10	110.97	207.13	158.29	266.86	155.02	47.92	37.19	201.46	88.69	196.71	121.01
57	295.84	216.66	134.64	80.23	228.35	119.96	211.58	164.20	267.81	156.14	50.43	38.39	203.28	90.91	198.85	123.79
58	295.84	216.66	134.64	80.23	233.60	128.94	216.20	170.34	269.20	157.78	52.95	39.59	205.11	93.13	201.08	126.67
59	295.84	216.66	134.64	80.23	238.85	137.92	220.99	176.70	270.59	159.41	55.47	40.79	206.94	95.34	203.33	129.58
60	295.84	216.66	134.64	80.23	244.10	146.91	225.96	183.29	271.98	161.04	56.90	41.99	208.77	97.56	205.46	132.53
61	274.03	200.68	134.64	80.23	249.34	155.89	231.12	190.14	254.08	151.19	54.74	40.14	195.73	92.74	199.10	130.15
62	252.85	185.17	124.23	74.03	254.59	164.88	236.47	197.24	236.54	141.45	52.51	38.21	182.87	87.81	191.44	126.97
63	232.28	170.11	114.13	68.01	254.69	185.02	242.01	204.61	219.36	131.81	50.22	36.21	170.18	82.78	183.27	125.51
64	212.32	155.49	104.32	62.17	242.92	184.27	226.47	194.00	202.53	122.29	47.86	34.14	157.68	77.67	170.59	118.58
65	192.94	141.30	104.62	69.30	230.44	181.73	210.76	182.88	186.05	112.87	45.19	32.01	212.48	156.29	168.92	125.20
66	174.12	127.52	94.42	62.54	217.28	177.49	197.66	174.94	169.07	102.56	41.87	29.09	194.19	143.36	155.51	116.79
67	155.85	114.14	84.51	55.98	203.48	171.63	183.99	165.98	152.58	92.56	38.67	26.25	176.25	130.59	142.19	108.16
68	147.64	108.62	74.89	49.61	189.08	164.22	169.70	155.92	136.57	82.85	35.60	23.50	158.65	117.98	130.30	100.38
69	130.14	95.79	65.55	43.42	174.12	155.34	154.70	144.66	121.03	73.42	32.64	20.82	141.39	105.51	117.08	91.28
70	113.15	83.33	57.09	38.21	155.39	139.51	138.94	132.13	105.93	64.26	29.81	18.23	124.45	93.20	103.54	81.27
Average	228.77	167.63	110.39	67.81	222.32	151.67	204.28	170.97	212.13	126.01	46.14	33.28	183.69	102.50	172.53	117.12

Full includes domestic work, Partial excludes domestic work.

Table B2. Pension wealth for women across the countries, ages 55–70 (thousand €)

Last year of work	Belgium		Denmark		Finland		Germany		Netherlands		Portugal		UK		Average	
	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial
	55	420.08	273.69	104.55	87.69	96.63	87.41	85.67	99.60	141.77	131.62	47.87	49.99	182.86	70.49	154.21
56	420.08	273.69	104.55	87.69	105.14	95.11	98.79	113.23	144.96	134.33	49.46	51.65	184.20	72.29	158.17	118.29
57	420.08	273.69	104.55	87.69	113.65	102.81	102.48	117.46	146.01	137.04	51.06	53.32	185.54	74.10	160.48	120.87
58	420.08	273.69	104.55	87.69	122.17	110.51	106.31	121.85	147.52	139.75	52.65	54.98	186.88	75.91	162.88	123.48
59	420.08	273.69	104.55	87.69	130.68	118.21	110.28	126.40	149.04	142.46	54.25	56.65	188.22	77.71	165.30	126.12
60	420.08	273.69	104.55	87.69	139.19	125.91	114.39	131.12	150.55	145.17	55.85	58.32	189.56	79.52	167.74	128.77
61	394.49	260.49	104.55	87.69	147.70	133.61	118.67	136.02	143.09	139.14	53.94	56.33	200.55	194.44	174.71	143.96
62	369.65	244.21	97.73	81.97	156.21	141.31	123.10	141.10	135.71	133.06	51.95	54.25	244.67	183.18	168.43	139.87
63	345.52	228.39	91.11	76.42	177.73	160.77	127.69	146.37	128.42	126.92	49.87	52.08	229.14	172.08	164.21	137.58
64	322.10	213.04	84.68	71.02	179.75	162.60	123.48	141.54	121.21	120.74	47.71	49.83	213.93	161.14	156.12	131.41
65	299.37	198.13	89.99	80.23	180.38	163.17	119.05	136.46	114.09	114.51	45.48	47.50	199.05	150.35	149.63	127.19
66	277.29	183.66	83.04	74.03	179.67	162.53	116.89	133.98	106.03	106.42	42.13	43.99	184.49	139.71	141.36	120.62
67	255.86	169.61	76.43	68.55	177.69	160.74	114.33	131.04	98.21	98.58	38.87	40.59	170.24	129.23	133.09	114.05
68	235.05	155.97	69.86	62.66	174.50	157.85	111.33	127.61	90.62	90.96	35.71	37.29	156.29	118.90	124.77	107.32
69	214.85	142.72	63.49	56.94	170.16	153.93	107.87	123.64	83.25	83.56	32.64	34.09	142.64	108.72	116.41	100.51
70	195.23	129.86	57.95	51.70	158.42	143.31	103.90	119.09	76.10	76.38	29.66	30.97	129.27	98.68	107.22	92.86
Average	339.37	223.01	90.39	77.34	150.60	136.24	111.51	127.91	123.54	120.04	46.20	48.24	190.47	119.15	150.30	121.70

Full includes domestic work, Partial excludes domestic work.