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Hours of work and retirement behavior*

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Abstract

Using a novel dataset from the 2006 Portuguese Labor Force Survey this paper examines the impact of a voluntary reduction in hours of work, before retirement, on the moment of exit from the labor force. If, as often suggested, flexibility in hours of work is a useful measure to postpone retirement, then a reduction in working hours should be associated with retirement at later ages. Results prove otherwise suggesting that reducing hours of work before retirement is associated with early exits from the labor force. A reduction in hours of work seems to signal the worker's wish to retire sooner rather than to announce the desire of remaining in the labor market. This result may enclose the need for some alternative policy strategies regarding working hours.

Keywords: aging, retirement, working hours, older workers
JEL classification: J14, J26, J22, J21

1 Introduction

Population aging is increasing the ratio of retirees to workers rising sustainability issues to Social Security systems. To ease financial pressures as well as to increase older workers labor force participation policy makers have been promoting the expansion of working lives finding measures that postpone labor market exit attractive.

This has been enforced through the elimination of mandatory retirement, the adoption of age discrimination legislation[1] and/or increasing legal retirement age. Nonetheless, the effect of these measures on older workers labor supply is not straightforward. For instance, Shannon and Grierson (2004) show that making compulsory retirement illegal would have a small impact on the size of the older workforce and, for that reason, such a policy alone would not solve the problems associated with an aging population and the consequent

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[1] Age discrimination laws prohibit discrimination in hiring, promotion, wages or firing on the grounds of age. These laws may also forbid the inclusion of statements or specifications in job notices, or advertisements, of age preference and limitations; the laws can additionally prohibit mandatory retirement based on age.

reduction in the share of the population employed, while Ashenfelter and Card (2002), studying the effect of the elimination of mandatory retirement at age 70 on faculty retirement patterns, conclude that such elimination decreased by approximately two thirds the retirement rates of 70 and 71 year olds.

On the other hand, Adams (2004) suggests that age discrimination legislation increases employment among individuals that are in the legally protected age ranges and that there is a decline in retirement among the protected workers. Also, Neumark and Stock (1999) show that age discrimination laws lead to steeper age-earnings profiles in the labor market and that they strengthen the relationship between workers and firms, leading to the adoption of Lazear (1979) contracts. Furthermore, the authors find that age discrimination legislation increases the relative employment of older workers.

Focusing on the labor demand implications of a change in the legal retirement age for women in Portugal, Martins *et al.* (2009) find that older women affected by the new law faced virtually no change in wages and working hours.

There seems to be no unique and effective instrument to achieve a longer and higher participation of older individuals in the labor force. This paper brings another variable to the discussion on active aging policies: it studies the impact of a reduction in hours of work before retirement on the age of exit from the labor force. Indeed, combining a reduction in working hours with increased leisure time at older ages may motivate individuals to work longer while gradually withdrawing from the labor market. As individuals age, their preference for work and leisure experience a change since older workers may get higher satisfaction from additional hours of leisure and less hours of work than younger workers. Also, due to health constraints or care obligations, as workers age they may want to reduce their hours of work. This change in the valuation of time implies a change in reservation wages over the life cycle, which influences the labor force participation decision.[2]

If workers could freely choose hours of work they would prefer to gradually reduce their time at work as they age (Gustman and Steinmeier, 2004). Since the decision does not depend solely on the individual's will, gradual retirement is not as common as workers would like it to be (Hutchens and Grace-Martin, 2006). Although there is evidence for the United States that some workers engage in 'part-time' retirement by working fewer hours in the years prior to complete withdrawal from the labor force (Ruhm, 1990; Burtless and Moffit, 1985; Gustman and Steinmeier, 1984), most people move directly from full-time

[2] Stylized facts show that labor force participation rates are smaller for older workers (aged 55-64) than for prime-age workers (25-54 years old).

work to full-time retirement (Hutchens and Grace-Martin, 2006). As Gielen (2009) notes, a discrete drop in hours of work is only observed at the time of retirement, not before.

Given that most often workers face the choice of working full-time or no time (retirement), the constraint in hours of work may influence the labor force participation decision. In fact, there are broad indications suggesting that reduced hours of work would contribute to raise employment rates of older individuals. In the European Union, older workers are already over-represented in part-time employment and Member States, like Sweden, with higher shares of older workers in part-time employment tend to present higher employment rates for the 55-64 age group. However, part-time employment is not very common in the Portuguese labor market[3] and, nevertheless, the economy shows high employment rates for older individuals.

Despite the fact that flexibility in hours of work is perceived to be a relevant policy mechanism to increase older individuals' labor force participation, few studies focused on its effect on labor supply. Among these, Gustman and Steinmeier (2004) show that working hours' flexibility extends the working lives of older workers, but produces only a small net increase in labor supply. Gielen (2009) finds that, especially for full-time workers, over-employed older women (those reporting that they wish to work fewer hours than the actual hours of work) leave the labor force prematurely due to the absence of gradual retirement opportunities. Nonetheless, a striking finding is that flexibility in hours of work would result in a reduction of older workers' labor supply since the increase in labor participation of older workers due to the extension of their working careers is cancelled out by a decline in working hours of over-employed older individuals.

From a labor demand point of view, the work by Hutchens and Grace-Martin (2006) studies how and why establishments differ in their willingness to permit an older worker to take phased retirement. Phased retirement is perceived to be a way of encouraging older workers to extend their working lives. In this sense, workers reduce their working hours without changing employers (Hutchens and Papps, 2005). The former authors conclude that employers are willing to permit phased retirement but primarily as an informal arrangement. Opportunities for phased retirement are greater in establishments that employ part-time workers, allow job sharing and have flexible starting times (this latter result is also obtained by Blau and Schvydko, 2007).

[3] In 2007, part-time employment in Portugal accounted for 10% of overall employment (European Commission, 2007).

If flexibility in hours of work, as a means of gradual retirement, can effectively delay the exit from the labor force then workers who actually take advantage of such flexibility are expected to leave the labor market later in their lives.

Overall, retirement decisions are influenced by individual characteristics, demographic factors, and financial incentives (Mitchell and Fields, 1984; Dugan, 1984; Belloni and Alessie, 2008), health conditions (Burtless and Quinn, 2000; Bartel and Sicherman, 1993; Hanoch and Honig, 1983; Quinn, 1977) and labor market constraints (Osberg, 1993; Bartel and Sicherman, 1993; Friedberg, 2003; Dorn and Sousa-Poza, 2009). This paper examines the influence of working hours' reduction before retirement on the retirement decisions of older individuals and intends to provide an answer to the following questions: is the reduction in hours of work associated with retirement at later ages? Can it be used to extend older workers' labor force participation and delay the complete withdraw from the labor force? We find that a voluntarily reduction of working hours is associated with exit from the labor market at earlier ages.

The main contribution of this research is to explore the relevance of working hours' reduction on the retirement behavior of older individuals. No such study exists for Portugal and, hence, besides the novelty of this research for the Portuguese labor market it is also a new contribution to the incipient literature on the subject. Additionally, we take advantage of a recent and, to our knowledge, not yet used inquiry called "Transition to Retirement", conducted simultaneously with the 2006 Portuguese Labor Force Survey.

The paper proceeds as follows. The next section provides an overview of the major legislation changes on retirement benefits eligibility in Portugal. Section 3 describes the data. Section 4 presents the model and the empirical strategy. Results are shown in Section 5 while sensitivity analysis is performed in Section 6. A summary and discussion conclude the paper.

2 Legal setting on retirement in Portugal

To accommodate demographic aging and its impact on the Social Security system the Portuguese government has approved several legislation changes concerning retirement over the last fifteen years.

Since 1999, 65 years is the minimum legal age that grants access to full retirement pension both for male and female workers in Portugal. By the end of 1993, the promulgation of a legal diploma set a gradual standardization of the legal retirement age (LRA) for both men and women, with effectiveness from 1994 onward. Until then, the

LRA was 65 years for men and 62 years for women, and this law increased the LRA for women by six months every year until reaching 65 years old (the LRA by 1999). Other major changes introduced by the law were, on one hand, a raise from 10 to 15 in the required number of years with payments to Social Security for a worker to become eligible for retirement benefits and, on the other hand, a change on the pensions' method of computation.

At the beginning of 1999, and in the course of macroeconomic growth, the age of access to retirement was rendered more flexible, according to contributions' profiles. In this sense, a new law made it possible for workers at least 55 years old and a working career of 30 complete calendar years to become eligible to pension benefits. Even though there was a reduction factor linked to early retirement pensions, this flexibility imposed significant financial pressure on the Social Security system. As a consequence, the legal norms that allowed access to a pension before the worker reached the legal retirement age were suspended in 2005. Early retirement schemes became once again possible in 2007, over a new law that was published for discussion in November 2006, but with severe penalties imposed to pensions. The 2007 law also prohibits the accumulation of early retirement pension earnings with labor earnings if the worker remains in the same firm or corporation.

Through legal changes, policy makers are trying to delay older workers' exit from the labor force. In effect, as is inscribed in the 2012 Portuguese Government Budget Law proposal, the minimum early retirement age will increase to 57 years old.

An important feature of the Portuguese legislation on retirement is that there is no possibility of partial retirement, that is, workers cannot continue in the labor market through part-time employment while receiving partial retirement pension. Retirement is a full-time job.

For a comprehensive synopsis on retirement legislation changes in Portugal see Appendix A.

3 Data

The data used in the empirical analysis comes from a specific module of the Portuguese Labor Force Survey (*Inquérito ao Emprego*) called "Transition to Retirement". These data were collected by the Portuguese Statistics Office (INE) and they refer to the second quarter of 2006. The module was addressed to individuals aged 50 to 69, inclusive, employed and non-employed. Non-employed individuals must have left the last job with 50

or more years of age. The aim of the module is to obtain exhaustive and comparable information on the transition from active life into retirement, in order to keep track of the progresses made in achieving the goals defined in the European Union towards promoting active aging and postponing the exit from the labor force.

Table 1 shows the sample values for the Labor Force Survey (second quarter of 2006) and the "Transition to Retirement" module.

Table 1: Sample values, Labor Force Survey (LFS) (second quarter 2006)

	Total	Men		Women	
		Total	%	Total	%
Individuals surveyed in the LFS	45,166	21,584	47.79	23,582	52.21
Individuals aged 50 to 69 in the LFS	11,685	5,439	46.55	6,246	53.45
Individuals surveyed in the module	9,485	5,044	53.18	4,441	46.82

Source: Explanation document from the Labor Force Survey's 2006 module "Transition to Retirement", INE.

Women represent more than half of the Labor Force Survey sample, and this is also the case for the subsample of individuals aged 50 to 69. However, gender representation is reversed in the "Transition to Retirement" module, with men accounting for 53% of the responses. Therefore, the module sample does not reproduce accurately the Labor Force Survey's gender composition.

From the initial sample we have excluded the military for they face a specific labor market (22 individuals), students (26 observations), and also unpaid household workers (371 observations - 99% of which are women) or other inactive older individuals (386 observations) due to a fragile involvement in the labor market. Also, we left out the unemployed (236 observations) because their motivation towards the reduction in hours of work is naturally biased, since they want to increase their actual number of hours of work (and, therefore, may report the intention of no reduction in hours of work just because they are currently out of employment), and the self-employed (2871 observations) since they can more freely alter hours of work than employees.

The sample includes individuals with 15 or more years of work (80 observations deleted) because this is the minimum required number of years with payments to Social Security for a worker to become eligible for retirement benefits. Finally, miners and fishermen were also excluded (73 observations) since, due to the legally recognized weary nature of these occupations, they are subject to specific retirement legislation and may withdraw from the labor force before age 65. These exclusions led to the sample size depicted in Table 2.

Table 2: Study sample

	Sample	
Labor market status	Total	%
Employed	3,319	62.94
Retired (1)	1,954	37.06
Total	5,273	100

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.
Note: (1) These have completely withdrawn from the labor force.

The questionnaire of the "Transition to Retirement" module is presented in Appendix B. Besides the variables collected through the questionnaire, the database includes additional information taken from the Labor Force Survey like gender, age, marital status, education, labor market situation (employed, unemployed, retired, home worker, student, other inactive) and nationality. For employed individuals it also presents information on the location, industry and size of the firm where they work and on the occupation, type of contract, date of admission into the firm, regime of work (part-time or full-time), hours of work and earnings. For those non-employed it shows the reason for leaving the last job, occupation held and the industry where he/she worked. Information on labor earnings before retirement is inexistent. Unfortunately, non-employed respondents were not asked about their labor income prior to retirement or unemployment. Also, the survey does not include any measure of the individual's wealth. This is regrettable since income and wealth are important determinants of the retirement decision (Hanoch and Honig, 1983; Mitchell and Fields, 1984; Dugan, 1984; Ruhm, 1990).

Question 2 of the "Transition to Retirement" survey is the question of interest in this research: "Did you reduce or do you intend to reduce your working schedule before exiting the labor force?" The inquiry's instructions state that "exiting the labor force" means having no professional occupation with earnings as motivation, regardless of the legal retirement age. A summary of the possible answers is illustrated in Table 3 according to the individuals' labor market status. Answering "Yes, I have reduced it" means that the individual has intentionally reduced his/her working hours to prepare the exit from the labor force.

Table 3: Working hours' reduction before retirement, by labor market status

Hours' reduction (before retirement)	Employed	Retired(1)
(a) Yes, I have reduced it	3.25%	20.98%
(b) No, but I intend to reduce it in the next 5 years	11.96%	--
(c) No, and I have no intention to do so in the next 5 years / Did not reduce	30.37%	79.02%
(d) Will not reduce	54.41%	--
Observations	3,319	1,954

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.
Note: (1) Retired individuals that have answered "No, but intends to reduce it in the next 5 years" or "Won't reduce" were reclassified into the category "Did not reduce" for they are already out of the labor force.

As Table 3 shows, one in five retirees has reduced hours of work before retirement. These individuals averaged 64 years of age in 2006 and 59 years old when they started collecting a retirement pension, which is clearly below the legal retirement age. Data additionally show that those who did and those who did not reduce hours of work present the same age averages; thus, one may start wondering about the efficacy of hours' reduction on postponing the exit from the labor force. Nevertheless, early retirement was very attractive in Portugal until 2005. Negligible penalties on pension benefits associated with labor market exit before age 65 made early retirement very appealing. Hence, this sample feature of labor force withdrawal before reaching the legal retirement age may be explained by Social Security incentives.

As for employed older individuals, only a little more than 3% report a reduction in hours of work to prepare their exit from the labor force and their mean age is 59 years old. On average, these individuals are older than the ones who have not reduced their working hours.

Other two questions of relevance are: Question 3b "At what age do you intend to leave the labor force?" and Question 7b "At what age did you start collecting a retirement pension?" Question 3b is addressed to individuals who are still in the labor force, in this case employed older individuals, while Question 7b is directed both at people who might already be retired and at employed individuals. The mean intended age of retirement is 64 years old and 59 is the mean and median age of start of pension collection. Conditional on being in the labor force, employed individuals report a higher "expected" age of retirement when compared to the average age of retirement of retirees (64 versus 59 years old, respectively). Considering that in 2005 (see Appendix A) a legal diploma suspended all early retirement schemes, making the collection of pension benefits only possible at age 65 or over, retirement expectations of active individuals are surely influenced.

Table 4 provides detailed descriptive statistics of the sample used in the empirical analysis by gender and labor force status. The average working career of Portuguese workers is considerably long. Retired individuals have worked for almost 40 years and they started collecting retirement pension benefits before age 60, on average. Women have shorter careers in the labor force but they retire at slightly later ages than men. Overall, Table 4 also shows that a reduction of hours of work is not very common in the Portuguese labor market: less than 10%[4] of the individuals report a reduction in hours of work as a way of gradual retirement. Women reduce hours of work to a greater extent than

[4] Of the individuals reporting hours' reduction 1/3 work in full-time jobs. Overall, only 8% of the individuals in the sample are in part-time employment.

men, and this difference is more pronounced for those still in the labor force (i.e, employed).

Table 4: Descriptive statistics, by gender and labor force status

Variable	All			Men			Women		
Labor force status	All	Retired	Employed	All	Retired	Employed	All	Retired	Employed
Age[1]	56.84	58.82	55.68	56.85	58.67	55.75	56.84	59.02	55.59
	(4.86)	(4.72)	(4.56)	(4.82)	(4.69)	(4.56)	(4.91)	(4.74)	(4.57)
Years of work[1]	37.95	39.60	36.98	39.30	40.81	38.39	36.35	38.11	35.33
	(7.93)	(7.95)	(7.76)	(7.20)	(7.22)	(7.04)	(8.45)	(8.53)	(8.23)
Reduction[2] (Yes)	9.82	20.98	3.25	8.45	19.96	1.51	11.46	22.23	5.29
Activity sector									
Agriculture	5.59	7.37	4.55	5.17	4.92	5.31	6.10	10.38	3.66
Industrial	28.43	31.83	26.42	37.52	39.00	36.63	17.61	23.03	14.50
Services	65.98	60.80	69.03	57.31	56.08	58.05	76.29	66.59	81.84
Blue-collar	54.45	53.89	54.78	59.23	55.15	61.69	48.75	52.34	46.70
Education									
0 years	11.87	19.75	7.23	8.62	12.91	6.04	15.74	28.16	8.62
4 years	51.55	46.88	54.29	56.37	55.25	57.05	45.81	36.60	51.08
6 years	6.77	5.73	7.38	7.19	6.59	7.55	6.27	4.68	7.18
9 years	11.06	11.21	10.97	11.55	12.53	10.96	10.47	9.58	10.97
High school	6.92	6.45	7.20	6.70	6.87	6.60	7.18	5.93	7.90
University	11.83	9.98	12.93	9.56	5.85	11.80	14.53	15.05	14.24
Region									
North	24.50	22.72	24.83	25.55	24.88	25.95	22.26	20.07	23.51
Centre	12.90	10.39	14.37	13.16	10.21	14.93	12.58	10.60	13.72
Lisbon	22.57	25.74	20.70	21.40	26.18	18.51	23.96	25.20	23.25
Alentejo	15.91	17.86	14.76	14.21	15.04	13.70	17.94	21.32	16.00
Algarve	9.84	9.77	9.88	9.56	10.03	9.28	10.17	9.46	10.58
Azores	6.96	7.47	6.66	8.48	8.82	8.28	5.15	5.82	4.77
Madeira	7.78	6.04	8.80	7.64	4.83	9.34	7.93	7.53	8.16
Active spouse[3]	62.58	23.45	85.94	67.73	39.62	87.86	59.48	11.74	84.91
Observations	5,273	1,954	3,319	2,865	1,077	1,788	2,408	877	1,531

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.
Notes: For retired individuals, the variable *Age* refers to the age of start of pension benefits' receipt. [1]Continuous variables: standard deviations are presented in parenthesis. All other variables are dummies and values reported are percentages. [2]Answers (b), (c) and (d) of Question 2 were gathered into a single category "Did not reduce". [3]There are 2,670 observations for the variable *Active spouse*.

Almost two thirds of the individuals in the sample work in Services, which is also the activity sector where a reduction in hours of work before retirement is more prevalent, both for men and women. For 54% of the individuals the occupation held was classified as blue-collar. The definitions of blue/white collar and the industries included in each of the activity sectors are presented in Appendix C (Tables C1 and C2).

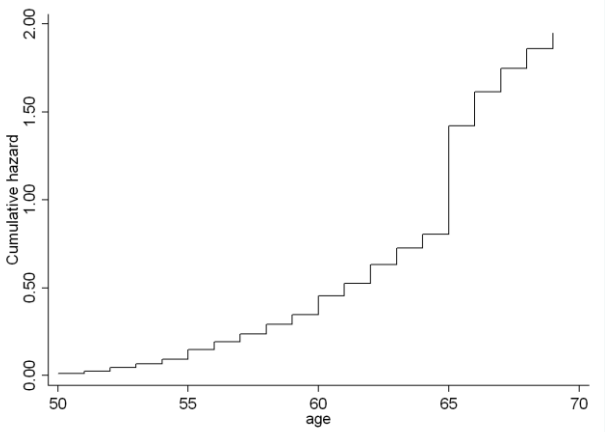
The sample is characterized by low educational levels: more than 60% of the individuals have 4 or less years of school attainment. This feature of the sample is not surprising given the age range of the individuals, 50 to 69 years old (which means that they were born between 1937 and 1964) and the fact that until 1986 mandatory schooling in Portugal comprised just 6 years.[5] However, almost 12% of the individuals show higher

[5] In 1929, mandatory schooling in Portugal comprised 3 years and, in 1955, it increased by 1 year for men. Only in 1961 mandatory schooling was standardized in 4 years for both men and women and, three years later, it was increased by 2 years; a law passed in 1986 set it at 9 years for students with first school registration in the 1987/1988 academic year and subsequent years. Hence, in 1995/1996 mandatory schooling comprised 9 years.

education attainment, with women reporting a higher incidence of this higher educational level.

A worker's participation in the labor force may be modelled using survival analysis where survival is interpreted as the presence in the labor market. The use of survival analysis techniques to describe the data, which is done in Figure 1, shows that, as expected, the cumulative hazard[6] in Figure 1 is rising with age at an increasing rate and it faces a considerable increase at age 65. As shown in Table 5, after age 65 the probability of survival is around 0.17, indicating that at that age roughly 83% of the sampled individuals were out of the labor force.

Figure 1: Nelson-Aalen cumulative hazard estimates



Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.

Table 5: Kaplan-Meier survival and Nelson-Aalen cumulative hazard functions

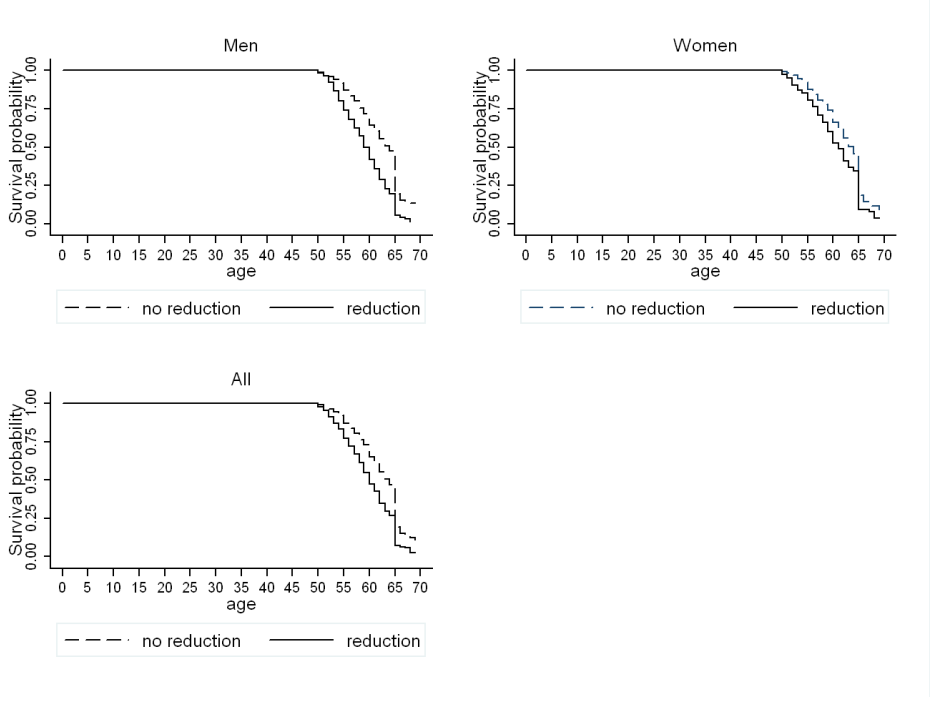
Age	Beginning total	Failures	Survivor function	Standard error	Cumulative hazard	Standard error
50	5,273	70	0.9867	0.0016	0.0133	0.0016
51	4,868	57	0.9752	0.0022	0.0250	0.0022
52	4,471	83	0.9571	0.0029	0.0435	0.0030
53	4,066	90	0.9359	0.0036	0.0657	0.0038
54	3,638	101	0.9099	0.0043	0.0934	0.0047
55	3,261	179	0.8600	0.0055	0.1483	0.0062
56	2,803	124	0.8219	0.0062	0.1926	0.0074
57	2,465	108	0.7859	0.0068	0.2364	0.0085
58	2,159	117	0.7433	0.0075	0.2906	0.0099
59	1,877	105	0.7017	0.0081	0.3465	0.0113
60	1,623	177	0.6252	0.0090	0.4556	0.0140
61	1,282	88	0.5823	0.0095	0.5242	0.0158
62	1,097	119	0.5191	0.0101	0.6327	0.0186
63	874	83	0.4698	0.0105	0.7277	0.0213
64	694	54	0.4333	0.0108	0.8055	0.0238
65	565	346	0.1679	0.0098	1.4179	0.0406
66	164	32	0.1352	0.0095	1.6130	0.0533
67	98	13	0.1172	0.0094	1.7456	0.0648
68	53	6	0.1040	0.0098	1.8588	0.0796
69	23	2	0.0949	0.0108	1.9458	0.1006

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.

[6] The Nelson-Aalen estimator is a non-parametric estimator of the cumulative hazard function consisting of a staircase function. The steps are located at each observed death time and the vertical size of the steps is computed as 1/(number at risk), where (number at risk) is the count of subjects just before the death that are still observed to be alive.

Relating the *Age* of exit from the labor force with the *Reduction* variable, Figure 2 plots the survival function by reduction status (that is, if the individual reduced or not his/her hours of work) and gender. It shows that those with a reduction in hours are more likely to exit the labor market at earlier ages. This is true for both men and women, but the difference in survival times by reduction status is higher for men than for women.

Figure 2: Kaplan-Meier survival function estimates, by reduction status and gender



Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.

The Nelson-Aalen cumulative hazard functions, by reduction status, shown in Table 6, reveal that the hazard increases at a higher rate for those who reduce hours of work than it does for the individuals who do not reduce hours of work.

Table 6: Nelson-Aalen cumulative hazard functions, by reduction status

Age	No reduction	Reduction
50	0.0120	0.0251
52	0.0378	0.0928
54	0.0824	0.1838
56	0.1762	0.3191
58	0.2655	0.4710
60	0.4169	0.7135
62	0.5730	0.9986
64	0.7329	1.2380
66	1.5332	2.0601
68	1.7280	2.7030

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.

4 Econometric setup

4.1 Transition data models: a parametric approach

Transition or duration analysis models the length of time spent in a given state (for instance, in the labor force) before transition to another state (e.g. retired). The time of transition to retirement is called "failure time". A "state" is a qualitative characteristic of an individual at a specific point in time, "transition" is the change from one state to another, and a "spell" length or duration is the time spent in a given state.

In the empirical analysis there are two possible states a person can be in: active (in the labor force) or retired (out of the labor force). By failure time we mean the age of retirement (the age of exit from the labor force). The hazard rate is defined as the probability that retirement will occur at a particular age to an individual, given that the individual is at risk (i.e. in the labor force) at that age. The hazard is an unobserved variable, but it controls both the occurrence and the timing of events (or state transitions). Therefore, it is the fundamental dependent variable in transition data models. If the hazard is known to depend strongly on age but only weakly on time since other starting point (the date of entry in the labor force), then age is the most appropriate way to define the time scale (Allison, 1984).

Due to the nature of the data used, some individuals are already in the initial state (thus we do not observe the date of entry into the labor market). This is relevant for the definition of the "spell". With age as the time scale and because the starting times are not observed, the spell is the duration of an individual's life until retirement. From now on we will call this duration a "spell of activity" (although it does not measure the number of working years).

We assume that, once an individual leaves the initial state (becomes retired), he/she remains in inactivity (that is, there is no reversed retirement; individuals do not come back to the labor force after retirement) which is not a very strong assumption considering that, according to the European Commission (2007), more than 99% of the people that were inactive in a given year remain inactive in the following year.

Transition or survival data are usually censored since some spells are incompletely observed. A complete spell of activity can be seen for retirees but for subjects that are still in the labor force we do not observe the complete spell of activity. That means that data are right-censored or censored from above. Censoring is the main reason for modelling

transitions instead of the mean duration as weaker distributional assumptions are needed to obtain consistent estimates (Cameron and Trivedi, 2005).

A Weibull parametric regression model is used to study the effect of a reduction in hours of work on the age until which a person remains in the labor force. The Weibull has a hazard function given by $\lambda(t) = \gamma \alpha t^{\alpha-1}$,[7] where γ is the hazard rate, α is a shape parameter indicating the monotonicity of the function and *t* is a time variable. The hazard function will be monotonically increasing if $\alpha > 1$ and monotonically decreasing if $\alpha < 1$. The Weibull distribution assumes that $\gamma > 0$ and $\alpha > 0$. In other words, it considers a hazard that it is not constant over time.

Estimation of the Weibull model is made by maximum likelihood. Following Cameron and Trivedi (2005), with censored data the observed survival time *t* is the age at an incomplete spell, and the data are augmented by a censoring indicator variable. For right-censored observations it is known that the age of retirement exceeded *t* so the contribution to the likelihood is

$$\Pr[T > t] = \int_t^{\infty} f(u \mid \mathbf{x}, \boldsymbol{\theta}) du = 1 - F(t \mid \mathbf{x}, \boldsymbol{\theta}) = S(t \mid \mathbf{x}, \boldsymbol{\theta}) \qquad (1)$$

where *T* denotes the age of retirement without censoring, $\mathbf{x}$ are regressors that can vary across individuals but do not vary over a spell for a given individual and $\boldsymbol{\theta}$ is a $q \times 1$ parameter vector. $S(.)$ represents the survivor function.

The conditional density for the *i* th observation is $f(t_i \mid \mathbf{x}_i, \boldsymbol{\theta})^{\delta_i} S(t_i \mid \mathbf{x}_i, \boldsymbol{\theta})^{1-\delta_i}$, where δ_i is a right-censoring indicator with

$$\delta_i = \begin{cases} 1, \text{ if complete spell (no censoring)} \\ 0, \text{ if incomplete spell (right censoring)} \end{cases}$$

Taking logs and summing, assuming independence over *i*, the maximum likelihood estimator $\hat{\boldsymbol{\theta}}$ maximizes the likelihood function

$$\ln L(\boldsymbol{\theta}) = \sum_{i=1}^{N} [\delta_i \ln f(t_i \mid \mathbf{x}_i, \boldsymbol{\theta}) + (1 - \delta_i) \ln S(t_i \mid \mathbf{x}_i, \boldsymbol{\theta})] \qquad (2)$$

In the Weibull model, regressors are usually introduced by letting $\gamma = \exp(\mathbf{x}'\boldsymbol{\beta})$, ensuring that $\gamma > 0$ while α, the shape parameter, does not vary with regressors. Then,

$$\ln f(t \mid \mathbf{x}, \boldsymbol{\beta}, \alpha) = \ln[\exp(\mathbf{x}'\boldsymbol{\beta}) \alpha t^{\alpha-1} \exp(-\exp(\mathbf{x}'\boldsymbol{\beta}) t^{\alpha})] = \mathbf{x}'\boldsymbol{\beta} + \ln \alpha + (\alpha - 1) \ln t - \exp(\mathbf{x}'\boldsymbol{\beta}) t^{\alpha}$$

and

[7] The survivor function is given by $\exp(-\gamma t^{\alpha})$

$$\ln S(t \mid \mathbf{x}, \boldsymbol{\beta}, \alpha) = \ln\left[\exp\left(-\exp(\mathbf{x}'\boldsymbol{\beta})t^{\alpha}\right)\right] = -\exp(\mathbf{x}'\boldsymbol{\beta})t^{\alpha}$$

Then, the likelihood function in (2) becomes

$$\ln L = \sum_i \left[\delta_i \left\{\mathbf{x}'_i \boldsymbol{\beta} + \ln\alpha + (\alpha - 1)\ln t_i - \exp(\mathbf{x}'_i \boldsymbol{\beta})t_i^{\alpha}\right\} - (1 - \delta_i)\exp(\mathbf{x}'_i \boldsymbol{\beta})t_i^{\alpha}\right] \qquad (3).$$

The key policy variable in the model is the reduction of hours on work before retirement and its impact on the retirement hazard is of relevance for this analysis.

4.2 Variables used in the estimation

Working hours' reduction is the explanatory variable of interest in the model. Question 2 of the survey allows four possible answers (see Table 3). We consider answers (c) and (d) as being the same for those employed, meaning that they will not reduce hours of work before exiting the labor force. The main issue is how to treat the workers' 'intentions of reduction' (answer (b)). For retirees this problem does not arise since they either reduced or did not reduce their hours of work before leaving the labor market. As for employed individuals the treatment is not as straightforward.

Nevertheless, in order to explore this variable we use two different classifications for it. First, we consider just the actions that have occurred so far, that is, treat the intentions as non-actions. We therefore construct a variable called *Reduction A* which equals 0 if the person did not/will not reduce hours of work or if he/she intends to do so, and 1 if the individual has already reduced. If, however, intentions can predict future actions, treating intentions as actions might be useful to study the influence of an action (reduction in hours of work) on an outcome (labor force participation) when the specific action has not yet occurred. The study of intentions and subsequent behavior is a subject of relevance in Psychology. The theory of reasoned action (Ajzen and Fishbein, 1980;[8] Fishbein and Ajzen, 1975) postulates that a person's intention to engage in a behavior is the immediate determinant of that behavior. In other words, people are expected to behave in accordance with their intentions. Evidence also provides support to the theory by showing high correlations between intentions and actual behavior that range from 0.72 to 0.90 (Ajzen, 2005). In the light of this theory, and as a second alternative, we treat reported intention of reducing hours of work as an action in order to study its effect on the elderly 'survival' in the labor force. The resulting variable is *Reduction B* which is equal to 0 if the person will

[8] Cited from Ajzen (2005).

not reduce hours of work and 1 if the individual did reduce or intends to do so. We expect that using these alternative *Reduction* variables will enable us to see how sensitive the age of exit from the labor force is to the assumptions made for the variable of interest.

Age is the analysis time variable and it refers to the actual age for the people that are still active (incomplete spells) but, for retired individuals (complete spells), it is the age of retirement. We use the age at which the individual started receiving a retirement pension as a proxy for the age of retirement, since the survey does not ask when he/she actually withdrew from the labor force (the retirement age) but it asks the age he/she started collecting a pension.[9] This is done in order to capture the approximate moment of failure (exit) for retirees. Also, in Question 3b of the survey people report the age at which they intend to retire and this age intention is used as the analysis time variable for employed subjects when using the *Reduction B* as the covariate of interest.

Another limitation as a consequence of the questionnaire's design is that it is not possible to know when the reduction started (close or far from the effective age of exit) or the amount of hours reduced (for example, if the worker made a transition from full-time to part-time employment, or if it was just a 1 hour reduction). Such information would contribute to the enrichment of the analysis.

Besides the R*eduction* variable we also include in the model regressors like gender, activity sector, type of occupation, education and region of residence. Additionally, for married (or living with a partner) people we include the spouse/partner labor force status (active or retired). Table 7 shows some descriptive statistics of the variables used.

[9] If this module is to be surveyed in the future we suggest the inclusion of a question to obtain the age of retirement.

Table 7: Definition of the variables and mean characteristics

Variable	Definition	Mean or percentage		
		All	Men	Women
Age (time)	Person's age if employed or, if retired, the age of start of pension receipt	56.84 (4.86)[1]	58.66 (5.85)[1]	58.59 (5.96)[1]
Retired (failure)	=1 if the person already exit the labor force	37.06	37.59	36.42
Reduction A	=1 if the individual has effectively reduced his/her hours of work	9.82	8.45	11.46
Reduction B[2]	=1 if the individual did reduce or intends to reduce hours of work	20.12	19.20	21.21
Male	=1 if the person is of male gender	54.33	--	--
Activity sector				
Agriculture	=1 if the person works or worked in the agriculture sector	5.59	5.17	6.10
Industrial	=2 if the person works or worked in the industrial sector	28.43	37.52	17.61
Services	=3 if the person works or worked in the services sector (omitted category)	65.98	57.31	76.29
Blue-collar	=1 if the individual works or has worked in an occupation classified as blue-collar	54.45	59.23	48.75
Education				
0 years	=1 if the person has no complete degree of education	11.87	8.62	15.74
4 years	=2 if the person completed 4 years of education	51.55	56.37	45.81
6 years	=3 if the person completed 6 years of education	6.77	7.19	6.27
9 years	=4 if the person completed 9 years of education	11.06	11.55	10.47
High school	=5 if the person has a high-school diploma	6.92	6.70	7.18
University	=6 if college degree	11.83	9.52	14.53
Region				
North	=1 if the person resides in the North of Portugal (omitted category)	24.05	25.55	22.26
Centre	=2 if the person resides in the Centre	12.90	13.16	12.58
Lisbon	=3 if resides in Lisbon	22.57	21.40	23.96
Alentejo	=4 if he/she resides in Alentejo	15.91	14.21	17.94
Algarve	=5 if he/she resides in Algarve	9.84	9.56	10.17
Azores	=6 if he/she resides in Azores	6.96	8.48	5.15
Madeira	=7 if he/she resides in Madeira	7.78	7.64	7.93
Active spouse[3]	=1 if the spouse is still in activity	62.58	67.73	59.48

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.
Note: [1] Standard deviation of the variable *Age*; [2] There are 2,738 observations for this variable; [3] There are 2,670 observations for the variable *Active spouse*. Number of observations: 5,273.

There are 37% of failures (retirees) in the sample which means that the rest of the observations in the sample are censored.

The overall sample is also characterized by low educational levels. Younger individuals are more educated than older ones. Indeed, only 5% of the individuals aged 65 to 69 have a university degree, against 8%, 13% and 15% for those in the age groups 60-64, 55-59 and 50-54, respectively. Women are overrepresented both at the bottom (0 years) and at the top (university) of the education ladder, and more than ¾ work in the Services. Also, women reduce hours of work more often than men. Table 8 provides additional labor market statistics concerning hours of work, activity sector and gender. It shows that women work fewer hours than men regardless of the activity sector.

Finally, from Table 7, both the likelihood of retirement and the probability of reducing hours of work rise with age.

Table 8: Distribution of employed population by regular hours of work, activity sector and gender (second quarter, 2006)

	Activity sector											
	Agriculture			Industrial			Services			Total		
Regular hours of work	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women
1-10	10.39	6.85	14.10	0.43	0.36	0.62	1.31	0.49	1.99	2.12	1.16	3.26
11-30	39.12	35.58	42.85	2.56	1.75	4.57	8.38	4.59	11.52	10.26	6.94	14.15
31-35	1.90	2.06	1.73	1.40	1.11	2.12	22.02	17.43	25.82	13.37	9.13	18.34
36-40	20.39	23.52	17.11	79.18	77.12	84.34	48.67	52.10	45.82	54.58	58.95	49.82
41 or more	25.20	29.10	21.11	15.54	18.60	7.83	18.83	24.20	14.37	18.58	22.51	14.37

Source: INE. Labor Force Survey, 2nd quarter 2006.

Note: Values reported are percentages. Some columns do not sum 100%, due to missing values.

5 Results

Tables 9 and 10 present the results for the Weibull model in the presence of censoring. Estimates on the Weibull parameter α suggest that the hazard is increasing over time $\alpha > 1$, at an increasing rate ($\alpha > 2$).[10]

Moreover, despite the assumptions made for the *Reduction* variable, results remain unchanged: the reduction of hours of work before leaving the labor market shortens an individual's presence in the labor force. In fact, in Table 9 the coefficient on *Reduction A* at column (1) suggests that reducing hours of work increases the hazard rate by 61% compared to the subjects that did not reduce hours of work. Gielen (2009) finds that working hours flexibility have a positive effect on labor force participation of older women, but increasing working hours flexibility has little effect on raising older workers total labor supply. Nevertheless, Gielen (2009) considers that increasing the legal retirement age would be more effective in raising older workers' labor force participation and concludes that working hours' flexibility may not be a suitable instrument to improve older workers' labor supply. Using simulations, Gustman and Steinmeier (2004) suggest that if firms allowed partial retirement at the same hourly wage, this would impact retirement outcomes: partial retirement would increase from 30% to 67%. When there is no restriction in partial retirement, the percentage completely retired declines by 4.7 to 14.1 percentage points at each year of age between 58 and 65. Additionally, the number fully retired falls by 15.3 and 13.8 percentage points, respectively, for ages 67 and 69. Nevertheless, half the increase in partial retirement comes from full-time work, reducing total hours of work. The authors conclude that, among those aged 62 to 69 who have a long term commitment to the labor market, the flexibility in hours of work would contribute to reduce by 10 to 15 percentage points the fraction completely retired. Partial retirement in that age group would increase by 20 percentage points. If hours' constraints were abolished, partial retirement would increase significantly but full-time employment and full-time retirement would reduce, resulting in a small net increase in full-time equivalent employment. This suggests that working hours' flexibility plays a marginal role in the expansion of overall older workers' labor force participation.

The variable *Reduction* that we use is more limited and less informative than the approaches used in literature. We use only an indicator variable and other studies use hours of work to assess the reduction. Additionally, these studies take advantage of longitudinal

[10] Older people have a higher hazard of exit from the labor force.

data while we use cross-sectional data. Also, previous literature focuses on the labor force participation and not on the age of retirement.

One may wonder if the reduction of hours of work was the result of the will of the worker or if it was initiated by the employer. In the eminence of a layoff firms often reduce hours of work before permanent shutdown and the reduction of working time could be capturing this effect. Nevertheless, considering just the subsample of retirees, a glance at the reason for retirement (Question T10 of the survey) highlights that only 1.5% of the retirees who report a reduction in hours of work before retirement answer "job loss" as the reason for retirement. Therefore, the fear of a potential endogeneity problem can be mitigated.

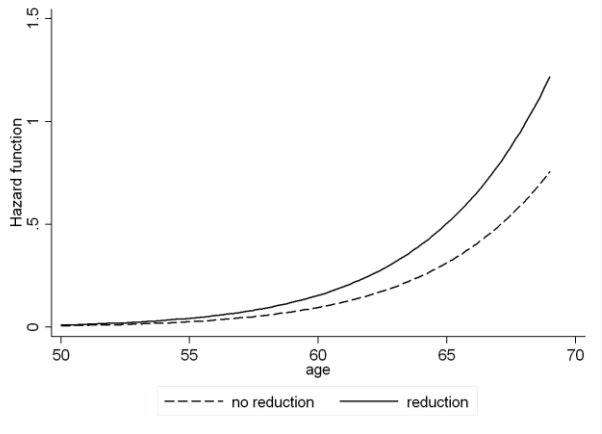
Table 9: Weibull regression coefficients using *Reduction A*

Variable	All (1)	All (2)	All (3)	Men (4)	Women (5)
Reduction A	0.477***	0.330***	0.343***	0.637***	0.330***
	(0.057)	(0.079)	(0.082)	(0.080)	(0.083)
Male	0.018	0.068	-0.036	--	--
	(0.049)	(0.069)	(0.054)		
Reduction A x Male	--	--	0.265**	--	--
			(0.112)		
Activity sector					
Agriculture	0.018	0.020	0.012	-0.397***	0.359***
	(0.098)	(0.133)	(0.098)	(0.153)	(0.133)
Industrial	0.255***	0.291***	0.248***	0.026	0.620***
	(0.056)	(0.082)	(0.056)	(0.072)	(0.088)
Blue-collar	-0.330***	-0.331***	-0.324***	-0.437***	-0.154
	(0.062)	(0.094)	(0.062)	(0.079)	(0.102)
Active spouse	--	-0.886***	--	--	--
		(0.077)			
α	15.749	15.615	15.760	15.475	16.275
	(0.251)	(0.365)	(0.251)	(0.334)	(0.383)
Observations	5,273	2,670	5,273	2,865	2,408
Log likelihood	1,000.678	629.093	1,003.460	556.010	494.336

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.
Note: Standard errors are presented in parentheses. ***/**/* means significance at 1%/5%/10% level, respectively. All models have *Education* and *Region* dummies.

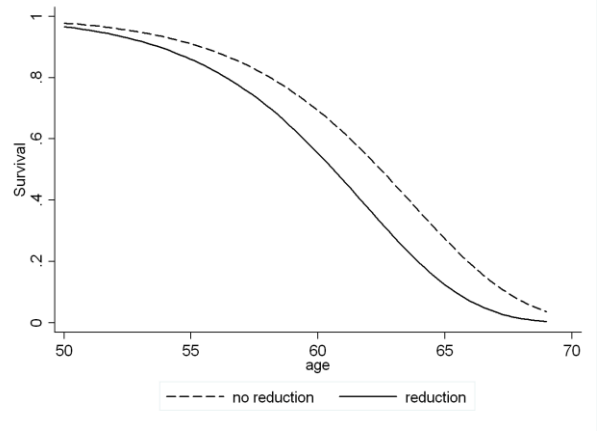
Figure 3 clearly shows that the hazard of retirement increases with age at an increasing rate and that it is higher for individuals that reduced hours of work. The same pattern is obviously reflected in the survival curve in Figure 4. Those that do not reduce working time on average stay longer in the labour market.

Figure 3: Retirement hazard, by reduction status (*Reduction A*)



Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.

Figure 4: Survival curve, by reduction status (*Reduction A*)



Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.

The coefficients for the *Blue-collar* variable are negative and quite similar through columns (1) to (3), Table 9. The coefficient in column (1) shows that blue-collar workers experience a hazard rate that is only 72% of the hazard for white-collar workers. This result is consistent with the findings of Dorn and Sousa-Poza (2005). However, this result may be capturing an income effect. In the absence of income and wealth variables, since blue-collar occupations are associated with lower earnings, that result may hint on the fact that individuals with lower wages retire at later ages.

Looking at column (2) in Table 9, for those who are married or live with a partner, having a wife/husband that is still in the labor force reduces the retirement hazard. Effectively, the hazard of retirement for those who have an active spouse is just 41% of the hazard for those who have a spouse who is already out of the labor force. Dorn and Sousa-Poza (2005) and Johnson *et al.* (2000) present similar findings. The former authors conclude that the odds of retiring early are 44% higher for those with a non-active partner.

While the latter find that individuals were less likely to retire if their spouses were still working than if their spouses were already retired.

The variable *Male* shows no statistical significance, which means that there is no difference in the retirement hazard between men and women. Also, those working in the industrial sector face a 34% higher hazard than those working in services.

Column (3) introduces an interaction term between the *Reduction* variable and gender. Results show that those who reduce hours of work face a hazard 41% higher than those who do not reduce hours. Additionally, men who reduce hours of work increase the hazard of retirement by 30%.

Dividing the sample by gender, separate estimates for men and women are presented in columns (4) and (5) of Table 9. Both for men and women, a reduction in hours of work before retirement is associated with a higher retirement hazard. A Chow test[11] performed on these models rejects the null hypothesis of the equality of coefficients between men and women. Also, for a 95% confidence level, the difference between the gender coefficients on the *Reduction A* variable is statistically significant. For the Swiss case, Dorn and Sousa-Poza (2005) find that men are more likely to retire earlier than women. There are statistical differences in the explanatory power of the covariates for men and women. For men, the retirement hazard of those who reduced hours of work compared to those who did not (1.89) is 60 percentage points higher than the hazard obtained for women (1.39). The interaction term estimate in column (3), Table 9, highlights the above reported difference in the hazard for men and women, between those who reduced hours of work and those who did not.

Comparing columns (4) and (5) in Table 9 we find relevant gender differences concerning the impact of the variable *Activity sector* on the hazard. Effectively, men employed in agriculture experience a retirement hazard that is only 67% of the hazard for men that work in services. There are no differences in the hazard between men employed in services and those in the industrial sector. However, for women, the effect is quite the opposite: women in agriculture and in the industrial sectors face, respectively, a 43% and 85% higher hazard than women employed in services. It seems that being employed in services is associated with retirement at earlier ages for men while, for women, working in services delays retirement. Because work in agriculture and in the industrial sectors is more physically demanding, women may want to exit the labor force earlier. The impact of the variable *Blue-collar* is also different between genders. Men in blue-collar occupations have a

[11] Chi-squared statistic for 15 degrees of freedom is equal to 90.91 (p-value=0.00).

smaller retirement hazard compared to men in white-collar occupations (the hazard for blue-collars is only 65% of the retirement hazard for white-collar men). Since wages are particularly low in blue-collar occupations, these workers probably do not have the financial support needed to exit the labor force at early ages. As for women, there are no statistical differences between the hazards experienced by female employees in white or blue-collar occupations.

Treating intentions as the best predictor of future actions, Table 10 reports the same effect of the *Reduction* variable on the retirement hazard as in the previous analysis.

Table 10: Weibull regression coefficients using *Reduction B*

Variable	All (1)	All (2)	Men (3)	Women (4)
Reduction B	0.124***	0.145**	0.133**	0.162**
	(0.048)	(0.070)	(0.067)	(0.070)
Male	0.033	0.041	--	--
	(0.041)	(0.045)		
Reduction B x Male	--	-0.041	--	--
		(0.096)		
Activity sector				
Agriculture	-0.026	-0.026	-0.224*	0.101
	(0.084)	(0.084)	(0.126)	(0.117)
Industrial	0.098**	0.099**	-0.012	0.316***
	(0.048)	(0.048)	(0.061)	(0.078)
Blue-collar	-0.277***	-0.277***	-0.402***	-0.099
	(0.053)	(0.053)	(0.069)	(0.083)
α	15.290	15.290	15.170	15.686
	(0.203)	(0.234)	(0.315)	(0.355)
Observations	2,738	2,738	1,484	1,254
Log likelihood	3,128.664	3,128.754	1,690.526	1,462.922

Source: Computations from the authors based on the "Transition to Retirement" module data, 2006.
Note: Standard errors are presented in parentheses. ***/**/* means significance at 1%/5%/10% level, respectively.
All models have *Education* and *Region* dummies.

From Table 10, column (1), those who have reduced hours of work before leaving the labor market face a 13% higher hazard of retirement than those who did not. Again, it indicates that the reduction in working hours is associated with retirement at earlier ages.

When intentions are treated as effective actions (*Reduction B*, Table 10) the retirement hazard declines by 48 percentage points compared to the hazard in column (1) of Table 9 (*Reduction A*), but it is still higher for those who reduced hours of work. Therefore, working hours' flexibility will have no effect in expanding older workers' labor force participation. Those who reduce hours of work leave activity earlier than those who do not. As Gielen (2009) suggests, other instruments, like the increase in the legal retirement age, seem to be more effective in delaying the exit from the labor market.

Like in Table 9 columns (3) and (4), Table 10, show separate estimates by gender. Once again, a Chow test[12] performed on these models rejects the null hypothesis of the equality

[12] Chi-squared statistic for 15 degrees of freedom is equal to 53.96 (p-value=0.00).

of coefficients between men and women. However, in this sample, the gender difference for the *Reduction B* is not statistically different from zero (Chi-squared=0.09 and p-value=0.7634). This is in accordance with the statistical significance of the coefficient of the interaction term.

As in Table 9, being employed in the industrial sector reduces the likelihood of remaining in activity: columns (1) and (2) in Table 10 suggest that the hazard of retirement is 10% higher for those working in the industrial sector compared to those employed in services. However, the coefficients on this variable are smaller in Table 10; in fact, the hazard is reduced by 18-19 percentage points[13] when considering *Reduction B* rather than *Reduction A*. Once again, this difference is mainly due to women.

The evidence discussed so far indicates that a reduction in hours of work before retirement seems to be associated with retirement at earlier ages[14]. In fact, when asked (Question 4 of the survey) if working hours' flexibility would work as an incentive to expand labor force participation, more than 90% of the elderly responded negatively.

Portuguese older workers (55-64 years) present high activity and employment rates (54% and 51%, respectively), above the European Union (EU25) average and already above the 50% threshold for the employment rate to be achieved in EU countries by 2010 (European Commission, 2008). Table 4 in section 3 shows a strong link between older workers and the labor market: current and past working careers average above 35 years.

Until August 2005, Portuguese workers were eligible to early retirement benefits as long as they comprise the following conditions: at least 55 years old and a working career of 30 complete calendar years. Although eligible, more than half of the workers who remain in the labor force state the need of obtaining a sufficient household income as the main reason to keep working. Conditional on being in the labor force, more than 2/3 of the workers who did not reduce hours of work report the above reason to remain in the labor force while it is the reason pointed by 50% of those that have reduced hours of work. Additionally, more than 30% of the employed individuals that have reduced hours of work say they continue to work to increase retirement benefits against 20% of the answers for those that have not reduced working hours. The percentage that keeps working for non financial reasons is higher (14%) for subjects with hours' reduction than for those that have not reduced hours of work (9%). There seems to be different financial motivations between individuals that reduce hours of work and those who do not.

[13] The difference results from comparing estimates for the "Industrial" category in Columns (1) and (2), Table 10, with columns (1) and (3) of Table 9.

[14] We have also run each regression excluding the public sector. Results are not different from the ones reported.

When someone chooses to reduce hours of work he/she knows that their labor earnings will suffer a reduction. In a country with low average wages, like Portugal, with no partial retirement mechanisms that decision embodies relevant financial implications. Therefore, either the individual has a financial safety net that allows him/her to supplement the drop in labor income with savings from previous periods or has other types of income (such as rents, interests, etc) allowing him/her to accommodate a wage reduction. If this is the case, the same individual will be willing to retire at early ages despite the pension reduction.

Those who do not reduce hours of work may face stronger financial constraints. They may have to work full-time for as long as possible and, therefore, exit from the labor force later.

6 Sensitivity analysis

Parametric models for survival analysis may be implemented in the proportional hazard (PH) form or in the accelerated failure time (AFT) metric. In the PH form, the covariates have a multiplicative impact on the hazard function:

$$h(t) = h_0(t)g(\boldsymbol{x})$$

The function $h_0(t)$ may assume a parametric form, such as Weibull, exponential or Gompertz. In the PH form, each regression coefficient indicates the proportional effect on the hazard of absolute changes in the respective covariate.

An AFT model models ln *t* rather than *t* such as:

$$\ln t = \boldsymbol{x}'\boldsymbol{\beta} + u$$

where *t* is the survival time to event, $\boldsymbol{x}$ is a vector of regressors, $\boldsymbol{\beta}$ is the vector of coefficients, and u represents the error term with a probability density function given by $f(.)$. The distributional form of the error term u determines the AFT model (Cameron and Trivedi, 2005). If the function $f(.)$ has normal density, then the above model is called a lognormal regression model. Alternatively, if $f(.)$ is of logistic density, then a log-logistic regression model is in order. When $f(.)$ is an extreme-value density, an exponential or Weibull regression models are obtained. AFT models change the time scale by a factor of $\exp(-\boldsymbol{x}\boldsymbol{\beta})$: if it is greater than 1, time is accelerated and if that factor is less than 1, time is decelerated. This means that if an individual at the baseline faces a probability of survival past time *t* equal to $S(t)$, the survivor function, then an individual with covariates $\boldsymbol{x}$ would

experience probability of survival past time t equal to $S(t)$ evaluated at the point $\exp(-\boldsymbol{x}\boldsymbol{\beta})t$. This implies a deceleration of time with the increase of a covariate. An AFT regression coefficient relates proportionate changes in survival time to a unit change in a given covariate, *ceteris paribus*.

Choosing between different distributional forms is straightforward when parametric models are nested. Likelihood-ratio or Wald tests can be used to choose between alternatives. This can be done to discriminate between Weibull versus exponential or between lognormal versus Weibull.

However, when models are not nested, likelihood-ratio or Wald tests are not appropriate and an alternative statistic has to be used. The most common is the Akaike information criterion (AIC). Considering this, even though the model that best fits the data is the one with the largest log-likelihood, the preferred model is the one with smallest AIC value. Exponential and Weibull models are the only ones that can be implemented both in PH and AFT metrics.

Results reveal that the Weibull model is the preferred specification in the PH form, regardless of the *Reduction* variable used, since it shows the highest log-likelihood and the smallest AIC value. Since the Weibull can be specified both in the PH and AFT forms we can compare it with other AFT distributional forms. Doing so, the preferred specification is sensitive to the *Reduction* variable considered. The Weibull model is once again preferred in a specification that includes the *Reduction B* variable but, when the covariate of interest is *Reduction A* the model that best fits the data is the lognormal. In the previous section, I chose to present the results for the Weibull model for both specifications, in the PH form. Nevertheless, we have also computed estimates using the lognormal and also the log-logistic but it produced no relevant differences compared to the Weibull estimates. This is why we report the estimates on the PH Weibull model, measuring the effect of each covariate on the hazard and not on the survival time.

Whatever the specification adopted, a reduction in hours of work before retirement increases the retirement hazard (PH form) or shortens the survival time in the labor force (around 3% to 3.8% for the *Reduction A* variable and about 0.8% to 1% for the *Reduction B* variable, in the AFT form).

As Cameron and Trivedi (2005) point out, estimation of parametric models for single-spell transition data is straightforward in the presence of censored observations but it produces inconsistent estimates if the parametric model is not correctly specified. Therefore, as an empirical alternative, we have also used the semiparametric Cox model to

check the robustness of the results presented in the previous section. They remain unaltered.

A Piecewise-Constant Exponential model was another semiparametric strategy adopted. This specification does not completely characterize the shape of the hazard function; it is left to be fitted from the data and not specified a priori. The model was used to incorporate the existing ties on the age of retirement at ages 55, 60 and 65. Again, results remained unchanged.[15]

7 Summary and discussion

Reducing hours of work before permanently leaving the labor force is believed to be a potentially useful measure to improve the attractiveness of work for older workers. This research, however, shows that the reduction leads to retirement at earlier ages. Workers that choose to reduce their working schedule appear to be preparing their exit from the labor force rather than delaying it.

A reduction of hours of work is not very usual in the Portuguese labor market and this is, perhaps, the result of deficient opportunities provided by employers when it comes to flexibility in hours of work. If that is true, those older workers that actually reduce hours of work may be employed in firms that can offer phased retirement opportunities.

On the other hand, reducing hours of work implies a decline in labor earnings. In Portugal there are no partial retirement mechanisms, that is, the possibility of accumulating part-time wage with part-time retirement. Partial retirement could smooth the transition from active life into retirement, motivating workers to work longer while reducing hours of work with no significant income loss.

With these data we cannot tell if those that have reduced hours of work have more income sources. In effect, the lack of variables associated with financial incentives is a major drawback in the analysis. Also, the static, cross-sectional nature of the data does not allow us to explore some dynamic features of relevance in the study of the retirement behavior. These include the evolution of working hours in the latest years in the labor force as well as the correspondent change in wages, supplemented by information on Social Security incentives.

The use of panel data with information on income and wealth variables, on Social Security benefits, on hours of work and also on the moment that the reduction took place

[15] Results for the different model specifications may be obtained from the authors upon request.

would allow us to get more solid conclusions on the relevance of hours' flexibility among active aging policies. Disentangle what is behind this positive association between reduction and the retirement hazard for the Portuguese labor market remains a topic for future research.

Since financial incentives are significant determinants of retirement behavior, as a broad analysis for future research, and if we are to be granted access to anonymous Social Security data, we intend to combine these data with matched longitudinal employer-employee data. Doing so, it would be possible to know how much the reduction in the working hours was, as well as to know if there are wage losses associated and what is their magnitude. Also, with Social Security data we can have information on the individuals' payments records and on their incentives to retirement. Knowing how much a worker would receive of pension in each moment of time would be an informative variable in the study of retirement decisions.

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Appendices

Appendix A: Overview of relevant legislation changes on retirement pension's access

Legal diploma	Old-age pension' s access conditions	Flexibilization of the retirement age		Combining old-age pension income with work income	Relevant changes	Date of effectiveness
		Before LRA[b]	After LRA			
***Decreto* no. 45266**, 23rd of September 1963	• Age: 65 years old (no distinction is made for men or women); • Eligibility period[a]: 10 years	Only in situations of disability	There is no additional benefit in old-age pension income	Not allowed between the ages of 65 to 70 years: implies the suspension of old-age pension.	----------	September 1963
***Decreto-Lei* no. 329/93**, 25th of September 1993	• Age[c]: Men: 65 years old Women: 62 years old + 6 months annual increase until reaching 65 years old (1999) • Eligibility period: 15 years.	Never before 60 years of age. Situations covered: • Long-term unemployment; • According to the nature of the activity performed; There is no penalization in old-age pension income	There is no additional benefit in old-age pension income	Accumulation is possible, and there exists an annual actualization of the pension.	• Gradual standardization of the LRA for men and women; • Increase of the eligibility period from 10 to 15 years; • Changes the pension's method of computation.	1st of January 1994 (to applications presented after the date of effectiveness)
***Decreto-Lei* no. 9/99**, 8th of January 1999	• Age: 65 years old both for men and women • Eligibility period: 15 years.	Conditions: • Eligibility period; • At least 55 years old; • A working career of 30 complete calendar years. Penalizes pensions through a reduction factor (rate of reduction: 4.5% year for the number of years of anticipation)	After the age of 65 and with 40 years of contributions: there is an additional benefit in the pension of 10%/year, until the worker reaches the age of 70.	Accumulation is possible, and there exists an annual actualization of the pension.	• Flexibility of the age of access to retirement according to contributions' profiles; • Penalizes early retirement pensions; • Creates an additional pension's benefit when retirement occurs after the age of 65 with a working career above 40 years.	1st of April 1999
***Decreto-Lei* no. 125/2005**, 3rd of August 2005	• Age: 65 years old both for men and women • Eligibility period: 15 years.	----------	After the age of 65 and with 40 years of contributions: there is an additional benefit in the pension of 10%/year, until the worker reaches the age of 70.	Accumulation is possible, and there exists an annual actualization of the pension.	• Suspends the legal norms which allowed access to old-age pension before the worker reached the LRA.	4th of August 2005
***Decreto-Lei* no. 187/2007**, 10th of May 2007	• Age: 65 years old both for men and women • Eligibility period: 15 years.	Conditions: • Eligibility period; • At least 55 years old; • A working career of 30 complete calendar years. Penalization: rate of reduction: 0,5% month for the number of months of anticipation)	The additional benefit is variable depending on the number of years with payment records	It is forbidden to accumulate early retirement pension income with work income in the same firm for a 3 year period since the date of access to early retirement pension.	• Changes the pension's method of computation; • Penalizes early retirement pensions; • Prohibits the accumulation of early retirement pension income with work income in the same firm or group.	1st of June 2007 (published for public discussion in November 2006)

Source: Authors' synopsis based on Portuguese legislation published at *Diário da República* (dre.pt). Notes: (a) Eligibility period: years of work need to become eligible for retirement benefits; (b) Legal retirement age. (c) A 1977 government's decree (*Decreto Regulamentar* no. 26/77, 4th of May) had introduced a positive discrimination in the legal retirement age for women, reducing it to 62 years.

Appendix B: Questionnaire of the module "Transition to Retirement"

$$\text{Filter 1} \begin{cases} \text{if } 50 \leq \text{age} \leq 69 \rightarrow \text{Filter 2} \\ \text{otherwise} \rightarrow \text{End} \end{cases}$$

$$\text{Filter 2} \begin{cases} \text{if the individual is employed or nonemployed (who has left the last job with 50 or more years of age} \rightarrow \text{Question 1} \\ \text{otherwise} \rightarrow \text{End} \end{cases}$$

Question 1. For how many years have you been working or how many years did you work?

Question 2. Did you or do you intend to reduce your working hours before leaving the labor force?
(a)Yes, I reduced working hours
(b)No, but I intend to do it in the next 5 years
(c)No, and I have no intention to reduce it in the next 5 years/ I did not reduce
(d)No, and I do not have plans for the next 5 years or do not consider the possibility
(e)Refuse to answer
(d)Do not know

Question 3a. Can you state the exact age at which you intend to leave the labor force?
(a)Yes
(b)No → Question 3c
(c)Already left the labor force → Question 4

Question 3b. At what age do you intend to leave the labor force?

Question 3c. Despite the fact that you cannot tell the exact age at which you intend to leave the labor force, do you have an idea of when it will occur?
(a)I do not know the exact age, but it will be before 60
(b)I do not know the exact age, but it will be between 60 and 64 years of age
(c)I do not know the exact age, but it will be at 65 or later
(d)Do not know
(e)Refuse to answer

Question 4. Would the possibility of a more flexible working schedule contribute (or would it have contributed) to make you work longer?
(a)Yes
(b)No
(c)Refuse to answer
(d)Do not know

Question 5. Would more opportunities to develop your knowledge or your professional skills contribute (or would it have contributed) to make you work longer?
(a)Yes
(b)No
(c)Refuse to answer
(d)Do not know

Question 6. Would better hygiene, health and/or security at the workplace contribute (or would it have contributed) to make you work longer?
(a)Yes
(b)No
(c)Refuse to answer
(d)Do not know

$$\text{Filter 3} \begin{cases} \text{if the individual is receiving any pension} \rightarrow \text{Question 7a} \\ \text{otherwise} \rightarrow \text{Question 7c} \end{cases}$$

Question7a. Was your pension a retirement pension?
(a)Yes
(b)No → Question 7c

Question 7b. At what age did you start collecting a retirement pension? → **Filter 4**

Question 7c. Are you entitled to collect a retirement pension?

(a)Yes, although I am not receiving it yet
(b)No or not yet
(c)Refuse to answer
(d)Do not know

$$\text{Filter 4} \begin{cases} \text{if the individual is nonemployed who has left the last job with 50 or more years of age} \rightarrow \text{Question 8} \\ \text{otherwise} \rightarrow \text{Filter 5} \end{cases}$$

Question 8. Did you receive any disability pension, illness benefit, benefits due to other early retirement schemes or income supplements?

(a)Yes, disability pension or illness benefit
(b)Yes, benefits due to other early retirement schemes
(c)Yes, income supplements
(d)Yes, a combination of the previous options
(e)No
(f)Refuse to answer
(g)Do not know

Question 9. After leaving your last job or business, what was your occupational status?

(a)Unemployed → End
(b)Retired (old-age or early retirement)
(c)Illness or disability → End
(d)Other status → End
(e)Refuse to answer → End
(f)Do not know → End

Question 10. Why did you retire? (the reason)

(a)Lost job → End
(b)Mandatory retirement age → End
(c)Illness or disability → End
(d)Childcare or other dependents' care → End
(e)Problems at work → End
(f)Favorable financial conditions → End
(g)Left work for other reasons than those previously mentioned → End
(h)Other reason → End
(i)Refuse to answer→ End
(j)Do not know→ End

$$\text{Filter 5} \begin{cases} \text{if the individual is employed, receiving a retirement pension,} \\ \text{or althougth not receiving it, he/she is entitled to it} \rightarrow \text{Question 11} \\ \text{otherwise} \rightarrow \text{End} \end{cases}$$

Question 11. Why are you still working?

(a)To raise retirement pension's benefits
(b)To have sufficient household income
(c)It is not related to financial motives
(d)Refuse to answer
(e)Do not know

Appendix C: Definitions of industry and worker type

Table C1: Definition of the sectors of activity

Activity sector	Industry reported in the survey	Distribution (Retirees' subsample) %	Distribution (All) %
Agriculture	1. Agriculture, animal breeding, hunting and forestry	5.65	5.59
Industrial	2. Manufacturing industry	20.00	19.19
	3. Production and supply of electricity, gas and water	2.25	1.46
	4. Construction	5.43	7.78
Services	5. Commercial services; automobile vehicles, motorcycles and personal use and domestic items' repair	5.14	7.98
	6. Accommodation and restaurants	2.61	4.10
	7. Transports, storage and communications	9.57	6.71
	8. Financial activities	7.39	3.43
	9. Real estate activities, rentals and services to firms	1.38	2.54
	10. Public administration, national defence and mandatory social security	16.74	13.43
	11. Education	10.29	9.43
	12. Health and social services	6.09	9.27
	13. Other collective, social and personal services activities	2.17	2.71
	14. Families with domestic employees and family production for personal use	4.86	6.11
	15. International organisms and other extraterritorial institutions	0.43	0.27

Source: Labor Force Survey's module "Transition to Retirement", 2006.

Table C2: Definition of blue-collar and white-collar workers

Worker defined as:	Occupation reported in the survey	Distribution (Retirees' subsample) %	Distribution (All) %
White-collar	1. High-level managers	1.88	2.41
	2. Specialists from intellectual and scientific occupations	8.12	8.36
	3. Technicians and medium-level professionals	17.54	11.57
	4. Administrative personnel and similar	14.49	10.89
	5. Services and sales personnel	10.94	12.33
Blue-collar	6. Farmers and skilled workers from agriculture	1.30	2.67
	7. Blue-collar workers, craftsmen and similar workers	17.61	19.00
	8. Equipment and machine operators and assembly line workers	9.78	10.68
	9. Unskilled workers	18.33	22.09

Source: Labor Force Survey's module "Transition to Retirement", 2006.

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