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Abstract

Low fertility rates combined with increases in early retirement pose a serious challenge to the sustainability of social security systems in most industrialized countries. Therefore, it is important for policy makers to understand the determinants of early retirement and especially the role that institutional factors play in the retirement decision. However, analyzing such factors ideally requires international microdata, which have in the past been largely unavailable. To fill this void, this paper investigates early retirement determinants across several European countries using the rich 2005 SHARE (Survey of Health, Aging and Retirement in Europe) microdataset, which produces more precise estimates of the effects of institutional and economic factors like pension systems, unemployment, and employment protection legislation. The analysis shows that pension systems offering generous early retirement options encourage early departure from the labor market. In addition, pension wealth accrual rate exerts a greater influence on early retirement decisions than does the average replacement rate, while stricter employment protection legislation has no significant impact.

Keywords

Early Retirement, Pensions, Pensions System, Employment Protection.

JEL Classification

J26; J21, H55.

1. Introduction

Aging populations present a challenge to the stability of social security systems and economic growth in all industrialized countries. In particular, high unemployment rates and high early retirement rates among those 55 years and older are undermining the sustainability of the welfare state in societies with decreasing fertility rates and increasing life expectancies. The current discussion across Europe of raising both the legal retirement age and female labor participation rate must be seen in light of these developments.

As regards early retirement particularly, understanding its motivations could assist the formulation of policies that might encourage the return of younger retirees to active employment. In general, the decision to cease work before the legal retirement age (around 65 in most developed countries) is influenced by a variety of factors that may be firm characteristics, employee traits, job requirements, and/or (most important to our study) institutional and macroeconomic conditions. However, understanding such influences is hampered the paucity of studies using international microdata to examine early retirement determinants. One study by Dorn and Sousa-Poza (2005b) does use a crossnational microdataset, but its primary focus is the decision to retire voluntarily rather than to retire early (i.e., it looks at a specific subsample of early retirees).

The remaining international studies (e.g., Duval 2003) analyze early retirement determinants only at the aggregate level (i.e., using a panel of countries). Thus, these country level studies are potentially subject to an endogeneity of the pension system and macroeconomic regressors with regard to the dependent variable (i.e., the labor participation rate) that is quite difficult to resolve (e.g., Johnson 2001, Blöndal and Scarpetta 1999). Moreover, in many international macro studies, including those by Blöndal and Scarpetta (1999), Johnson (2000, 2001) and Gruber and Wise (1999),[1] the low number of observations restricts the number of explanatory variables, thereby raising the additional problem of the so-called ecological fallacy,[2] which is equally likely to produce potentially misleading results. This research void thus calls for the use of international microdata that provide sufficient and specific information for specific analysis of the retirement decision.[3]

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1 The cross-section of country data used by Gruber and Wise (1999) may be biased by the omission of country -specific determinants.

2 The term *ecological fallacy* alludes to the fact that the analysis of individual decision making at an aggregate level may generate biased estimators compared to the outcome at an individual level (Robinson 1950).

3 Blöndal and Scarpetta (1999) cite several national studies on the determinants of early retirement that are based on national individual data. Gruber and Wise (2002) describe first results of an international project to estimate the impact of social security programs on retirement decisions using microdata for each of the participating countries.

Using an international microdataset is particularly attractive not only because it provides ample variation in institutional settings and macroeconomic conditions, but because it allows the inclusion of individual and firm-specific determinants that permit investigation of the partial effects of institutional variables on early retirement behavior. Moreover, even though the factors that affect the inclination to retire early are widely recognized, it is only with the aid of a crossnational microdataset that precise estimates can be obtained. Providing such estimates is the main contribution of this paper.

Overall, we contribute to this field of research by (1) jointly testing individual and institutional factors of early retirement and (2) using microdata from 10 European countries, which allows for cross-European comparisons and circumvents the simultaneity problem of the macro studies. To our knowledge, this paper is the first to empirically examine a complete set of early retirement determinants across Europe using individual data — the SHARE data[4], collected primarily in 2003–2004, which covers 5,500 early retirees in 10 European countries. Thus, our model incorporates both institutional and macroeconomic factors at the aggregate level together with a complete set of individual and job-related characteristics.

The remainder of the paper is organized as follows. After a brief review of the theoretical and empirical context of institutional determinants of early retirement, we describe the data and introduce the model to be estimated. We then present the empirical results and conclude with some policy recommendations.

2. Theoretical context

The decision to retire early is traditionally explained by a worker's personal preferences for premature withdrawal, probably influenced by, among other factors, the characteristics of the pension system. Some theoretical models of labor supply suggest that workers choose the consumption of leisure and work so as to maximize their intertemporal utility (e.g., Mitchell and Fields 1982, Johnson 2000). Such models can easily be extended to include effort cost and other disutility generated by working, as well as additional benefits like procedural utilities and fringe benefits. The optimal date of retirement is then chosen accordingly.

[4] The data used are from the early release 1 of SHARE 2004. This release is preliminary and may contain errors that will be corrected in later releases. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life). Additional funding came from the US National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064). Data collection in Austria (through the Austrian Science Fund, FWF), Belgium (through the Belgian Science Policy O¢ ce) and Switzerland (through BBW/OFES/UFES) was nationally funded.

Because the amount of future financial resources is equally influenced by the institutional design of the pension system, both its generosity and actuarial neutrality should be important institutional determinants of early retirement. Indeed, international comparisons using country data show that more generous or actuarially neutral pension systems trigger larger declines in the labor participation rates of older persons (for men, see Blöndal and Scarpetta 1999, Johnson 2000; for women, see Johnson 2001; see also Duval 2003). Analogous results are reported in various national studies using microdata (for an overview, see Gruber and Wise 2002).[5] This empirical finding might also be explainable by a labor demand side argument; namely, that more firms send their older workers into early retirement when social security and pension system benefits are generous, because these then subsidize the company's own costs of financing premature retirement (Hutchen 1999). Duval (2003) finds that more generous early retirement options (provided by the social security system) lead to a greater drop in male labor force participation rates. In addition, Gruber and Wise (2002) show that early departures accumulate at the age when early retirement first becomes an available choice.[6]

Another important institutional determinant of early retirement is the degree of labor protection through national laws. From an employer's perspective, protection of the labor force through employment legislation may hinder a simple lay-off policy, leaving early retirement programs as the sole option (Dorn and Sousa-Poza 2005b). Along the same lines, Blöndal and Scarpetta (1999) argue that the degree of protection reflects labor market rigidities that make realization of age-adjusted wage schemes difficult. This view again leads to the supply side argument that stronger labor protection discourages firms from employing older workers, thereby decreasing their reemployment opportunities and making them choose the early retirement scheme (Johnson 2000, Duval 2003). In their international empirical analysis of microdata, Dorn and Sousa-Poza (2005b) detect a positive association between more protection and a greater likelihood of self-reported "forced early retirements." However, in this paper, we argue additionally that stronger protection of those still employed may equally create legal obstacles to some forms of (forced) early retirement, leading to fewer cases of premature departures from the labor force. Support for this hypothesis is provided by Blöndal and Scarpetta's (1999) finding in their international study of a rising influence on participation rates of higher union density that potentially reflects greater bargaining power.

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[5] From a theoretical point of view, the effect the pension accrual rate on continuing working is ambiguous on labor supply (Mitchell and Fields 1984, Lazear 1986), but the empirical evidence to date is clear cut.

[6] Duval (2003) provides four alternative explanations for this phenomenon.

Other possible influences on workers' retirement decisions are macroeconomic factors like labor market conditions or level of national wealth, as well as employers' taste for early retirement driven by the state of the economy. For example, from a supply side perspective, when unemployment rates reflect the chances of finding new employment, higher unemployment rates lead to more early retirement through discouragement (Walker 1985, Blöndal and Scarpetta 1999). Similarly, from a demand side perspective, changes in unemployment rates are indicators of demand shocks (Duval 2003, Dorn and Sousa-Poza 2004, 2005a) to which firms respond through a rejuvenation policy or work force reduction (Hutchens 1999, Stern 1987, 1994). Indeed, empirical evidence based on cross-country data suggests that higher unemployment is another factor inducing lower labor force participation of older men (Johnson 2000, 2001, Blöndal and Scarpetta 1999, Duval 2003). Moreover, using individual data from Norway, Røed and Haugen (2003) report a positive linkage between a firm's downsizing policy and the probability of early retirement, while an international empirical micro study by Dorn and Sousa-Poza (2005b) reveals that growing unemployment rates are associated with more forced (i.e., company driven) retirement.

Opposing predictions can be made for national wealth, which behaves countercyclically compared to the unemployment rate. For instance, Duval (2003) and Johnson (2000) suggest that higher national wealth increases the demand for leisure because of rising living standards; that is, a wealth effect induced by higher earning levels acts as an incentive for early withdrawal. An alternative explanation, based on Dorn and Sousa-Poza's (2005b) finding of a positive GDP level influence on voluntary retirement probability, relies on the positive linkage between wealth and the financial affordability of ceasing work prematurely. In contrast, a labor participation lowering influence of GDP growth can be predicted based on a demand side perspective: it assumes human capital to be technology specific, meaning that technological progress leads to its eventual erosion, particularly in the case of older workers who no longer invest in acquiring new skills (Ahituv and Zeira 2000).

3. Data

3.1 The SHARE data on retirement

In this study, we use the SHARE data from a random sampling of 22,000 interviewees over 50 (at the time of interview) in the 10 European countries of Austria, Denmark, France,

Germany, Greece, Italy, the Netherlands, Spain, Sweden, and Switzerland. Following the OECD (1995), we define retired persons as those that (1) self-assess their employment status as retired and (2) are factually out of the labor force. This latter means that the individual (2a) reports having done paid work at some time in her life and (2b) can indicate the year the last job was terminated.[7] About half the respondents (10,600 persons) in the SHARE dataset assessed their current job situation as "being retired."[8] However, the reader should note that this definition of retirement is not based on current reception of retirement pension payments and does not include self-reported unemployed, housekeeping, or disabled persons.[9]

The SHARE survey includes all eligible persons (i.e., those aged 50 or older) in each household, many of which consist of married couples or cohabiting pairs of retired persons. Thus, to enable investigation of partner effects, we split the data between interviewees and interviewed partners (if applicable) and construct a dataset with only one observation per household (about 7,300 observations). This procedure creates no gender bias (47 percent of the remaining sample are female) because the respondent identification variable is randomly assigned. Moreover, for individuals that were divorced or widowed at the time of interview, this dataset provides basic information on earlier partners. After elimination of observations with missing values, about 7,200 retirees remain in the dataset.

Even though the dataset does not directly identify those who have retired early, information is available on the year the interviewees ceased working and whether they were self-employed or employed in the state sector or private industry. Therefore, we define an early retiree as a retired person who withdrew from the active labor force before the legal age of pension payment eligibility. Data on the legal retirement age for the countries in our sample, reported in Table A1 of the Appendix, was collected from Blöndal and Scarpetta (1999) and Duval (2003). Because of the definition's breadth—designed to meet our interest in anyone leaving the labor force prematurely regardless of age—about 77 percent of the retirees sampled (approximately 5,500) must be viewed as early retired and our dataset includes persons who withdrew from the active labor force before age 45.[10] However, as Table 1

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[7] The last employment might have been terminated well before the i interview. For this reason, early retirement decision might have taken place at an age younger than 50 years. See also Table 1.

[8] Other choices were being "unemployed," "(self-)employed," "permanently sick or disabled," 'being a homemaker," or "other current job situation."

[9] Alternative definitions focus on the receipt of pension payments, irrespective of employment status, or on all persons out of the labor force including the disabled and homemakers (see OECD 1995). In contrast, our definition follows the approach in Dorn and Sousa-Poza (2005a).

[10] Other studies on early retirement restrict their analyses to the upper age groups to which early retirement regulations apply. In contrast, our focus is not only on the institutional determinants but on a more general set of macroeconomic and sociodemographic factors, which apply to any retirement age. Nonetheless, most estimation results in this paper do not change significantly when we restrict our sample to those persons retired at age 45 or above.

shows, the majority of early retirees (about 86 percent) ceased working at the age of 45 or beyond. Nevertheless, we also observe a peak in early retirement decisions for about 2.5 percent in the 30 to 34 age group, with a substantial percentage of premature withdrawals in the age groups before and after this peak (about 1.8 percent each). Splitting the sample by gender clearly shows that before age 40 the incidence of early retirement is driven mainly by departing female laborers, most probably deciding to take care of their families full time.

Lastly, as illustrated in Table 2, the year of departure in the sample of early retirees ranges from a minimum in 1935 to a maximum in 2004, with the average occurring in 1989 and the median in 1992, which indicates a distribution that is skewed to the left.

Table 1: Early retirees by age group and gender

Retirement age	Percent of all observations (5532 early retirees)	Percent of females (2551 early retirees)	Percent of males (2981 early retirees)
Age 60 to 65	35.72	28.38	42.00
Age 55 to 59	30.53	26.85	33.68
Age 50 to 54	14.10	14.03	14.16
Age 45 to 49	5.19	6.94	3.69
Age 40 to 44	3.04	4.90	1.44
Age 35 to 39	1.88	2.90	1.01
Age 30 to 34	1.79	3.21	0.08
Age 25 to 29	2.49	4.98	0.37
Age 20 to 24	1.75	3.65	0.13
Age 15 to 19	0.36	0.71	0.07

Table 2: Year of retirement

Percentiles	Smallest			
1%	1948	1935		
5%	1962	1935		
10%	1974	1935	Obs	5532
25%	1984	1937	Sum of Wgt.	5532
50%	1992		Mean	1989.11
	Largest		Std. Dev.	11.98465
75%	1998	2004		
90%	2001	2004	Variance	143.6319
95%	2003	2004	Skewness	-1.52444
99%	2004	2004	Kurtosis	5.649569

3.2. Explanatory variables

As regards the institutional determinants, data on the employment protection legislation index (Version 1)—in which higher values indicate a higher degree of protection—is

provided by the OECD. Pension system design is usually characterized by both degree of neutrality towards an early retirement and generosity of pension payments with respect to the employee's last wage. Cumulated pension wealth accruals, which measure the opportunity costs of retiring early at age 55 instead of at age 65, were taken from Blöndal and Scarpetta (1999: 34) and indicate "the relative increase in the pension benefit that a worker can expect by staying employed ten more years." One measure for pension system generosity, the expected gross replacement rate for persons age 60 averaged over the future five years of life, was taken from Duval (2003:6) and reflects the "ratio of annual [retirement pension] benefits to earnings just prior to retirement." Measures for the macroeconomic condition of the country were obtained from the Penn World Table 6.1 (GDP per capita) and the OECD (unemployment rates), while information on retiree's sociodemographic characteristics, last employment, and partner characteristics were obtained from the SHARE dataset. A more detailed description of the sources, construction of these variables, and the handling of missing values can be found in Table A4 of the Appendix.

4. Model and methodology

To investigate the institutional determinants of early retirement, we view the (conditional) probability of early retirement, $P(y_i = 1|x_i)$, as a function of (workers') personal and job characteristics (including partner's), measured at the time of the retirement decision but recorded in the 2005 SHARE data, and macroeconomic and institutional factors, measured and observed at the time of retirement. Even though retirement decisions took place in different years, each person was observed only once in the 2005 SHARE data, which calls for a cross-sectional approach.

The model is estimated on the given cross-section of microdata using a probit estimation:

$$P_{2005}(y_i = 1|x_{i\ ret\_year}) = \Phi(\alpha + \beta x_{i\ ret\_year}),$$

where Φ is the cumulative distribution function for the normal distribution. Intuitively, given this functional form, the probit model chooses α and β to fit the best possible curve to the data. The normal distribution has the advantage that, in contrast to the *t*-distribution used by the logit estimation method, its tails are not fat. Clustering at the country level ensures that standard errors are corrected for the downward bias induced by aggregate determinants

(Moulton 1990). The standard errors produced by this procedure are equally robust to heteroscedasticity.

Following Duval (2003) and Dorn and Sousa-Poza (2005b), we employ the following set of institutional and macroeconomic determinants of early retirement: real average gross replacement rate, decrease of pension wealth accrual, the OECD indicator of employment protection legislation (EPL index), the level of unemployment rate, and GDP per capita, all measured at the time of retirement. These factors not only vary between countries but also over time. The variables "average gross replacement rate" and "decrease of pension wealth accrual" relate to the pension system: the first proxies pension system generosity; the second measures the growth in pension income foregone by early retirement. As an additional institutional factor, the OECD employment protection legislation index takes into account (1) regulations governing the terms and conditions of permanent contracts in case of individual dismissals, (2) additional provisions in the face of mass layoffs, and (3) regulations governing the possibility of hiring on temporary contracts. Finally, both GDP per capita and the unemployment rate measure a country's general economic condition.

Sociodemographic factors of influence provided by the SHARE data include gender, marital status at the time of retirement, age of retirement, year of retirement, level of education, type of employment (civil servant, employed, or self-employed), hierarchical position, and firm size at the time of retirement. Also proxied are the level of education and the age of the partner at the time of retirement.[11] Most explanatory variables are dichotomous except for age and year of retirement, which are continuous and have been logarithmized to account for nonlinearity.

5. Empirical results

Table 3 displays the results for the estimated models of early retirement determinants. Model (1) contains only sociodemographic and positional determinants, while model (2) is augmented by institutional and macroeconomic factors. Finally, in model (3) we add information on partner characteristics, a specification that reduces the sample to those pensioners who were not single, separated, or divorced at the time of retirement. The model

[11] In contrast to Dorn and Sousa-Poza (2005), inclusion of last wage was not possible because of the vast number of missing observations for that question. Similarly, no information was available on whether the partner was active in the labor market at the time of retirement.

fit appears substantially altered when we include the institutional and macroeconomic determinants.

Model (1) shows that, ceteris paribus, female workers have a lower probability of retiring early.[12] This widely recognized phenomenon is also reported by micro studies for Switzerland (Dorn and Sousa-Poza 2005b, Bütler et al. 2004) and for workers over 63 in Norway (Røed and Haugen 2003). In model (1), in contrast to findings in other micro studies (e.g. Holtmann et al. 1994 for the U.S., Røed and Haugen 2003 for Norway), being married does not seem to influence the early retirement decision. However, the direction of influence of the interaction term "being married and female" indicates a tendency to early retirement, which would support previous findings for individual retirement decisions in Switzerland (e.g., Bütler et al. 2004). Moreover, even though its significance is disguised by the inflated standard error generated by its high correlation with "being female" and "married," the Wald test reveals a joint significance at the 5 percent level.

Worker education level appears equally decisive for premature withdrawal from the labor force. Being educated beyond primary school is associated with a higher probability of early retirement (with a significance of up to the 1 percent level). Such a positive linkage between years of education and propensity to retire early is also reported for the U.S. (Holtman et al. 1994), Switzerland (Dorn and Sousa-Poza 2005b), and Norway (Røed and Haugen 2003). Indeed, it may well be that level of education proxies for preretirement wage level (not reported in the SHARE data), an interpretation supported by survey analyses for the U.S (Johnson et al. 2003, Holtman et al. 1994).

In contrast, retirement age is apparently negatively associated with the decision to cease work before the legal age of retirement, with quite a substantial marginal effect. That is, as workers near the official retirement age, they become less prone to leave the active labor force prematurely, which mirrors the estimation outcome of an earlier micro study for the U.S. (Holtmann et al. 1994). An alternative supply argument (in line with Johnson 2000) is that the shorter the remaining work life, the stronger the domination of a wage increase's substitution effect over the wealth effect, which motivates the laborer to work relatively longer. However, the year in which (early) retirement occurs shows no significant impact on the probability of retiring early, which indicates that there are no systematic time trends in retirement.[13] This

[12] Since in Europe standard retirement age rarely changes over time but often differs between genders (see Table A1 of the Appendix), the impact of a "standard age" variable, usually employed in studies with aggregate panels (see Duval, 2003), is captured by the "gender" variable. This is different in the U.S. where both sexes retire at the same age.

[13] Identical estimation results are obtained when we classify retirement years into categories rather than using a continuous variable.

finding echoes that of an earlier international micro study on involuntary retirement decisions in which age of retirement but not point in time was important (Dorn and Sousa-Poza 2005a). As regards job characteristics, in contrast to earlier studies that find both work experience and tenure to be positively related to early retirement (Dorn and Sousa-Poza 2005b for Switzerland, Bratberg et al. 2004 for Norway), in this study (whose measures may not be exactly comparable) the more years worked in the last employment, the lower the probability of early retirement.

Firm size[14] also seemingly plays an important role in early retirement decisions. Those employed in small to medium sized firms retired earlier than their colleagues in very small firms (0 to 5 employees), while being employed in a firm of 200 employees or more had no impact whatsoever on the retirement decision. This result contrasts with the strong positive impact on retirement decisions for firms above a specific size found by three micro studies for Europe (Røed and Haugen 2003 for Norway, Dorn and Sousa-Poza 2005b for Switzerland, Wübbeke 1999 for Germany). This difference may be explained by variations in model specifications, data quality, and the crossnational nature of our sample.[15] A supply side explanation of this finding is that firm size may impact (albeit indirectly) the speed of a worker's pension wealth accumulation through net wages, with the influence potentially following an inverted U-curve.[16] Indirect supporting evidence for the existence of such a non-linear impact can be drawn from analyses on the relationship between firm size and the remuneration of unobservable worker characteristics or the size of health premia (Ferrer and Lluis 2004; Popkin and Company 2005).[17]

In terms of position characteristics, we test the influence of the laborer's supervisory power[18] as a proxy for managerial position. Supervising a small or medium number of workers (1 to 199 persons), as opposed to having no supervisory power at all, increases the probability of early retirement, with a marginal effect of about 1 percentage point. However,

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[14] In the case of self-employed individuals, we use the size of their own company.

[15] Using the categorical variable "firm size" as a continuous variable produces an inverted U-curve relation between firm size and the probability of early retirement, with each coefficient being significant at the 1 percent level.

[16] Although counterintuitive, company pension funds may also have become more generous in local small and medium sized companies than in large, primarily international, global players, which are less dependent on attracting locals as workers. For the U.S., there is evidence that between 1979 and 1998, pension coverage through firm funds decreased substantially for firms employing more than 500 people (by 17 percentage points) but increased slightly for firm sizes smaller than 100 (about 5 percentage points) (Medoff and Calabrese 2001).

[17] For the U.S. and Canada, Ferrer and Lluis (2004) show that wage components for unobservable worker characteristics follow an inverted U-curve in firm size—with the maximum at medium sized firms. However, health premiums follow a U-curve, indicating they are highest for both small and large firms (c.f., Popkin and Company 2005 for U.S. firms).

[18] In the case of the self-employed, we use the number of the individual's own employees.

top managers show no significantly higher propensity to depart from the active labor force prematurely.[19]

Finally, as regards employment sector, being employed in a state industry (rather than being self-employed) is positively associated with the probability of departing before the pension age (at the 1 percent level of significance), with marginal effects of about 1 percentage point. Moreover, workers in the private sector also appear prone to cease work prematurely (at the 5 percent significance level). However, the early retirement behavior of civil servants is no different than that for the self-employed persons who serve as the reference category.

Model (3) tests the additional influence of the education level of the worker's partner, as well as age at the time of retirement. All coefficients for the various levels of partner's education have a positive sign, indicating a probability-raising influence on the decision to retire early (with a partner having no education constituting the reference group). Whereas having a partner with tertiary or secondary II education exerts a significant impact, having a partner with primary education (just) misses significance at the 10 percent level. Moreover, the coefficients on secondary I and postsecondary II education levels are insignificant. From a supply side perspective, having a partner with a higher education level can be expected to correlate strongly with higher earnings that may relax budget constraints on the potential retiree, making retirement affordable at an earlier point in time.

Our variables of primary interest — the institutional and macroeconomic factors of influence — are included in models (2) and (3). Even though the impact of sociodemographic, job, and firm characteristics appears quite robust to the inclusion of these variables,[20] in most cases, their marginal effects are up to ten times more sizeable in these more complete models. On a national level, the pension system itself exerts considerable influence over the retirement decision. Specifically, whereas the system's generosity, as measured by the average replacement rate (i.e., the transformation rate of the last earnings into the first pension payment), does not significantly impact the probability of retiring before the legally stipulated

[19] Employing the "number of supervised employees" categorical variable in specification (2) produces a strong nonlinear functional form of supervisory power having the shape of an inverted U-curve (at the 1 and 5 percent levels of significance). Similarly, employing a dichotomous variable indicating "supervisory power" results in a decreasing impact on early retirement at the 10 percent level of significance.

[20] Small differences are observable for the coefficient on "married," which now, in line with previous studies (e.g., Holtmann et al. 1994 for the U.S., Røed and Haugen 2003 for Norway), becomes significant at the 10 percent level. Additionally, the full interaction effect now yields a mean effect of 0.00869. Also newly significant is the positive impact of primary school education, which loses its significance in models (2) and (3), due possibly to the inclusion of the labor legislation protection index. In model (2), the positive impact for group leaders in a department (supervision of 1 to 5 persons) observed in model (1) disappears. Supervisory power loses its importance in specification (3), most probably because of the inclusion of partner's educational level. Finally, in model (3), being employed in the private industry loses significance.

age, the decrease in pension wealth accrual is a decisive determinant (significant up to 1 percent in model(3)). This finding echoes earlier reports by Blöndal and Scarpetta (1999) and Johnson (2000, 2001) of substantially higher significance levels for pension wealth accrual than for average replacement rate (whose coefficients in their estimated models are mostly insignificant). Indeed, our estimation results show that, as predicted, a higher absolute decrease in the pension wealth accrual rate (the implicit tax on continued working) significantly lowers the propensity to cease work prematurely. Clearly, from a worker's perspective, not retiring early when the financial opportunity costs in form of a loss in pension wealth are high is a rational decision. Alternatively, from a firm's perspective, inducing employees to quit becomes more difficult (i.e., costly) when workers are experiencing a strong financial incentive to keep their jobs (Hutchens 1999). In addition, the pension wealth accrual effect dominates the influence of the average replacement rate, not only in significance but also in the magnitude of its marginal effect. Moreover, even though the marginal effects are of comparable magnitude (−0.42 vs. −0.47), taking into account their actual mean values, the impact of the implicit tax rate (mean = 2.59) is clearly greater than that for the average replacement rate (mean = 0.48). The marginal impacts reported in Blöndal and Scarpetta (1999, Table V.3) for changes in male labor force participation rates are additional supportive evidence for this dominance.[21] Moreover, the low correlation of 0.42 in model (2) between wealth accrual and the replacement rate is closely matched in model (3). Nonetheless, exclusion of the wealth accrual rate has no effect on the insignificance of the average replacement rate coefficient in either model, while, in turn, exclusion of the average replacement rate shows a tendency toward higher significance.[22]

The other institutional determinant under investigation is the strictness of employment protection legislation, which, in contrast to empirical evidence on forced early retirement (Dorn and Sousa-Poza 2005a), shows no significant influence on early retirement decisions in either model (2) or (3). Thus, no support is found for either the conjecture that a higher degree of protection is an indicator of more generous early retirement schemes or that it exerts a discouraging effect on workers, nor for the prediction that greater protection creates legal obstacles to worker redundancy. Whereas it is possible that the ambiguous influences of

[21] A similar dominance in terms of elasticities but a contrasting dominance in terms of relative magnitudes are reported in Johnson (2001). We must note, however, that his implicit tax measure is not fully comparable to the decrease in pension wealth accrual by Blöndal and Scarpetta (1999).

[22] In contrast, in an analysis based on country data, Johnson (2000, 2001) reports a correlation higher than 0.8 and finds both pension system variables too closely related to make their separate impacts distinguishable (although it should be noted that his pension system-related variables are not identical to our data). Indeed, Duval (2003) addresses the high correlation in his own data by using a joint index that incorporates both factors.

single components in this compound index cancel each other out,[23] it is equally likely that countries with more generous pension systems are also those with the strongest protection of workers' rights (e.g., Germany or Switzerland as two contrasting extremes). Indeed, in models (2) and (3), the correlation between the protection through labor legislation and the two pension system variables exceeds 0.31 and amounts to 0.48. Also observable is a strong but negative correlation between the EPL index and level of GDP (-0.77 and -0.80, respectively). However, exclusion of the pension system and the GDP variables does not raise the significance of the labor protection coefficient to any conventional level, even though its *t*-value is considerably increased. Nevertheless, the signs of the EPL index in both models point to a potential to decrease early retirement.

At the aggregate level, economic performance also impacts the probability of early retirement: in models (2) and (3). Higher levels of national income are (albeit at the 10 percent level) negatively correlated with early retirement.[24] From a labor demand viewpoint, such production of goods and services in the economy is difficult to maintain if a large part of the working staff departs prematurely from the active labor force. However, from a supply perspective, this finding, even though it contrasts with our predictions, can be rationalized by the reduced amount of consumed leisure when a wage increase's substitution effect dominates the income effect. That is, people trade off leisure and work at a different rate than before the increase. Supportive evidence for this assumption is provided by Johnson's (2000) finding of a procyclical effect on the labor force participation rate of older men with respect to short-term GDP growth once unemployment rate is controlled for.[25]

Equally, in both models, an increase in the unemployment rate leads to a higher propensity to retire early (at the 1 percent level), a finding comparable to results with aggregate data (e.g., Blöndal and Scarpetta (1999) and those studies described in section 2. Thus, in economically worse times (defined in terms of change in unemployment rate), early retirement is more probable. This finding supports the demand perspective expectation that the probability of retirement is higher in the presence of economic shocks that call for a rejuvenation of the firm's workforce. At the same time, the supply side perspective addends

[23] According to Duval's (2003) argument, the indirect impact of some components of the EPL index' on labor demand may already be captured by the unemployment rate, which calls for an analysis excluding competing aggregate determinants.

[24] Taking the log of the GDP per capita does not alter the sign of the coefficient; the significance slightly misses the 10 percent level.

[25] It should be noted that estimation results employing only one of the two macroeconomic determinants might suffer from an omitted variable bias. Then, as noted in Johnson (2001), the wealth and the unemployment effect could become inseparable. However, in our specification, change in unemployment and GDP per capita are only slightly correlated (*rho* about 0.11) and omission of the unemployment variable leads to no increased significance level for the GDP variable.

the expectation that higher unemployment growth might be linked to the discouragement effect, which propels laid off workers directly into early retirement (see section 2).

Table 3: Determinants of early retirement across Europe

	(1)	(1a)	(2)	(2a)	(3)	(3a)
	Earlyret	Marg effect	Earlyret	Marg effect	Earlyret	marg effect
Female	-0.668**	-0.024**	-0.542*	-0.094*	-0.414	-0.079
	(2.69)	(2.69)	(2.03)	(2.03)	(1.30)	(1.30)
Married	0.016	0.001	0.268(*)	0.048(*)		
	(0.13)	(0.13)	(1.75)	(1.75)		
Female * married	0.092	0.003	0.023	0.004		
	(0.39)	(0.39)	(0.08)	(0.08)		
Primary school	0.386	0.01	0.923*	0.114*	1.135**	0.163**
	(1.12)	(1.12)	(2.27)	(2.27)	(2.71)	(2.71)
Secondary I	0.736**	0.016**	0.900*	0.099*	1.220**	0.142**
	(2.70)	(2.70)	(2.44)	(2.44)	(2.86)	(2.86)
Secondary II	0.795**	0.019**	0.890*	0.112*	1.034*	0.153*
	(2.91)	(2.91)	(2.17)	(2.17)	(2.40)	(2.40)
Postsecondary II	1.157**	0.012**	1.765**	0.092**	2.214**	0.117**
	(2.97)	(2.97)	(4.74)	(4.74)	(5.63)	(5.63)
Tertiary I or II	0.729**	0.014**	0.961*	0.100*	1.183**	0.142**
	(2.66)	(2.66)	(2.46)	(2.46)	(2.87)	(2.87)
Ln (retirement age)	-17.379**	-0.545**	-26.694**	-4.224**	-25.528**	-4.775**
	(5.09)	(5.09)	(6.44)	(6.44)	(5.42)	(5.42)
Ln (year of retirement)	-31.864	-1.000	-0.483	-0.077	43.39	8.116
	(1.06)	(1.06)	(0.00)	(0.00)	(0.33)	(0.33)
Years working in last job	-0.010**	-0.000**	-0.001	0.000	0.000	0.000
	(2.98)	(2.98)	(0.34)	(0.34)	(0.01)	(0.01)
Firm size 6–15	0.208**	0.006**	0.294**	0.041**	0.363**	0.058**
	(2.60)	(2.60)	(3.79)	(3.79)	(6.08)	(6.08)
Firm size 16–24	0.265**	0.007**	0.400**	0.051**	0.399(*)	0.061(*)
	(3.15)	(3.15)	(3.90)	(3.90)	(1.78)	(1.78)
Firm size 25–199	0.197**	0.006**	0.256**	0.038**	0.249(*)	0.043(*)
	(3.41)	(3.41)	(3.55)	(3.55)	(1.65)	(1.65)
Firm size 200–499	0.115	0.003	-0.065	-0.011	0.097	0.017
	(1.17)	(1.17)	(0.33)	(0.33)	(0.47)	(0.47)
Firm size >500	0.19	0.005	0.121	0.018	0.139	0.024
	(1.55)	(1.55)	(0.53)	(0.53)	(0.69)	(0.69)
Supervision 1–5	0.217*	0.006*	0.004	0.001	-0.004	-0.001
	(2.49)	(2.49)	(0.07)	(0.07)	(0.06)	(0.06)
Supervision 6–24	0.336**	0.008**	0.212*	0.030*	0.177	0.031
	(5.81)	(5.81)	(2.45)	(2.45)	(1.13)	(1.13)
Supervision 25–199	0.23(*)	0.006(*)	0.142	0.021	0.146	0.025
	(1.83)	(1.83)	(1.57)	(1.57)	(0.54)	(0.54)
Supervision >200	-0.121	-0.004	-0.098	-0.017	-0.099	-0.02
	(0.48)	(0.48)	(0.32)	(0.32)	(0.23)	(0.23)
Private industry	0.292*	0.010*	0.270(*)	0.043(*)	0.233	0.044
	(2.41)	(2.41)	(1.91)	(1.91)	(1.17)	(1.17)
Civil servant	0.017	0.001	-0.031	-0.005	-0.072	-0.014
	(0.16)	(0.16)	(0.20)	(0.20)	(0.27)	(0.27)
State industry	0.735**	0.015**	0.685**	0.085**	0.779**	0.115**
	(3.39)	(3.39)	(3.48)	(3.48)	(3.17)	(3.17)

Table 3: Determinants of early retirement across Europe (cont.)

GDP per capita		-0.186(*)	-0.029(*)	-0.174	-0.033
		(1.71)	(1.71)	(1.45)	(1.45)
Average replacement rate		-0.297	-0.047	-0.419	-0.078
		(0.45)	(0.45)	(0.61	(0.61)
Decrease in wealth accrual		-0.263*	-0.042*	-0.333**	-0.062**
		(2.58)	(2.58)	(2.58)	(2.58)
Change in unemployment		0.199**	0.031**	0.232**	0.043**
		(3.69)	(3.69)	(2.75)	(2.75)
EPL index		-0.386	-0.061	-0.06	-0.011
		(0.61)	(0.61)	(0.09)	(0.09)
Primary school partner				0.668	0.108
				(1.61)	(1.61)
Secondary I partner				0.635	0.092
				(1.48)	(1.48)
Secondary II partner				0.672*	0.107*
				(2.07)	(2.07)
Postsecondary II partner				0.487	0.068
				(1.35)	(1.35)
Tertiary I or II partner				0.604(*)	0.087(*)
				(1.78)	(1.78)
Ln (age of partner at retirement date of interviewee)				-0.041	-0.008
				(0.05)	(0.05)
Constant	313.642	118.727		-220.815	
	(1.35)	(0.15)		(0.22)	
Observations	7194	3382		1260	
Log pseudolikelihood	-2073.2758	-948.7751		-366.9059	
Pseudo R^2	0.4671	0.5260		0.5059	
Wald test (female, married, interaction)	8.48*	22.05**			
Wald test (married, interaction)	0.47	18.04*			

6. Conclusion

The question of what determines early retirement has grown in importance as industrialized countries grapple with ageing populations. In the face of such changing demographics, early withdrawal of employees and self-employed persons from the active labor force will affect both economic growth and the sustainability of social security systems. Thus, policy makers need to understand not only the individual and job-related characteristics that drive early retirement but also its institutional and macroeconomic determinants.

On the institutional level, this study — one of very few cross-national analyses based on a rich set of microdata — supports previous findings based on aggregate data. In particular, our study reveals that pension systems offering generous early retirement options encourage early departure from the labor market. It also finds that the influence of the pension wealth accrual rate to be stronger than that of the average replacement rate. Additionally, in terms of macroeconomic determinants, higher national wealth is associated with a lower probability of early retirement, while a growing unemployment rate triggers more early retirement. The added value of our analysis with respect to these factors of influence lies in having obtained more robust estimators since a wide range of individual characteristics have been controlled for — something studies based on country-level data cannot account for.

We also tested the potential impact of the protection of employment using a newly constructed measure by the OECD. As opposed to the results of Blöndal and Scarpetta (1999) in their aggregate analysis, our investigation shows that employment protection legislation (EPL) exerts no observable influence on early retirement.

On an individual level, married female workers and those with a better education are more likely to retire early, while the probability of early retirement is lower for persons close to the statutory pension age. In general, a company will try to induce premature quitting in employees they deem less productive. On the other hand, workers may prefer to retire earlier when the net gain from premature departure is greater than the net benefit from working longer. Thus, not surprisingly, job characteristics, firm size, and industry also influence retirement decisions. Interestingly, these individual- and firm-specific determinants of early retirement do not correlated with institutional and macroeconomic factors.

Policy makers, as our estimation results imply, should consider lowering the probability of early retirement by amending pension systems to make early retirement a less attractive choice. One suitable lever might be the pension wealth accrual rate — a lower implicit tax on continued working would significantly decrease incidences of early retirement. Alternatively, decreasing the unemployment rate would lead to a stabilization of the social security and health systems across Europe. Nonetheless, this alternative, while it may prove favorable, represents a more long-term goal. The pension system lever, on the other hand, might exert considerable influence in the short term.

References

Ahituv, A. and Zeira, J. (2000), Technical Progress and Early Retirement, C.E.P.R. Discussion Paper No. 2614.

Blöndal, S. and Scarpetta, S. (1999), The Retirement Decision in OECD Countries, *OECD Economics Department Working Papers*, No. 202, OECD Publishing.

Bratberg, E., Holma, T.H., and Thøgersen, Ø. (2004), Assessing the effects of an early retirement program, *Journal of Population Economics* 17, pp. 387–408

Bütler, M., Popa, O. and Teppa, F. (2004), What Triggers Early Retirement? Results from Swiss Pension Funds, C.E.P.R. Discussion Paper No. 4394, May 2004.

Dorn, D. and Sousa-Poza, A. (2004), Motives for Early Retirement: Switzerland in an International Comparison. Discussion Paper of the Research Institute for Labor Economics and Labor Law at the Univeristy of St. Gallen No 99, St. Gallen FAA-HSG.

Dorn, D. and Sousa-Poza, A. (2005a), Early Retirement: Free Choice or Forced Decision? CESifo Working Paper No. 1542.

Dorn, D. and Sousa-Poza, A. (2005b), The determinants of early retirement in Switzerland, *Swiss Journal of Economics and Statistics*, 141(2), pp.247–283.

Duval, R. (2003), The Retirement Effects of Old-Age Pension and Early Retirement Schemes in OECD Countries. EOCD Economics Department Working Paper No. 370. Paris: OECD.

Ferrer, A. and Luis. S. (2004), Should Workers Care About Firm Size? University of British Columbia and University of Minnesota, unpublished manuscript. Available from: http://www.econ.ubc.ca/ferrer/firmsize.pdf

Gruber, J. and Wise, D.A. (1998), Social security and retirement: An international comparison, *American Economic Review*, 88 (2), pp. 158–63.

Gruber, J. and Wise, D.A. (1999), *Social Security and Retirement around the World*. Chicago: University of Chicago Press.

Gruber, J. and Wise, D.A. (2002), Social Security Programs and Retirement around the World: Micro Estimation, NBER Working Paper No. 9407.

Gruber, J. and Wise, D.A. (2005), Social Security Programs and Retirement around the World: Fiscal Implications, Introductions and Summary. NBER Working Paper No. 11290.

Johnson, R. (2000), The Effect of Old-Age Insurance on Male Retirement: Evidence from Historical Cross-Country Data, Federal Reserve Bank of Kansas City, Research Working Paper No. RWP 00–09.

Johnson, R. (2001), The Effect of Old-Age Insurance on Female Retirement: Evidence from Cross-Country Time-Series Data, Federal Reserve Bank of Kansas City, Research Working Paper No. RWP 01–08.

Johnson, R.W., Davidoff, A.J., and Perese, K. (2003), Health insurance costs and early retirement decisions, *Industrial and Labor Relations Review,* 56 (4), pp.716–729.

Holtmann A.G., Ullman, S. G. Fronstin, P., and Longino, C. F., Jr. (1994), The early retirement plans of women and men: An empirical application, *Applied Economics*, 26, pp.591–601.

Lazear, E.P. (1986), Retirement from the Labor Force, in O. Ashenfelter and R. Layard (eds), *Handbook of Labor Economics*, Vol. 1, North Holland, Amsterdam.

Popkin, J. & Company (2005), *Cost of Employee Benefits in Small and Large Business*, Report developed for the Small Business Administration, Office pf Advocacy, August 2005 Available from: http://www.sba.gov/advo/research/rs262tot.pdf

Medoff, J. L. and Calabrese, M. (2001), The Impact of Labor Market Trends on Health and Pension Benefit Coverage and Inequality, Final Report to the Pension and Welfare Benefit Agency, U.S. Department of Labor, 2001. Available through: http://www.newamerica.net/Download_Docs/pdfs/Pub_File_608_1.pdf

Mitchell, O.S. and Fields, G.S. (1982), The effects of pensions and earnings on retirement: A review essay, in , R.G. Ehrenberg (ed.), *Research in Labor Economics*, Vol. 5. London: JAI Press.

Mitchell, O.S. and Fields, G.S. (1984), Determinants of the optimal retirement age: An empirical investigation, *Journal of Human Resources*, 19(2), pp. 245–62.

Moulton, B.R. (1990), An illustration of a pitfall in estimating the effects of Aggregate variables on micro units, *Review of Economics and Statistics* 77(2), pp. 334–338.

Norton, E.C. and Ai, C. (2003), Interaction terms in logit and probit models, *Economics Letters* 80, pp.123–129.

Norton, E.C., Wang, H., and Ai, C. (2004), Computing interaction effects and standard errors in logit and probit models, *Stata Journal* 4 (2), pp.103–116.

OECD (1995), The transition from work to retirement, *Social Policy Studies No. 16*, Paris.

Peracchi, F. and Welch, F. (1994): Trends in labor force transitions of older men and women, *Journal of Labor Economics*, 12(2): 210–242.

Pozzenbon, S. and Mitchell, O.S. (1989), Married women's retirement behavior, *Journal of Population Economics*, 2(1), pp. 39–53.

Robinson, W.S. (1950), Ecological correlations and behavior of individuals, *American Sociological Review* 15, pp. 351–357.

Røed, K. and Haugen, F. (2003), Early retirement and economic incentives: evidence from a quasi-natural experiment, *Labour*, 17 (2), pp. 203–228.

Stern, S. (1994), Ability, promotion, and optimal retirement, *Journal of Labor Economics* 12(1), pp. 119–137.

Stern, S. (1987), Promotion and optimal retirement, *Journal of Labor Economics* 5(4), p. 107–123.

Walker, A. (1985), Early retirement: Release or refuge from the labour market? *Quarterly Journal of Social Affairs*, 1(3), pp.211–229.

Wübbeke, Ch. (1999), Der Übergang von sozialversicherungspflichtiger Beschäftigung in den Rentenbezug zwischen sozialpolitischer Steuerung und betrieblichen Interessen. Eine Untersuchung der Ursachen des Frühverrentungstrends in Westdeutschland für den Zeitraum von 1975 bis 1990 auf der Basis der IAB-Beschäftigtenstichprobe, *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung* 32(1), pp.102–117.

Appendix

Table A1: Entitlement ages for the public retirement pension system

	1961	1975	1995	2003	1961	1975	1995	2003
	Male				Female			
Country								
Austria	65	65	65	65	60	60	60	60
Germany	65	65	65	65	65	65	65	65
Sweden	67	67	65	65	67	67	65	65
Netherlands	65	65	65	65	65	65	65	65
Spain	65	65	65	65	65	65	65	65
Italy	60	60	62	65	55	55	57	65
France	65	65	60	60	65	65	60	60
Denmark	67	67	67	65	67	67	67	65
Greece	65	62	62	65	60	57	57	65
Switzerland	65	65	65	65	63	62	62	63

Source: Blöndal and Scarpetta (1999), Table III.1. According to the authors, in most of the OECD countries, the entitlement age has been unchanged since the early 1960s. Values for 2003 are taken from Duval (2003), Table 1.

Table A2: OECD Index of Labor Market Protection, Version 1

Country	1990	1998	2003
Austria	2.2	2.2	1.9
Denmark	2.1	1.4	1.4
France	2.7	3	3
Germany	3.2	2.5	2.2
Greece	3.6	3.5	2.8
Italy	4.1	2.7	1.9
Netherlands	2.7	2.1	2.1
Spain	3.7	2.9	3.1
Sweden	3.5	2.2	2.2
Switzerland	1	1.1	1.1

Table A3: Summary statistics for models (1), (2), and (3)

	Model 1 7194 observations				Model 2 3382 observations				Model 3 1260 observations			
	Mean	Std.dev.	Min.	Max.	Mean	Std.dev.	Min.	Max.	Mean	Std.dev.	Min.	Max.
Early retirement	0.7687	0.4217	0	1	0.7212	0.4485	0	1	0.7238	0.4473	0	1
Female	0.4623	0.4986	0	1	0.3888	0.4876	0	1	0.4595	0.4986	0	1
Married	0.8707	0.3355	0	1	0.8684	0.3381	0	1				
Female*married	0.3692	0.4826	0	1	0.2995	0.4581	0	1				
Primary school	0.2820	0.4500	0	1	0.2833	0.4507	0	1	0.2889	0.4534	0	1
Secondary I	0.2178	0.4128	0	1	0.1916	0.3936	0	1	0.1746	0.3798	0	1
Secondary II	0.2816	0.4498	0	1	0.2912	0.4544	0	1	0.3000	0.4584	0	1
Postsecondary	0.0142	0.1182	0	1	0.0216	0.1453	0	1	0.0190	0.1367	0	1
Tertiary I or II	0.1490	0.3561	0	1	0.1715	0.3770	0	1	0.1849	0.3884	0	1
Ln (retirement age)	4.0264	0.2109	2.7081	4.5433	4.0927	0.0852	3.6636	27.5727	4.1010	0.0796	3.6636	4.3820
Ln (retirement year)	7.5960	0.0057	7.5679	7.6029	7.5995	0.0021	7.5959	0.8	7.5989	0.0020	7.5959	7.6029
Years in last job	25.7123	13.6863	0	75	26.9181	13.1310	0	7.9	26.6341	13.3648	0	75
Firm size 6 – 15	0.1732	0.3784	0	1	0.1715	0.3770	0	2.98	0.1619	0.3685	0	1
Firm size 16 – 24	0.0955	0.2939	0	1	0.0952	0.2935	0	4.1	0.1000	0.3001	0	1
Firm size 25 – 199	0.2592	0.4383	0	1	0.2812	0.4496	0	4.4543	0.2786	0.4485	0	1
Firm size 200 – 499	0.0820	0.2744	0	1	0.0840	0.2774	0	7.6029	0.0897	0.2858	0	1
Firm size > 500	0.1087	0.3113	0	1	0.1230	0.3285	0	75	0.1071	0.3094	0	1
Supervision 1–5 persons	0.1592	0.3659	0	1	0.1721	0.3775	0	1	0.1825	0.3864	0	1
Supervision 6–24 persons	0.1219	0.3272	0	1	0.1434	0.3505	0	1	0.1357	0.3426	0	1
Supervision 25–199 persons	0.0562	0.2302	0	1	0.0668	0.2498	0	1	0.0659	0.2482	0	1
Supervision > 200 persons	0.0132	0.1142	0	1	0.0154	0.1231	0	1	0.0143	0.1187	0	1
Private industry	0.5374	0.4986	0	1	0.5198	0.4997	0	1	0.5056	0.5002	0	1
Civil servant	0.1054	0.3070	0	1	0.1056	0.3073	0	1	0.0841	0.2777	0	1
State industry	0.1972	0.3979	0	1	0.2312	0.4217	0	1	0.2508	0.4336	0	1
GDP per capita					21.5913	2.2491	15.5353	1	21.4672	1.9480	15.5353	26.9767

Table A3: Summary statistics for models (1), (2), and (3) (cont.)

Average replacement rate	0.4831	0.2753	0	1	0.4614	0.2737	0	0.8
Decrease in wealth accrual	2.5896	2.4268	0	1	2.4452	2.3315	0	7.9
Unemployment rate	-0.0490	0.9813	-3.32	1	0.0909	0.9641	-3.32	2.98
EPL index	2.5797	0.6130	1	1	2.6272	0.6270	1	4.1
Primary school–partner					0.3095	0.4625	0	1
Secondary I–partner					0.1722	0.3777	0	1
Secondary II–partner					0.2952	0.4563	0	1
Postsecondary–partner					0.0270	0.1621	0	1
Tertiary I or II–partner					0.1563	0.3633	0	1
Ln (age of partner at retirement date of interviewee)					4.1061	0.1045	3.6109	4.4543

Table A4: Definition of variables

Early retirement	1 if retirement age is below the legal pension age, 0 otherwise
Female	1 if gender is female, 0 otherwise
Married at time of retirement	1 if person was married or with partner at the time of retirement, 0 other wise. Variable constructed using information on retirement year civil status, year of separation or death of partner
Female * married	Interaction term of "female" and "married"
Primary school	1 if person attended an institution of primary education, 0 otherwise
Secondary I	1 if person attended an institution of secondary I education, 0 otherwise
Secondary II	1 if person attended an institution of secondary II education, 0 otherwise
Postsecondary	1 if person attended an institution of postsecondary education, not leading to a tertiary degree, 0 otherwise
Tertiary I or II	1 if person attended an institution of tertiary I or II education, 0 otherwise
Ln (retirement age)	Logarithm of retirement age. Retirement age is retirement year minus year of birth.
Ln (retirement year)	Logarithm of retirement year.
Years in last job	Number of years worked with the last employer before retirement
Firm size	Categorical variable based on firm size information of employers and civil servants and firm size information of self-employed. 0 indicates smallest size (1 person firm) and 6, largest (more than 500 employees)
Firm size 6–15	1 if firm size is between 6 persons and 15 persons, 0 otherwise
Firm size 16–24	1 if firm size is between 16 and 24 persons, 0 otherwise
Firm size 25–199	1 if firm size is between 25 and 199 persons, 0 otherwise
Firm size 200–499	1 if firm size is between 200 and 499 persons, 0 otherwise
Firm size > 500	1 if firm size is more than 500 persons, 0 otherwise
Supervision	Categorical variable based on information of the number of supervisees in the last job in case of employees and civil servants, and based on the size of firm in case of self-employed persons. 0 indicates the lowest number of responsible persons (0 persons) and 6, the highest (more than 500 persons).
Supervision 1–5 persons	1 if person had managerial power over 1 to 5 persons in last job, 0 otherwise
Supervision 6–24 persons	1 if person had managerial power over 6 to 24 persons in last job, 0 otherwise
Supervision 25–199 persons	1 if person had managerial power over 25 to 199 persons in last job, 0 otherwise
Supervision > 200 persons	1 if person had managerial power over 200 persons in last job, 0 otherwise
Private industry	1 if person was employed in private industry, 0 otherwise
Civil servant	1 if person was a civil servant in last job, 0 otherwise
State industry	1 if person was employed in state industry in last job, 0 otherwise

Table A4: Definition of variables (cont.)

GDP per capita	Annual real GDP per capita in 1,000 U.S. dollars, constant prices, chain series, from 1950–2000 from PWT, 6.1. Missing data from 2001 to 2004 are constructed based on the values of the last year available and annual GDP per capita growth rates from the World Bank (WDI).
Average replacement rate	Expected gross replacement rate (over next 5 years) at age 60 in regular retirement pension system, averaged across six different life situations (3 earnings levels — 60%, 100% and 140% of average earnings — and 2 marital statuses — single or married with dependent spouse of same age). For most countries, values from 1990–1999 and 2003 are available; for some, even earlier time series starting in the late 1960s. Values for 2004 have been replaced by values for 2003. From 2000 to 2002 and elsewhere, feasible missing values in all countries were replaced by linear interpolation. Data made available by courtesy of Mr. Duval, OECD. For Denmark and Greece, this information was unavailable.
Decrease in wealth accrual	Cumulated pension wealth accruals for singles on average wages, 1967 and 1995, (Table III.6, Blöndal and Scarpetta, 1999, p. 65.) in year of retirement, for postponing retirement from 55 to 65 years of age. For Greece (both years) and for Spain (1967), this information was unavailable. Missing values between 1967 and 1995 were replaced by linear interpolation. From 1995 on, values for the year 1995 were used.
Unemployment rate	Unemployment rates from the OECD; gaps were filled with WDI data. For Austria and the Netherlands, time series data were largely replaced with WDI data to ensure data comparability (Austria) and the longest possible time series (Greece, Netherlands). Nonstandardized rates were also used to ensure maximum length of time series. Some gaps were filled with linearly interpolated data, where other data sources were unavailable, particularly for values in the mid-1960s and first measurements in the early 1970s for Spain. For many countries, data were unavailable before the 1980s or even the 1990s.
EPL index	Index of Labor Market Protection (OECD), Version 1, available for the years 1990, 1998, 2003. Missing values were approximated by linear interpolation. Values for 2004 were replaced by values for 2003.
Primary school–partner	1 if partner attended an institution of primary education, 0 otherwise
Secondary I–partner	1 if partner attended an institution of secondary I education, 0 otherwise
Secondary II–partner	1 if partner attended an institution of secondary II education, 0 otherwise
Postsecondary–partner	1 if partner attended an institution of postsecondary education, not leading to a tertiary degree, 0 otherwise
Tertiary I or II–partner	1 if partner attended an institution of tertiary I or II education, 0 otherwise
Ln (age of partner at retirement date of interviewee)	Logarithm of age of partner in the retirement year of interviewee. Age is interviewee's retirement year minus partner's year of birth.