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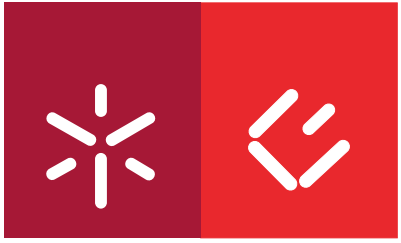
Cândida Sofia Ferreira Machado

Population Aging and the Labor Market

Dezembro de 2009

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UMinho | 2009



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Population Aging and the Labor Market

Tese de Doutoramento em Economia
Área de Conhecimento em Economia Industrial,
do Trabalho e da Empresa

Trabalho efectuado sob a orientação da
Professora Doutora Ana Rute Cardoso
e do
Professor Doutor Miguel Portela

Dezembro de 2009

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Título da tese: Population Aging and the Labor Market

Orientador(es): Professora Doutora Ana Rute Cardoso / Professor Doutor Miguel Portela

Ano de conclusão: 2009

Área de Conhecimento do Doutoramento: Economia Industrial, do Trabalho e da Empresa

É AUTORIZADA A REPRODUÇÃO PARCIAL DESTA TESE, APENAS PARA EFEITOS DE INVESTIGAÇÃO, MEDIANTE DECLARAÇÃO ESCRITA DO INTERESSADO, QUE A TAL SE COMPROMETE.

Universidade do Minho, 29/12/2009

Assinatura:

Acknowledgements

This thesis is the outcome of a series of contributions that I thankfully remember in the next paragraphs. Words could never fully express my sincere gratefulness to the people and institutions that have assisted me while I was carrying out this work.

I wish to acknowledge my advisors, Ana Rute Cardoso and Miguel Portela, for their guidance. Particularly, I thank Ana for her critical judgement and edifying comments towards the improvement of this research, and Miguel for his endless willingness and for valuable comments and suggestions concerning econometric models and specifications in chapters 4 and 5. I sincerely express my gratitude to you both.

The financial support of the Portuguese Foundation of Science and Technology (FCT) under the grant SFRH/BD/31103/2006 is gratefully acknowledged. I also thank the Statistics Department of the Ministry of Labor and Social Solidarity (Portugal) for granting me access to *Quadros de Pessoal*, the data set used in chapters 3 and 4. Additionally, for the development of chapter 5, I am grateful to the Portuguese Statistics Office (INE) for granting me access to the Labor Force Survey microdata, under the established protocol with the Ministry of Science and Higher Education.

I truly appreciate the comments and suggestions of Natália Monteiro (chapter 3), Carla Sá and João Cerejeira (chapter 4) and those of the participants in the workshops of PhD students in Economics at the University of Minho. I am also grateful to Francisco Carballo Cruz, my teacher at the undergraduate programme in Economics at the University of Minho, for valuable advises and for his friendship.

At the School of Management of the Polytechnic Institute of Cavado and Ave (ESG/IPCA) I am indebted to the former Head of Department, Pedro Nunes, for his objectiveness and incentive. I point out two of my teaching colleagues, Cláudia and Alexandrino, for the talks and their companionship. I specially acknowledge Claúdia for giving me access to some of the literature used throughout the thesis.

Whenever I needed to cheer up, I could always count on my friends. I thank Sílvia and Avelino for being the best of friends: they were there for me when I needed the most. You

and little Leonor will always be in my heart. I am grateful to Sara for listening to me: a natural blonde and a brunette understanding each other so well is still a mystery to me. Valentim and Jú, Glória and Freitas, Marta and Alexandre provided me fabulous evenings at their homes, served with great food, wine and invigorating discussion. My godson, Martim, always fills the room with his joy and innocence.

To my sisters and my brother, Lola, Xanó and Litos, I thank for a lifetime of complicity, sharing and great understanding. Miguel and Filipe, a different kind of brothers, are truly good friends. Gonçalo, my nephew and the family jewel, is one of the loves of my life.

This thesis is dedicated to my parents. A vós, mãe e pai, dedico a concretização deste projecto, por me terem proporcionado uma vida de amor, carinho e dedicação. Os vossos filhos estiveram sempre em primeiro lugar. Por isso, agradeço-vos com toda a minha admiração e ternura.

The final words go to the person that completely changed my existence. Hugo, with you I have grown into a mature, confident and serene woman. Thank you for having given me the greatest moments in life although I am absolutely sure that the best is yet to come.

C. Sofia Machado
Braga, 21 December, 2009

Population Aging and the Labor Market

Abstract. Under the demographic context of population aging and considering its implications on the age composition of the labor force, this thesis investigates the labor market opportunities experienced by older individuals and additionally questions whether a specific form of flexible work arrangement would help to expand older employees' working career, contributing this way to an active aging. Due to the fear of prospective labor supply shortages, as well as to issues related to the sustainability of Social Security systems, there exists a growing concern towards increasing the labor force participation of older workers. Therefore, opportunities must be created and/or made accessible to these individuals in order for them to find attractiveness in postponing the passage to inactivity.

For the study of labor market opportunities, using a longitudinal employer-employee data set, I concentrate on hiring and promotion prospects faced by the elderly. First, I make use of a fractional logit model to evaluate the hiring opportunities at the reach of older individuals. I find that although Portuguese firms employ older workers they have a preference for hiring younger individuals and this preference results from the fact that employers seem to favor long-term employment relationships with their employees. In effect, empirical results show a statistically significant negative association between the share of the workforce with more than 5 years of tenure and the share of older workers' hired.

Second, the research on older workers' opportunities for promotion departs from a sample of new firms and their employees. Survival analysis suggests that younger employees experience shorter times to promotion than older workers and, therefore, the latter face a smaller likelihood of promotion.

Both the above researches highlight the lack of opportunities for older individuals. They are passed over for hiring and promotion because of age. This calls for the need of policy intervention to incentive firms to hire and provide career development chances for those that are older.

As a means to extend older individuals' participation in the labor force, another dimension of active aging policies focus on the adoption of flexibility in working arrangements. Thus, in a third and final research, the underlying question is whether working hours' flexibility is associated with delayed exit from the labor market. Using a novel dataset from the 2006 Portuguese Labor Force Survey and employing duration models I find that reducing hours of work before retirement is associated with early exits from the labor force. A reduction of

hours of work seems to signal the wish to retire sooner rather than to announce the desire of retirement postponement. Hence, flexibility in hours of work appears not to be an effective instrument to promote active aging.

Envelhecimento Populacional e o Mercado de Trabalho

Resumo. Perante um contexto demográfico de envelhecimento populacional e tendo em consideração as suas implicações ao nível da composição etária da força de trabalho, esta tese investiga as oportunidades ao alcance dos trabalhadores mais velhos no mercado de trabalho e analisa o impacto de uma forma particular de flexibilidade nas relações laborais sobre a extensão da carreira dos trabalhadores idosos, contribuindo deste modo para o envelhecimento activo da população. Devido ao receio de uma futura escassez da oferta de trabalho, bem como a questões relacionadas com a sustentabilidade dos sistemas de Segurança Social, existe uma preocupação crescente com o aumento da participação dos trabalhadores mais velhos na força de trabalho. Como tal, devem ser criadas oportunidades para que estes trabalhadores sejam atraídos no sentido de permanecerem por mais tempo na força de trabalho, adiando deste modo a sua reforma.

Para estudar as oportunidades no mercado de trabalho, nomeadamente as oportunidades de contratação e promoção disponíveis para os trabalhadores mais maduros, são utilizados dados longitudinais provenientes dos *Quadros de Pessoal*. Em primeiro lugar, recorre-se a um modelo logit fraccional para avaliar as oportunidades de contratação ao alcance dos indivíduos mais idosos. Verifica-se que apesar das empresas portuguesas empregarem colaboradores mais velhos aquelas preferem contratar trabalhadores mais jovens. Esta preferência resulta do facto de os empregadores elegerem favorecer relações laborais de longo prazo com os seus colaboradores. Os resultados empíricos revelam uma relação negativa e estatisticamente significativa entre a proporção da força de trabalho com mais de 5 anos de antiguidade e a proporção de trabalhadores mais velhos recrutados.

Em segundo lugar, o estudo das oportunidades de promoção dos trabalhadores mais velhos tem por base uma amostra constituída por empresas novas e pelos seus colaboradores. A utilização de modelos de duração sugere que os trabalhadores mais novos enfrentam tempos para a promoção mais curtos que os trabalhadores mais velhos e, portanto, os últimos apresentam uma menor probabilidade de serem promovidos.

Os dois estudos acima mencionados evidenciam a ausência de oportunidades para os mais velhos. Pela sua idade, estes surgem preteridos no tocante a oportunidades de recrutamento e promoção. Esta situação chama a atenção para a necessidade de uma intervenção de política no sentido de incentivar as empresas a apostar no recrutamento e no desenvolvimento de oportunidades para os indivíduos mais idosos.

Com o intuito de prolongar a participação dos indivíduos mais velhos no mercado laboral, o âmbito das políticas de envelhecimento activo passa pela adopção de maior flexibilidade nas relações de trabalho. Logo, numa análise final, questiona-se se a flexibilidade do horário de trabalho está associada com o adiamento da saída do mercado de trabalho. Usando uma nova base de dados proveniente do módulo "Transição para a Reforma" do *Inquérito ao Emprego* e utilizando uma análise de duração, demonstra-se que a redução do horário de trabalho antes da passagem para a reforma está associada a saídas precoces da força de trabalho. A redução do horário de trabalho parece sinalizar a intenção de saída antecipada do mercado de trabalho em vez de anunciar o desejo de adiamento da reforma. Portanto, a flexibilidade do horário de trabalho não parece ser um instrumento eficaz na promoção do envelhecimento activo.

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Chapter 1

Introduction

This thesis was motivated by the growing attention devoted, in recent years, to the labor market participation of older people due to the phenomenon of demographic aging.

Even though the last years have been characterized by limited economic and employment growth, one of the most outstanding features of current trends in European labor markets has been the increase in the employment of older individuals. Nevertheless, compared to countries such as the United States or Japan, the labor force participation of older European still remains low and many workers continue to exit the labor market before age 65. Portugal, like the majority of the European Union countries, also needs to improve activity and employment rates for older workers by international standards; furthermore, early retirement is very common in the Portuguese economy.

In the context of population aging, increasing the participation and employment rates for older workers is fundamental to support economic growth and to guarantee the sustainability of Social Security systems. Raising the employment rate for older workers is essential to prevent labor supply shortages and to make full use of the available resources.

The enforcement of active aging policies, which aim at the extension of working careers, must however pay particular attention to the promotion of employment opportunities throughout working lives, strengthening incentives to work longer. To respond to the challenge of an aging population and increase the labor market participation of older people, it is crucial to create the conditions to support individuals who desire to take advantage of the opportunities provided by longer and more productive lives.

For the success of active aging policies, governments and social partners working side by side can contribute to developing the skills and employability of older individuals while maintaining the health, motivation and capacities of workers as they age. Changes are required in working conditions and employment opportunities in order to incorporate an

aging workforce. Also, age discrimination on recruitment and/or on career development opportunities must be eliminated to provide equal employment prospects regardless of age.

This thesis studies the employment opportunities available for older workers in the Portuguese labor market, in order to evaluate the effectiveness of active aging policies in attracting and motivating older people. In particular, it focuses on three dimensions of employment: hiring, promotion and working hours' flexibility.

This thesis is structured into four main chapters that, although treated independently, share a common denominator: older workers and their labor market situation. Chapter 2 develops the motivation, concentrating on the economic consequences of population aging and addressing the prospective labor market challenges and opportunities. This chapter highlights the impact on economic growth of an aging population, mainly due to the effect on overall employment levels of a reduction in the working-age population. Also, it stresses the relevance of raising the labor force participation of older people to prevent economic slowdown and the increasing pressure on public spending.

The remainder of the thesis is mainly empirical. Chapters 3 and 4 use the same matched employer-employee data set to study, respectively, the hiring and promotion opportunities offered by firms to older workers.

Chapter 3 evaluates the hiring opportunities of older workers in the Portuguese labor market. Labor market mobility in terms of new hires is lower for older workers than for prime-age workers. Previous literature on older workers' hiring opportunities suggests that older workers do not face the same hiring opportunities as younger workers. In effect, empirical evidence shows that firms employ older workers but when they hire new workers they prefer to hire younger ones.

High activity and employment rates confirm a strong attachment of Portuguese older workers to the labor market. Nevertheless, the country presents one of the lowest hiring rates for workers aged 55 to 64 meaning that workers in that age group face severe difficulties in what recruitment is concerned. So, if an older worker loses his/her job he/she may face major constraints to get back to work. Therefore, studying the hiring opportunities for Portuguese older workers should raise relevant questions concerning their labor market situation and the potential policy intervention of governments. The main contribution of this research relies on the fact that it employs fractional logit models on panel data in order to study the hiring opportunities of older workers. Previous empirical studies use estimation techniques that are not appropriate and do not comply with the

fractional nature of the dependent variable. Also, no such work has been done for the Portuguese labor market.

Findings suggest that firms employ older workers but prefer to hire younger workers, corroborating previous empirical literature. Therefore, once unemployed, older individuals find severe constraints to get back into employment.

In Chapter 4 I use a panel on new firms and their employees to study the promotion opportunities of older workers within the same firm. The underlying issue is whether workers are passed over for promotion because of age. After defining the promotion event, a first glimpse at both the distribution and rates of promotions by age group at hire hints on uneven prospects for older employees.

The empirical setting takes advantage of the event characteristic of the data. Both non-parametric and parametric duration models' results show that younger employees experience shorter times to promotion than older workers and, therefore, the latter face a smaller likelihood of promotion. This result is even stronger when modeling just the survival time to first promotion.

Chapter 5 discusses the transition from professional life into retirement, using a new data set from the 2006 Portuguese Labor Force Survey. Identifying the determinants of the decision to retire is crucial when policy makers attempt to postpone labor market exit of older cohorts. The aim of this chapter is to study the impact of a voluntary reduction in hours of work, before retirement, on the moment of exit from the labor force. It is often suggested that adaptable working arrangements in the form of flexibility in hours of work could be a useful measure to postpone retirement. Under this consideration, a reduction in hours of work before complete withdrawal from the labor force would be expected to be associated with retirement at later ages. Nevertheless, results prove otherwise. I find that reducing hours of work before retirement is associated with early exits from the labor force. A reduction of hours of work seems to signal the wish to retire sooner rather than to announce the desire of retirement postponement. Several robustness tests confirm these results.

Finally, Chapter 6 concludes summarizing the main results presented in the three previous chapters and focusing on the policy implications of the analysis. Furthermore, it addresses some guidelines for future research.

Chapter 2

Population aging: consequences, challenges and opportunities

2.1 Introduction

This chapter addresses the economic impact of population aging and focuses on the major challenges that developed countries face. These challenges may as well be viewed as opportunities. An opportunity to improve labor market conditions for older individuals but also an opportunity to enhance economic growth.

This descriptive chapter is structured as follows. Section 2.2 highlights the demographic trends in developed countries while Section 2.3 puts in evidence the economic consequences of population aging. The next section draws attention to the importance of increasing participation rates of older people in order to avoid labor force shortages caused by demographic aging. Section 2.5 concentrates on the labor market opportunities that may be driven by an aging population. Concluding remarks are presented in Section 2.6.

2.2 The demographic framework

As a result of both the increase in longevity and the decrease in fertility rates, expressed in Tables 2.1 and 2.2, developed countries face the aging of their population. Health conditions' improvements contributed significantly for raising life expectancy at birth, while women's increasing involvement in the labor market may be considered both as a cause and a consequence of the reduction in fertility rates.

Table 2.1: Life expectancy at birth, 1960-2004

Country	1960[a]	1970[b]	1980	1990	1995	2000	2004[c]
Austria	68.7	70.0	72.6	75.5	76.6	78.1	79.3
Belgium	70.6	71.0	73.4	76.1	77.3	78.3	78.8
Denmark	72.4	73.3	74.3	74.9	75.3	76.9	77.6
Finland	69.0	70.8	73.4	74.9	76.5	77.6	78.8
France	70.3	72.2	74.3	76.9	77.9	79.0	80.3
Germany	69.6	70.4	72.9	75.2	76.5	78.0	78.6
Greece	69.9	72.0	74.5	77.1	77.7	78.1	79.0
Ireland	70.0	71.2	72.9	74.9	75.7	76.5	78.3
Italy	69.8	72.0	74.0	76.9	78.1	79.6	79.7
Luxembourg	69.4	70.3	72.5	75.4	76.6	78.0	78.0
Netherlands	73.5	73.7	75.9	77.0	77.5	78.0	79.2
Portugal	64.0	67.5	71.5	73.9	75.2	76.6	77.4
Spain	69.8	72.0	75.6	76.8	77.9	79.2	80.5
Sweden	73.1	74.7	75.8	77.6	78.8	79.7	80.6
United Kingdom	70.8	71.9	73.2	75.7	76.6	77.8	78.5
EU15 average	70.1	71.5	73.8	75.9	77.0	78.1	79.0
Japan	67.8	72.0	76.1	78.9	79.6	81.2	82.1
OECD average	68.5	70.3	72.7	74.9	76.0	77.3	78.3
United States	69.9	70.9	73.7	75.3	75.7	76.8	77.5

Source: OECD Factbook 2007: Economic, Environmental and Social Statistics.
Notes: (a) The value reported for Italy refers to 1961; (b) The value reported for Italy refers to 1971; (c) The values reported for Belgium, Ireland, Italy, Luxembourg, Portugal, United Kingdom and United States refer to 2003.

Table 2.2: Fertility rates, 1970-2004

Country	1970	1975	1980	1985	1990	1995	2000	2004
Austria	2.29	1.82	1.62	1.47	1.45	1.40	1.34	1.42
Belgium	2.25	1.74	1.68	1.51	1.62	1.55	1.66	1.64
Denmark	1.95	1.92	1.55	1.45	1.67	1.80	1.77	1.78
Finland	1.83	1.68	1.63	1.65	1.78	1.81	1.73	1.80
France	2.47	1.93	1.95	1.81	1.78	1.70	1.88	1.91
Germany	2.03	1.48	1.56	1.37	1.45	1.25	1.38	1.36
Greece	2.39	2.38	2.21	1.68	1.39	1.32	1.27	1.29
Ireland	3.93	3.40	3.25	2.50	2.11	1.83	1.89	1.93
Italy	2.42	2.20	1.64	1.42	1.33	1.18	1.23	1.33
Luxembourg	1.98	1.55	1.49	1.38	1.61	1.69	1.76	1.70
Netherlands	2.57	1.66	1.60	1.51	1.62	1.53	1.72	1.73
Portugal	2.83	2.58	2.18	1.72	1.57	1.40	1.55	1.40
Spain	2.90	2.80	2.20	1.64	1.36	1.18	1.24	1.32
Sweden	1.92	1.77	1.68	1.74	2.13	1.73	1.54	1.75
United Kingdom	2.43	1.81	1.90	1.79	1.83	1.70	1.65	1.76
EU15 average	2.41	2.05	1.88	1.64	1.65	1.54	1.57	1.61
Japan	2.10	1.90	1.80	1.76	1.54	1.42	1.36	1.29
OECD average	2.72	2.38	2.14	1.89	1.86	1.69	1.63	1.62
United States	2.48	1.77	1.84	1.84	2.08	2.02	2.06	2.05

Source: OECD Factbook 2007: Economic, Environmental and Social Statistics.
Note: Fertility rate computed as the average number of children born to women aged 15 to 49.

Although present in all developed countries, the aging demographic feature is more prominent in some countries than others. In European countries like Portugal, Greece, Italy or Spain, and in Asian countries such as Japan, estimates show that, by 2050, more

than 30% of the population will be aged 65 and over. It corresponds to a 100% growth over a 50 year period. Other countries like Turkey, Mexico or the United States experience aging at a slower pace: 20% or less of their population is expected to have 65 or more years of age by 2050 (OECD, 2006).

The Portuguese economy reveals the same trend as the European or other developed economies regarding population aging. A study conducted by the Directorate-General for Employment and Labor Relations (2003) – a department of the Ministry of Labor and Social Solidarity – shows that in 2000 Portugal was the eleventh oldest country in the world, with 15.4% of its population aged 65 or older. In the 1991 Population Census, 20% of the Portuguese population had less than 15 years of age, 16% were between 15-24 years, 50% were aged 25-64 and 14% had 65 or more years of age. Ten years later, the 2001 Census revealed that the corresponding values were 16%, 14%, 53% and 16%, suggesting an aging trend for the Portuguese population. Consequently, the labor force is also aging. The Directorate-General for Employment and Labor Relations' investigation estimates that by 2020 the population aged 60 years or older will account for 24% of the total population, while those aged less than 20 years will represent just 22%. This means a drift away from the traditionally pyramidal age structure and towards a configuration that resembles a mushroom.

2.3 Economic consequences of aging

Demographic aging will have implications on the level of economic activity in the future. First, one of the influential impacts of population aging is on the sustainability of Social Security systems, since it will increase the number of older inactive individuals (Social Security recipients) compared to that of active subjects (Social Security contributors). The ratio of inactive population (aged 50 and over) to the labor force is one indicator of the economic burden of the older population on Social Security. In OECD countries, projections show that there will be 7 retirees for each 10 workers by 2050. For comparison, this ratio was equal to 38% in 2000. However, this ratio is of more concern in European Union (EU25) countries: there will be 1 retiree per 1 worker in 2050, compared to the ratio of 2 retirees per 4 workers in 2000. In Portugal, this ratio is expected to double from 2000 (when it was equal to 37%) to 2050 (75% estimate).

Such a demographic structure will inevitably lead to public expenditure growth due to a higher amount of pension recipients, on one hand, and to the increase in health care

expenditures, on the other hand. The pressure on public expenditure will have to be financed by loading the working population, through the raise in Social Security contributions and/or taxes increase, and/or by penalizing pension recipients through a reduction in benefits.

A second key aspect of demographic aging will be its effect on the size of the population aged 15 to 64, the working-age population, and therefore on productivity and economic growth. In many OECD economies, the working-age population is expected to decline both in relative and absolute terms to the total population over the next 20 years. In the European Union it is projected a 17% decline by 2050 compared to 2005. According to the European Commission (2007), in the long run the effect of population aging on the size and structure of the labor force will be most problematic in countries such as Portugal, Spain, Greece, Germany, Italy and some Eastern Europe countries, because they will experience significant declines in the working-age population, ranging from 20% to 30% by 2050, and almost all will face a 5 or over percentage points increase in the share of older workers in that population.

Therefore, if there are no changes in labor force participation patterns, population aging will lead to a drop in labor force growth which, in turn, will slow down economic growth. Without changing both the participation patterns and the rate of labor productivity growth, growth in gross domestic product (GDP) per capita in OECD economies would decline to around 1.7% a year over the next 30 years, which corresponds to a rate 30% smaller compared to the one in the 1970-2000 period (OECD, 2006). For the EU25, annual GDP growth will drop from 2.4% over the 2004-2010 period to 1.2% between 2030 and 2050 (European Commission, 2007). Developed countries will have to endure labor productivity growth in order to achieve economic growth. Simultaneously, older workers will gain relevance as resources in a scarce labor force.

2.4 Increasing participation rates of older individuals

The impact of population aging on employment and on the labor market is one of the main challenges that developed countries face. Pressures to increase the official retirement age and to improve the employment rate of older workers are therefore in the spotlight of governments' concerns. In effect, forecasting these new challenges, the European Union has imposed two major objectives to be accomplished by 2010: (a) at least 50% of the

European Union population in the 55-64 age group should be in employment, and (b) to attain a 5 year delay in the average age of exit from the labor force.

In Europe, employment among people aged 55-64 is low and the employment rate has been improving modestly. In 2007, the employment rate for older workers in the EU15 is just about 47% (it was 39% in 2001), compared to 62% and 66% in the United States and in Japan[1], respectively. Countries like Portugal, Netherlands, Germany, Sweden, Denmark, Finland or the United Kingdom already achieved the 50% threshold on the employment rate of older workers. However, in Italy, France, Greece or Spain there is still a long path to go in order to achieve that goal for the employment rate (almost 17, 12, 8 and 5 percentage points behind, respectively) (European Commission, 2008).

In addition, many withdraw from the labor market at early ages, due to early retirement schemes. However, in recent years, some penalties have been imposed to early retirees subsequent to stricter legislation on this matter. The average exit age from the labor force for the European Union was 61 years in 2003, and no Member State had an average exit age above the required by the end of the decade (65 years).

Special attention has also been devoted to the activity rates. In the European Union the activity rate is bellow 70%, which suggests an underutilisation of the labor force potential and inactivity remains high in most Member States. The main reasons for inactivity are: (a) education and training (particularly among young people), (b) retirement, (c) family responsibilities and (d) illness/disability. Therefore, to prevent a shortage of the labor supply, either governments promote an early entry of young people into the labor market (reducing years of education and training) or delay the exit of older workers from the labor force.

Thus, increasing the labor market participation of older workers is thought to be a requirement to increase the labor force in order to achieve full employment and, therefore, economic growth. Active aging policies that aim at postponing older workers' exit from the labor force are being enforced. The increase in the legal retirement age was the most visible instrument used to delay retirement. Nevertheless, there is also call for action in other fronts. First, pension penalties for early retirement in order to discourage early exits from the labor market are already being adopted. Second, opportunities must be created for employers to hire and keep older workers. Additionally, promoting access to training for older workers, who are underrepresented in training should be a concern. The promotion of hiring and training opportunities for older employees is essential for career development

[1] Data for the United States and Japan were obtained from the OECD *Employment Outlook 2009* via www.oecd.org, November 2009.

prospects at older ages. Finally, attention must also rely on improving the quality in work to provide a secure, attractive and flexible work environment throughout the working life, including the possibility of working hours' flexibility (part-time arrangements, gradual retirement).

If older workers could be attracted towards delaying their exit from the labor force, three important goals could be achieved: first, it would increase labor force growth and compensate the negative effect of population aging on economic growth; second, it would enhance public finances through the reduction in expenditure associated with early retirement while improving tax revenues; and third, it would aid employers by smoothing the pace at which they will have to replace individuals near retirement with new employees. Additionally, early retirement is not always a voluntary option (Osberg, 1993; Dorn and Sousa-Poza, 2009) and may cause financial difficulties for many older workers in the form of social exclusion and lack of prospects to guarantee an appropriate income in retirement. Therefore, policies that help the elderly to remain longer in the labor force can also have a more direct effect on enhancing individual welfare.

2.5 Labor market opportunities

Facing an aging population there is need to remove disincentives and barriers to employment of older individuals and, hence, future developments in the labor market should be focusing on promoting longer working lives through the provision of more opportunities for older people.

In effect, changes in the labor market over the last decades should work in favor of the employment of older workers. Technological change, world trade growth and shifts in consumer preferences altered the employment structure in developed countries. Employment shares in agriculture and manufacturing have declined significantly over time in all OECD countries while the employment share in the services sector rose. Overall, jobs in the services sector are less physically demanding than in agriculture or manufacturing. Reflecting, in part, this change in employment across sectors but also a change within each sector, manual work has been gradually replaced by non-manual work. Therefore, the share of older employees whose jobs are physically demanding has probably declined over time in most countries, and this trend will probably continue throughout the years. Also, better health conditions should work in favor of longer working lives.

Shifts in the characteristics and work experience of the younger generation of workers are also likely to contribute to higher participation rates compared to past generation, as these employees age. First, female labor force participation rose significantly over the last decades and this trend is expected to continue in the following years. Knowing that there is a strong cross-country correlation between participation rates of younger and older women, additional increases in participation rates of prime-age working women are likely to feed through to higher participation rates in the older age groups too. Second, future cohorts of older workers are likely to be better educated than present ones: whereas, on average, approximately 40% of older workers across OECD countries had less than an upper-secondary level of education in 2000, projections set it in 21% by 2050. On the other hand, the share of older individuals with a university degree is estimated to increase from 22% to 31% over the same period (OECD, 2006).

A better educated workforce will help to raise labor productivity which is essential for economic growth. Furthermore, considering that participation rates are positively associated with school attainment, increased levels of education are expected to have a positive impact on the participation rates of future cohorts of older individuals.

Market forces are also likely to respond to demographic aging through the increase in employment opportunities for older workers. For example, assuming flexible wages, larger cohorts of older workers relative to younger employees should reduce older people's relative wages and hence raise the demand for older employees. Moreover, as employers may find it difficult to obtain the skills they require throughout hiring younger workers, employers may be increasingly willing to offer greater training opportunities to older workers as well as to adapt working conditions closer to the needs of an aging workforce. Dychtwald *et al.* (2004) highlight that older workers are valuable assets with significant labor market experience and skills. The authors suggest that employers should take advantage of these capabilities through the promotion of opportunities for career changes at older ages as well as for mentoring or knowledge sharing programs.

Active aging policies must employ a range of instruments beyond just retirement reforms. In order for people to consider the possibility of extending their working lives, they have to be in good physical and mental health and must face good opportunities for working longer, they must have access to more flexible retirement schemes and work arrangements such as part-time employment and flexible working schedules, they must have the opportunity to update skills, and they should have access to available employment opportunities and not be faced with discriminatory prejudices.

2.6 Concluding remarks

Demographic aging poses major challenges to economic activity. On one hand, an elderly population will pressure Social Security sustainability. On the other hand, due to potential labor supply shortages, economic growth might be endangered if there is no increase in labor productivity.

Therefore, in order to avoid the decline in labor force, older workers must gain relevance in the working population. For this to happen, the challenge relies on increasing participation rates of older cohorts.

Population aging comprises both challenges and opportunities for developed countries. They will need to mobilise more fully the potential labor resources of older people as the key policy response to demographic aging. Implicit is the creation of better employment opportunities for older workers that go from encouraging employers to hire and retain older individuals, strengthen their employability and provide flexible working arrangements.

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Chapter 3

Hiring older workers: do firms prefer long-term commitments?

3.1 Introduction

Population aging, due to decreasing fertility rates and increasing life expectancy, will influence the age composition of the labor force causing, on one hand, a reduction in labor supply (enhanced by the fact that young people are postponing their entry into activity due to participation in education and training), and on the other hand, a detrimental impact on Social Security systems.

To overcome these demographic challenges, 'active aging' policies are being implemented focusing both on the rise of the employment rate of older workers and on delaying their exit from the labor force (for example, by an increase in the legal retirement age). For instance, the European Union (EU) has imposed two major objectives to be accomplished by 2010: (a) at least 50% of the EU population in the 55-64 age group should be in employment and (b) attainment of a 5 year delay in the average age of exit from the labor force.

In this crusade for raising the labor market participation of older individuals, much of the focus has been on financial issues – such as strengthening the link between contributions and benefits, increasing the legal retirement age and adjusting the pension as a function of life expectancy – while less attention has been devoted to the analysis of older people's labor market opportunities.

The aim of this chapter is to evaluate the hiring opportunities of older workers, focusing on the determinants of hiring older workers by Portuguese firms. I intend to answer the following questions: are older workers underrepresented among newly hired workers? If so, does evidence suggest that firms prefer long-term employment relationships

and, therefore, prefer to hire younger workers [as suggested by Oi (1962) and Lazear (1979, 1981)]?

Looking at the labor market situation of older workers and focusing on their labor market transitions, it is possible to see that workers aged 55-64 who become unemployed face more difficulties in finding a new job compared to prime-age or young workers. In effect, only 13% of older workers succeed in finding work within a one year time horizon, while the figures rise to 32% and 39%, respectively, in what regards prime-age and young unemployed. Additionally, more than 60% of the older unemployed (against 46% of the working-age population as a whole) face periods of unemployment equal or greater than 12 months (European Commission, 2007). Due to these greater obstacles to get back into work if losing their job, almost half of unemployed older workers leave the labor force within a year. Furthermore, the hiring rate[2] for older workers is clearly below that for prime-age workers, and for the EU as a whole it is only half of that for those aged 25-54 (7% versus 14%, respectively) (European Commission, 2007).

The interest in the Portuguese case comes from an apparent paradox. On one hand, I find evidence of a strong attachment of Portuguese older workers to the labor market that is confirmed by high activity and employment rates (54% and 50%, respectively). Nevertheless, and despite this high attachment of older individuals to the labor force, the country presents one of the lowest hiring rates for the age group 55-64 (less than 4%, compared to the 7% average for the EU), meaning that these workers face some difficulties in what recruitment is concerned (European Commission, 2007). Therefore, studying the hiring opportunities for Portuguese older workers should raise relevant questions concerning their labor market situation and the potential policy intervention of governments.

The innovative contribution of this study relies, on one hand, in the fact that it makes use of longitudinal data – matched employer-employee data – from a good and reliable database, on the other hand, the use of fractional logit models applied to panel data is also a novelty in studying the hiring opportunities of older workers. Additionally, and to my knowledge, no such work has been done for the Portuguese labor market.

The chapter is organized as follows. The next section introduces previous literature concerning employment relationships and older workers' hiring opportunities. Section 3.3 presents an overview of the demographic trends in Portugal and the labor market situation of older individuals. Section 3.4 describes the data and the methodology used, and results

[2] Hiring rate means the ratio of all those in employment with job tenure of 12 months or less (in the age category) relative to the total employment (in that age group).

are discussed in Section 3.5. Finally, Section 3.6 concludes and considers some policy implications.

3.2 Employment relationships and hiring opportunities for older workers

Previous empirical studies on employment relationships suggest that firms prefer long-term commitments with their employees in order to overcome fixed employment costs, to disincentive workers' shirking, cheating or reduction of effort, and to avoid monitoring costs.

Oi (1962) considers that labor is a quasi-fixed factor and that its fixity character arises from hiring and training costs in which the firm incurs. According to the author, these fixed employment costs induce firms to lengthen the periods of employment with their employees. In a study of temporary layoffs, Feldstein (1976) also suggests that the commitment between employer and employee tends to be permanent. This lifetime employment relationship is the starting point of Lazear's (1979) research explaining the existence of mandatory retirement. The theory of agency states that principal (firm) and agent (worker) may have different interests and this antagonism could work in favor of long-term employment commitments. To disincentive workers' shirking, cheating or reduction of effort, and to avoid expensive monitoring costs, Lazear considers that "it pays both parties to agree to a long-term wage stream which pays workers less than their VMPs [value of the marginal product] when young and more than the VMPs when old" (Lazear, 1979: 1283). In a later work, Lazear (1981) reinforces his conviction by presenting a model in which he shows that an upward-sloping age-earnings profile brings together the interests of the agent and the principal.

For the above stated reasons, the preference for long-term employment relationships may indicate that while firms employ older workers they may tend not to hire new older workers.

The literature on older workers' hiring opportunities seems to be concurrent, suggesting that older workers do not face the same hiring opportunities as younger workers. Empirical evidence shows that firms employ older workers but when they hire new workers they prefer to hire younger workers (Daniel and Heywood, 2007; Heywood *et al*, 1999; Hutchens, 1986, 1988).

Hutchens (1988) suggests that job opportunities decline with age, by showing that "recently hired older workers are less equally distributed across industries and occupations than both recently hired young workers and all old workers" (1988:98).

This negative discrimination towards older workers is theoretically explained by the existence of delayed compensation contracts, training and hiring costs that introduce a series of fixed costs, inducing firms to hire predominantly young, long-tenure workers (Daniel and Heywood, 2007; Heywood *et al.*, 1999; Hutchens, 1986; Oi, 1962). When a firm hires older workers it does not expect long employment tenure.

Hutchens (1986) focuses on jobs in which older workers are employed but not hired for and tries to assess if those jobs present features associated with delayed payment contracts (such as pensions, long-tenure employment, comparatively high wages for older workers, and mandatory retirement). His work is in line with Lazear's (1981) research, which considers that it is optimal to construct a long employment relationship. Therefore, jobs characterized by long-tenure employment, comparatively high wages for older individuals, pensions and mandatory retirement do not hire older workers (Hutchens, 1986).

However, Hutchens was not in the possession of firm-level data which, as he clearly states, "would be ideal for this purpose" (1986:451). Nevertheless, he constructed a hiring opportunity index for older workers, which was computed in the following manner:

$$I(i,j) = \frac{h(i,j)}{e(i,j)}$$

where $h(i,j)$ is the share of recently hired workers in industry i and occupation j that are over age 55, and $e(i,j)$ is the share of employment in industry i and occupation j that are over age 55.

This index identifies jobs that employ but do not hire older workers, that is, jobs characterized by low values of the index. It is used by Hutchens as an independent variable in his estimation procedure to assess its effect on some characteristics (pensions, tenure, wages, and mandatory retirement – the dependent variables) of jobs with delayed payment contracts. In a later research, using establishment level data, Heywood *et al.* (1999) use the index as a dependent variable. Using a variation of Hutchens (1986) methodology, Heywood *et al.* (1999) study the determinants of older workers' hiring opportunities in Hong Kong. Evidence shows that occupations with greater skill requirements are negatively associated with hiring opportunities for older workers. Also, when the

establishments have a high proportion of long-tenure workers and when pensions are offered, older workers face reduced hiring opportunities.

In a recent research conducted for the United Kingdom where nearly 1/3 of the firms which hired workers in the last five years did not hire older workers, Daniel and Heywood (2007) use the share of older workers' hiring as the dependent variable to show that firms which use deferred compensation schemes hire a smaller share of older workers. This also happens with firms in which specific human capital is required.

Therefore, empirical evidence suggests that firms prefer long-term employment relationships with their employees. This also implies difficulties for older workers in what concerns recruitment opportunities. In general, these studies use econometric methods that are not appropriate for dealing with a fractional dependent variable. Also, the data sets used are cross-sectional or even aggregate data that are not ideal for the analysis.

3.3 Older workers and the Portuguese labor market

Portugal faces the same scenario as the European Union or other developed economies regarding population aging and it can also be explained by the decline in fertility rates and the increase in life expectancy. Both in relative and in absolute terms, Portugal is at the top of the countries where the decrease in fertility rates and the increase in life expectancy are most significant.

Despite this demographic framework, which will influence the composition of the labor force, attention has been centered on the sustainability of the Social Security System and not on labor market implications. A possible explanation for this apparent lack of interest on labor market issues may arise, as stated, from the fact that Portuguese older workers (55-64 years) present high activity and employment rates (54% and 50%, respectively), above the EU25 average (47% and 44%, respectively) and already above the 50% threshold for the employment rate to be achieved until 2010 (European Commission, 2007).

Additionally, the country has a comparatively high average exit age from the labor force (63.1 years) (European Commission, 2007). According to the results obtained by a specific module – that focuses on workers' transitions from professional life to retirement – of the Portuguese quarterly labor force survey *Inquérito ao Emprego*, 62% of all workers aged 50 to

69 who are in employment and receiving a retirement pension[3] (or even though not receiving the pension were entitled to it)[4], continue in the labor market due to the need of obtaining a sufficient family income (INE, 2007). Apparently, Portuguese older workers remain longer in the labor force, not because they want to, but because they need to. Income seems to be a particularly relevant variable in the decision to completely withdraw from activity.

Purchasing power issues aside, in a country with such a strong attachment of older workers to the labor market, do these workers face the same employment opportunities as younger individuals? Once unemployed, the probability of finding a job is much lower for the older than for prime-age workers. If we look at the transitions between employment states for older workers (55-64) between 2005 and 2006, as depicted in Table 3.1, we can see that compared to the EU27, when a Portuguese older worker becomes unemployed he faces the same percentage of success in finding a new job (around 13%) within a one year period.

Table 3.1: Transitions between economic states for older workers (55-64), 2005-2006

	Economic status in 2006					
	Employed		Unemployed		Inactive	
Economic status in 2005	PT	EU27(a)	PT	EU27(a)	PT	EU27(a)
Employed	94.1	90.2	1.4	1.5	4.5	8.3
Unemployed	12.8	12.8	64.5	37.7	22.7	49.4
Inactive	0.4	3.0	0.1	0.7	99.4	96.3

Source: European Commission (2007).
Note: (a) EU27 covers the EU Member States excluding Belgium, Ireland, The Netherlands, and Sweden, for which data is not available in 2006 on status one year earlier.

Furthermore, the shift into inactivity is very much a one-way street: once inactive, people remain inactive. However, while in the EU27 almost a half of the older unemployed become inactive in the next period, this only happens for 23% of the older Portuguese unemployed. Almost 65% of the older unemployed in Portugal remain unemployed (against 38% for the EU27). I am not in the possession of data on economic transitions for younger age-groups in Portugal. Nevertheless, that kind of data exist for the EU27 (Table 3.2) and it shows that older workers face a greater challenge to get back into work if they lose their job.

[3] The Portuguese law allows a worker who is entitled to a retirement pension at the legal retirement age (65 years) to continue in the labor force, accumulating income from work and income from a pension.
[4] Under certain circumstances, early retirement schemes make it possible for workers to have access to a retirement pension before completing 65 years of age, although at the expense of a pension cut-off.

Table 3.2: Transitions between economic statuses in the EU27, by age group, 2005-2006

Economic status in 2005	Economic status in 2006		
	Employed	Unemployed	Inactive
Total Working Age Population			
Employed	94.6	2.5	2.9
Unemployed	31.2	43.4	25.4
Inactive	10.4	4.3	85.3
15-24			
Employed	89.9	5.6	4.4
Unemployed	38.9	40.4	20.7
Inactive	13.0	5.2	81.8
25-54			
Employed	95.7	2.3	2.0
Unemployed	32.3	45.2	22.5
Inactive	13.8	6.3	79.9
55-64			
Employed	90.3	1.5	8.2
Unemployed	12.8	37.7	49.4
Inactive	2.9	0.7	96.4

Source: European Commission (2007).
Note: EU27 covers the EU Member States excluding Belgium, Ireland, The Netherlands, and Sweden, for which data is not available in 2006 on status one year earlier.

Compared to the situation in other European economies, there is a high attachment of older workers to the labor market and it would be relevant to verify if that attachment results from long-tenure employment or if Portuguese older workers also have some opportunities in what concerns firms' hiring behavior.

Labor market mobility in terms of new hires is lower for older workers than for prime-age individuals. According to data of the European Commission (2007), Portugal presents one of the lowest hiring rates (computed, for each age group, as the ratio of people in employment with tenure of 12 months or less relative to overall employment in that age group), under 4%, compared to an average of 7% for the European Union.

Moreover, most new hires among older people are accounted for by "job changers", that is older workers who were working in the previous year, rather than by shifts into employment by older workers who were previously unemployed or inactive.

3.4 Data and methodology

3.4.1 Matched employer-employee data set

In order to study the determinants of hiring older workers in Portugal, I use a matched employer-employee data set known as *Quadros de Pessoal* (QP). QP is an annual mandatory survey conducted by the Ministry of Labor and Social Solidarity that gathers information on virtually all firms with wage-earners in Portugal. It includes information on firms (such

as location, industry, sales, number of employees, date of constitution, legal setting, ownership type), establishments (location, industry, number of workers) and workers (gender, age, education, hours of work, labor earnings, date of admission into the firm, etc). Civil servants and domestic service are not covered, and the coverage of agriculture is low given its low share of wage-earners.

I use longitudinal data on firms and their workers from 1986 to 2005 to identify the determinants of hiring older workers by Portuguese firms. Matching firms and workers' files, I use workers information to create some of the variables used in this research. I consider only firms with 5 or more years of existence (so that the tenure variable – see below – will be meaningful) and, additionally, firms that do some hiring in a given year (so that the hiring opportunity index for older workers would not be underestimated).[5] For this latter restriction I consider just workers for whom I have – or can recover – information on the date of admission into the firm. I classify an employee as a hire whenever he/she was admitted into the firm during the last 12 months. For instance, if in the 1999 survey (collected in October) the firm reports June 1999 as a particular worker's month and year of admission into the firm, then this worker is considered as new hire. These restrictions resulted in a sample of 20,910,160 workers. However, in order to avoid the overestimated influence of large firms in the estimation, I only keep one observation per firm in each year, which ended up in an unbalanced panel with 900,001 observations (firms/years), for a total of 258,588 firms. The construction of the data set used in this research is thoroughly described in Appendix 3.A.

Trying to assess the hiring opportunities for older workers in the Portuguese labor market I started by computing the hiring opportunity index, constructed by Hutchens (1986) and introduced in Section 3.2, using aggregate data from *Quadros de Pessoal*. Table 3.3 shows the hiring opportunity index for older workers in Portugal, for the period 1986-2005:

[5] I computed the hiring opportunity index for all firms (that did some hiring or not) and just for firms that hired workers. The values of the index are always smaller when computed for all firms.

Table 3.3: The Hutchens' hiring opportunity index (aggregate yearly data)

Year	% older hiring (1)	% older employment (2)	(3)=(1)/(2)[a]
1986	2.9	8.9	0.33
1987	3.0	9.0	0.33
1988	2.9	9.0	0.32
1989	3.3	9.1	0.36
1991	3.1	9.1	0.35
1992	3.2	8.9	0.36
1993	3.3	8.7	0.38
1994	3.5	8.3	0.42
1995	3.3	8.2	0.40
1996	3.6	8.3	0.43
1997	4.1	8.3	0.50
1998	3.9	8.5	0.47
1999	3.8	8.4	0.45
2000	4.1	8.4	0.49
2002	3.9	9.0	0.44
2003	4.3	8.5	0.51
2004	4.1	7.8	0.53
2005	4.1	8.6	0.48

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Notes: [a] This ratio is the hiring opportunity index developed by Hutchens (1986).
Columns (1) to (3): data from firms (and their workers) with 5 or more years of existence that hired workers.

Aggregate yearly data seems to indicate that younger workers have more hiring opportunities than older workers do (the hiring opportunity index for workers aged less than 55 is always greater than 1, meaning that the share of hires is greater than the share of employment for this age category). Portuguese firms hire older workers but they do not replicate the existing age composition of their work force, that is, on average for the 1986-2005 period, older workers represented almost 9% of the labor force employed and only around 4% of hiring. However, in this period, hiring opportunities for older workers seem to be increasing, although in a non-monotonic way.

Therefore, studying the hiring opportunities for older workers in a country where they have a strong attachment to the labor force should call upon the need of public policy measures towards improving labor market opportunities for older workers.

3.4.2 A fractional logit model

The dependent variable in this study (as in Daniel and Heywood, 2007) is the share of workers hired by firm *i* in year *t* who are above 54 years of age ($Shhir_{it}$). I have information on the date when the worker was hired. The distribution of the share of older hires (in percentage) across firms for the 1986-2005 period is depicted in Figure 3.1.

Figure 3.1: Distribution of the share of older workers hired



Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Notes: The share of older hiring (%) is computed as the ratio of the number of firm's hires who are above 54 years old relative to the total number of workers hired, times 100. Number of observations: 900,001 (firms/years).

Microeconomic data shows that, for 90% of the observations, Portuguese firms did not hire older workers. Also, of those, only 34% employ older workers, meaning that for more than a half of these observations firms neither hire nor employ workers with 55 or more years of age. Portugal presents employment and activity rates (both above 50%) that are relatively high compared to other European Union countries. However, in the event of a job loss, older individuals seem to face major difficulties in finding a new position. On one hand, a European Commission's (2007) report underlines that Portugal has one of the lowest hiring rates of older workers and, on the other hand, descriptive statistics presented above strengthens the lack of hiring opportunities for the elderly in the Portuguese labor market.

Why is it, then, that Portuguese firms do not hire older workers? Is it because firms prefer long-term employment commitments, as suggested by Oi (1962) and Lazear (1979; 1981)?

To answer these questions, I model the determinants of hiring older individuals using the share of workers hired who are above 54 years of age (*Shhir*) as the dependent variable. As independent variables I use the share of the workforce with more than 5 years of tenure (*Shten5*), the share of promotions in the firm (*Shprom*), the share of older employment (*Shemp*), the average education level of the firms' work force (*Aveduc*), the size of the firm (*Size*), the location of the firm (*Region*), and the industry in which the firm operates (*Industry*). The next table presents the means, standard deviations (or percentages, for categorical variables) of the variables used in this study:

Table 3.4: Variables definition, means and standard deviations (or percentages)

Variable	Definition	Mean or percentage	Standard deviation
Shhir	Share of workers hired who are above 54 years of age	0.47	0.18
Shten5	Share of the firms' work force with more than 5 years of tenure	0.29	0.25
Shprom	Share of the work force who were promoted	0.17	0.26
Size	Log of the number of employees in the firm	2.25	1.25
Shemp	Share of employees who are above 54 years of age	0.07	0.13
Aveduc	Average education level of the firms' work force	6.86	2.65
Region	Dummy variable for the region where the firm is located (Portuguese NUTS II)		
North		32.67	--
Algarve		5.26	--
Centre		21.43	--
Lisbon		29.31	--
Alentejo		7.26	--
Azores		2.08	--
Madeira		1.99	--
Industry	Dummy variable for the industry in which the firm operates		
Agriculture		3.70	--
Extraction		0.60	--
Manufacturing		23.70	--
Electricity, gas and water		0.04	--
Construction		13.12	--
Commercial services, restaurants and hotels		38.50	--
Transports, storage and communications		3.58	--
Banking and insurance		7.01	--
Social and domestic services		9.75	--

Source: Computations from the author based on Quadros de Pessoal, 1986-2005.
Note: *Region* and *Industry* are categorical variables and, hence, the values reported for these variables are percentages.

I expect *Shten5* to have a negative effect on the share of older hires (the dependent variable). This will indicate that firms which usually engage in long-term employment relationships prefer to hire younger workers. Heywood *et al.* (1999) found that indicators of long-term labor relations are associated with reduced hiring opportunities for older individuals. The coefficient on the variable *Shprom* is also hypothesized to have a negative sign. As shown by Daniel and Heywood (2007), firms using promotions to create an internal labor market hire less older workers. An internal labor market may be a vehicle to motivate workers but, as Adams (2002) suggests, older workers are less likely to be motivated by promotions. As for *Aveduc*, this variable is expected to influence negatively the hiring opportunity of older workers since that, by hypotheses, the higher the average education level in a firm the fewer older workers will be hired due to human capital depreciation.

To explain the determinants of hiring older workers I use a fractional logit model (Papke and Wooldridge, 1996 and 2005). Papke and Wooldridge (1996) propose models for the conditional mean of a fractional response variable for which the predicted values are kept in the unit interval. They consider that the mean function takes the logistic form and then apply a quasi-maximum likelihood estimation method to cross-section data. In recent work, Papke and Wooldridge (2005) develop methods for estimating fractional panel data models.

The methodology I use follows closely the one proposed by Papke and Wooldridge (2005).[6] The share of older workers hired, the dependent variable in my study, takes only values between zero and one ($0 \leq Shhir_{it} \leq 1$).

Considering longitudinal data with cross-sectional observation *i* and time period *t*, where the dependent variable is $Shhir_{it}$ and $0 \leq Shhir_{it} \leq 1$, for a set of independent variables $\boldsymbol{x}_{it}$ it is assumed that

$$E(Shhir_{it} \mid \boldsymbol{x}_{it}, c_i) = G(\boldsymbol{x}_{it}\boldsymbol{\beta} + c_i), \quad t = 1, \ldots, T \tag{3.1}$$

where $G(z) \equiv \Lambda(z) \equiv \exp(z)/[1+\exp(z)]$ is the logistic function satisfying $0 < G(z) < 1$ for all $z \in \Re$. Therefore, the predicted values of y must lie in the interval $(0,1)$. In equation (3.1), c_i represents the unobserved effect which is additively introduced in the logistic function.

The estimation procedure is conducted by using the pooled Bernoulli quasi-maximum likelihood estimator (QMLE). The explanatory variables are specified as $(1, \boldsymbol{x}_{it}, \bar{\boldsymbol{x}}_i)$ where $\bar{\boldsymbol{x}}_i$ is the time average of $\boldsymbol{x}_i$. I also use a generalized estimation equations (GEE) procedure to account for the presence of potential serial correlation and heteroscedasticity. Rather than attempting to find the variance $Var(Shhir_i \mid \boldsymbol{x}_i)$, Papke and Wooldridge (2005) use a "working" version of this variance, which is expected to be misspecified. The GEE approach maintains the form of the working variance while varying the working correlation matrix. I assume an "exchangeability" correlation pattern where it is considered as if the standardized errors have a constant correlation. With this working correlation structure it is assumed that correlations are not a function of $\boldsymbol{x}_i$.

[6] The same methodology has also been used by Hausman and Leonard (1997) and Wagner (2003), on proportion data.

3.5 Results

The main results are presented in Table 3.5. The coefficients on both models are very similar and present the same signs.

Table 3.5: Estimation results for the fractional logit model

Variable	Pooled QMLE	GEE
Shten5	-1.874***	-1.856***
	(.041)	(.042)
Shprom	-.108***	-.107***
	(.031)	(.031)
Logsize	.442***	.440***
	(.015)	(.016)
Shemp	11.449***	11.400***
	(.065)	(.070)
Aveduc	-.150***	-.150***
	(.006)	(.006)
Region		
North	-.040	-.044
	(.124)	(.125)
Algarve	-.097**	-.114**
	(.046)	(.048)
Centre	-.043*	-.044*
	(.025)	(.026)
Alentejo	.099***	.095***
	(.028)	(.030)
Azores	-.582***	-.580***
	(.081)	(.085)
Madeira	-.101	-.060
	(.273)	(.276)
Industry		
Agriculture	.150**	.143**
	(.065)	(.068)
Extraction	.032	.010
	(.071)	(.075)
Manufacturing	.052	.049
	(.039)	(.040)
Electricity, gas and water	.253	.263
	(.249)	(.256)
Construction	.272***	.258***
	(.019)	(.021)
Transports, storage and communications	-.003	-.007
	(.030)	(.033)
Banking and insurance	.358***	.356***
	(.032)	(.034)
Social and domestic services	.242***	.223***
	(.040)	(.042)
Log pseudolikelihood	- 106,968.1239	--
Observations	899,995	899,995

Source*:* Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Notes: (a) Both models contain year dummies from 1987 through 2005. (b) Lisbon is the omitted category in *Region*. (c) Commercial services, restaurants and hotels is the omitted category in *Industry*. (d) The models include time averages of the seven independent variables. (e) Robust (pooled QMLE) and semi-robust (GEE) standard errors in parentheses (when using STATA®, the estimation of a GEE model that requires the "robust" option produces valid standard errors even if the correlations within group are not as hypothesized by the specified correlation structure. Nevertheless, it requires that the model correctly specifies the mean. The resulting standard errors are thus labelled "semi-robust" instead of "robust"). (f) Standard errors are presented in parentheses; ***/**/* means significance at 1%/5%/10% level, respectively.

However, standard errors are somewhat smaller in the pooled QMLE model, compared to the GEE procedure. This may occur because, when employing the Bernoulli QMLE, standard errors and test statistics need to be adjusted to allow for arbitrary serial dependence across *t*. The standard errors that are robust to violations in the specified conditional variance but assume serial independence tend to be relatively small (Papke and Wooldridge, 2005).

As hypothesized, *Shten5* has a negative impact on the share of older workers hired. This suggests that Portuguese firms prefer long-term commitments with their employees. Therefore, firms which usually engage in long-term employment relationships prefer to hire younger workers.

The relationship between the share of older workers hired and the share of the workforce promoted (*Shprom*) presents also a negative sign. This indicates that firms using promotions to create an internal labor market hire less older workers. However, the size of a firm and the share of older employees seem to work in favor of older workers. In effect, the bigger a firm is (measured by the log of the number of its employees) the higher is the share of older workers hired. This is also the scenario if a firm presents a higher share of older workers employed. As for *Aveduc* its sign behaves as hypothesized. The higher the average education level in a firm the fewer older workers will be hired. Human capital depreciation is a possible explanation for this result. Therefore, this variable influences negatively the hiring opportunities for older workers.

Relative to Lisbon, only Alentejo seems to give some opportunities to older workers. This might be so because of the demographic structure of that particular region with a high percentage of older population, compared to the other Portuguese regions.

Looking at the results for the *Industry* variable, we see that compared to the Commercial services, restaurants and hotels' sector[7] all the other sectors provide more hiring opportunities for older workers.

Nonetheless, computation of marginal effects[8] for *Shten5* and *Shemp* indicates that, although statistically significant, their magnitude is small and, as expected, very similar in both specifications (pooled QMLE and semi-robust GEE). Indeed, *ceteris paribus*, if the share of the firms' workforce with more than 5 years of tenure (*Shten5*) increases by 0.1 (or, in percentage points (p.p.), a 10 p.p. increase) the share of older workers hired (*Shhir*) decreases on average 0.004 (or 0.4 p.p.). The variable that presents a stronger impact on the

[7] This sector represents almost 39% of the firms in the sample.
[8] Marginal effects were computed using Stata. On the text I report their values for selected variables: *Shten5* and *Shemp*.

share of older workers hired is the share of older workers employed by a firm (*Shemp)*. In effect, holding all other variables, if the share of older workers employed rises by 10 p.p., the share of older workers hired increases by 2.4 p.p. This seems to indicate that firms that employ older workers are more receptive to hiring older workers. However, their hiring behavior towards older workers does not seem to replicate their actual employment structure.

3.6 Conclusion and policy implications

Portuguese older workers present high activity and employment rates, suggesting a strong attachment to the labor market. Nevertheless, when they become unemployed, statistics show that these workers face more difficulties in finding a new job, compared to other age groups. Therefore, studying the hiring opportunities of older workers is relevant in an era of 'active aging' policies that aim at extending a workers' active life. For these policies to be effective, older workers should face the same opportunities as other workers do. However, this seems not to be the case.

The use of a fractional logit model applied to longitudinal data, a methodological novelty in the study of older workers' hiring opportunities, shows that firms employ older workers but prefer to hire younger workers. In effect, the higher the share of a firms' workforce with more than five years of tenure, the lower the share of older workers hired. This suggests that firms which favor long-term employment commitments with their employees are inclined to hire younger workers. This demand behavior by Portuguese firms reveals that if an older worker loses his/her job he/she will face major constraints to get back to work.

Creating labor market opportunities for older workers that allow them access, in terms of hiring, comparable jobs as other age group workers should be a political concern. This is a matter of particular interest in order to achieve the goals set under active aging policies.

There are other issues concerning labor market opportunities of older individuals that can be explored. For instance, studying the promotion prospects of the less young workers would also provide an insight of other sorts of labor market opportunities that are open to these workers.

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Appendix to Chapter 3

Appendix 3.A Construction of the data set

3.A1 Sample definition

The data set used – *Quadros de Pessoal* – gathers information on firms, their establishments and workers. I used the files containing information on firms and their workers for the 1986-2005 period (18 years), with an exception in 1990 and 2001, because the data were not collected these years. Each firm and each worker is identified by a unique registration number which allows me to trace them over time and match them. All information contained in these files is reported by the firm.

I started by "cleaning" some inconsistencies on the files for firms and workers separately. Afterwards, I merged firms and workers' files in order to obtain a single data set. The matching variables were the year of the survey and the firm's identification number. At this stage I ended up with 34,120,844 observations (workers/years). I call this data set 1 (DS1).

Since the firm is the observation unit in the analysis, information on workers was aggregated at the firm level in order to compute mean values for the educational level of the firm's workforce or to obtain other indicators such as the share of the workforce with more than 5 years of tenure, the share of promotions or the share of older employment in the firm.

Considering that the aim of the study is to assess the hiring behavior of Portuguese firms towards older workers, in the sample I include only firms with 5 or more years of existence (in order to make one of the explanatory variables, associated with tenure, meaningful) and firms that do some hiring in a given year. For this latter restriction, I had to use information on the worker's date of admission into the firm. These restrictions led to an unbalanced panel data set with 900,001 observations firm-year, for a total of 258,588 firms.

3.A2 Construction of the variables

The dependent variable in the estimation is the share of workers hired by firm i in year t who are above 54 years of age ($Shhir_{it}$). This variable is not directly available on any of the data sets (firms or workers' files). The starting point for its construction was DS1. The

$Shhir_{it}$ variable was generated from the following expression: $Shhir_{it} = \frac{\text{number of workers hired who are above 54 years of age}_{it}}{\text{total number of workers hired}_{it}}$. Using the "date of admission" of the worker into the firm I can assess when the worker was hired. Then, to obtain the numerator and the denominator of the expression above, the following steps were taken:

1. For every worker at a firm in a given year I have created a temporary dummy variable that equals 1 whenever the year of admission at the firm corresponded to the year of the survey, and 0 otherwise;
2. Since each worker is linked to a firm, the previous step allowed me to obtain the denominator of the $Shhir_{it}$ expression. This was made by summing the values of the temporary dummy variable by firm-year;
3. As for the numerator, the procedure was similar to the one in step 2, that is, I added the values of the temporary variable but with a restriction: to be included in the sum, the age of the worker had to be equal or higher than 55. With this I obtained the number of workers hired by firm *i* in year *t* who are above 54 years old.

   The dependent variable $Shhir_{it}$ was build according to its expression.

As for the independent variables, the *Region* and *Industry* variables are directly obtained from DS1 while the rest was derived. $Shemp_{it}$, representing the share of the firms' workforce above 54 years of age, was computed as the ratio $Shemp_{it} = \frac{\text{number of employees who are above 54 years of age}_{it}}{\text{total number of employees}_{it}}$. The data set presents the number of workers employed by a firm in each year and it is straightforward to obtain the number of those who are older than 54 years. To construct $Shten5_{it}$, the share of the firms' workforce with more than 5 years of tenure, I created a variable for tenure using the variable date of admission into the firm. I subtracted the date of admission to the year of the survey to get the tenure. Then, it was computed as $Shten5_{it} = \frac{\text{number of employees with 5 or more years of tenure}_{it}}{\text{total number of employees}_{it}}$. The variable $Shprom_{it}$, the share of the workforce who was promoted at firm *i* in year *t*, used, as a starting point, the variable date of latest promotion, available on DS1. Therefore, that explanatory variable $Shprom_{it}$ was given by the quotient $Shprom_{it} = \frac{\text{number of employees promoted}_{it}}{\text{total number of employees}_{it}}$. Finally, the variable $Aveduc_{it}$ refers to the mean of the educational level (this variable is available on

DS1, for each worker) of the work force and $Size_{it}$ is simply the logarithmic of the number of employees at firm *i* in year *t*.

Chapter 4

Age and opportunities for promotion

4.1 Introduction

As a response to the challenge of population aging, increasing the employment rate of older individuals and delaying their exit from the labor force are the core objectives of active aging policies. As the demographic prevalence of older cohorts grows, so does their relevance in the labor force.

Older workers have been the major contributors to employment growth in the European Union (EU). Between 2000 and 2007, workers aged 55 to 64 experienced a 34% change in employment in the EU, compared to an increase of approximately 5% for prime-aged workers (25-54 years) and a decrease in employment of over 2% for young workers (15-24 years); additionally, in 2007, older workers contributed 32% to the increase in total employment (European Commission, 2008). Despite these numbers suggestion that active aging policies are being effective, older individuals still face difficulties in what concerns employment[9] and career development opportunities. Adams (2002) studies the effect of age discrimination in promotion on wage growth, separations and early retirement, and finds that in firms where older individuals report that younger workers are favored in promotions, older workers face lower wage growth and a greater likelihood of early retirement. Data used are based on reported perceptions by older individuals of their firms' promotion practices. Johnson and Neumark (1997) also suggest that age discrimination is associated with a higher likelihood of job separation together with a smaller propensity to remain employed. Thus, age differences in promotion prospects have practical

[9] As for employment opportunities, empirical studies show that firms employ older workers but, as the former favor long employment relationships, preference goes to hire younger individuals (Daniel and Heywood, 2007; Heywood *et al*, 1999; Hutchens, 1986, 1988).

consequences on the labor force status of older individuals, influencing their retirement decision.

Since age appears to be a disadvantage factor in what labor market opportunities is concerned, this research aims to examine if there are any differences in career development between younger individuals and older ones. This is done employing survival analysis techniques on a sample of new firms and their workers.

I take advantage of a comprehensive data set called *Quadros de Pessoal* (QP). QP is a matched employer-employee longitudinal database that, given the mandatory nature of the underlying survey, covers the population of firms and workers in the private sector. Contrary to other data sets (such as the ones used by McCue (1996), Pergamit and Veum (1999), Francesconi (2001)), the promotion events are not self-reported but are supplied by the firm. This allows defining a benchmark, at least within firms, that reduces measurement errors associated with self-reported data.

Quadros de Pessoal has formerly been used to study the determinants of promotions in the Portuguese labor market. Lima and Pereira (2003) focus on workers' career and wages using a sample of large firms, highlighting the effect of promotions on wage growth, while Lima and Centeno (2003) study the careers of top managers. However, since both these studies centre the attention on particular groups (the former in large firms and the latter in top managers) results cannot be generalized. Lima (2004), Silva and van der Klaauw (2006), and Ferreira (2009) produce a set of results that can be generalized. Yet, none of these studies focuses on the promotion opportunities faced by older individuals.

Do older workers experience the same likelihood of promotion as younger ones? Considering a sample of new firms, my findings suggest that this is not the case: older employees are in fact in disadvantage when it comes to promotion opportunities.

This chapter is structured as follows. Section 4.2 presents a theoretical synopsis on employment relationships and career development. The following section displays previous empirical results on the determinants of promotions. A description of the data set used is presented in Section 4.4 and some descriptive statistics are presented. This section also highlights the survival time characteristic of the data. Section 4.5 describes and discusses the estimation procedures used and Section 4.6 reports the empirical results. Finally, Section 4.7 concludes.

4.2 Theoretical overview

The study of employment relationships in labor economics has grown in relevance over the last decades. Unequivocal is the statement that long-term employment relationships benefit both employers and workers. These benefits are highlighted, among other authors, by Oi (1962) and Lazear (1979, 1981). As job tenure increases, the employer becomes aware of the quality of the worker, measured by his productivity, and both recognize or not the quality of the match (Jovanovic, 1979). A mismatch leads to job separation while good matches may lead the worker through a defined career path within the firm's hierarchy. The concept of a career is the basic feature of an internal labor market where careers are seen as a sequence of promotions to higher hierarchical levels with higher pay and responsibility (Baker *et al.*, 1994a).

Firms implement internal labor markets in which careers and wages are somewhat protected from external labor markets (Baker and Holmstrom, 1995) as a means to motivate workers and, thus, enhance their productivity.

Gibbons (1996) provides an interesting review on the theory of wages and career dynamics within firms. The author mentions four underlying literatures: job assignment, tournaments, human capital and learning.

The job assignment literature (Sattinger, 1975; Rosen, 1982 and Waldman, 1984a) focuses on the assignment of workers to jobs when firms consist of an array of potential job assignments and there exists full information about workers and jobs. The models are static and based on the idea that employees with higher ability should be assigned to jobs where decisions have an impact over a larger scale of operations. However, since the models are static, they cannot explain wage and career dynamics (Gibbons and Waldman, 1999; 2006). Nevertheless, when the firm assigns the worker to a new job it signals information to competing firms about the worker's ability (Waldman, 1984b; Bernhardt and Scoones, 1993). Therefore, the wage increase offered to the employee must be sufficiently high to disincentive competition by other firms.

Lazear[10] and Rosen (1981) and Rosen (1986) see promotions as a prize awarded the winner of a competition. They develop a tournament theory based on a rank-order

[10] Lazear's (1979) theory of deferred compensation can also be seen as a worklife incentive scheme. This theory argues that senior workers receive wages above their marginal product to motivate them during the initial years of their careers (when wages are below their marginal product). Lazear (1999) relates worklife incentive theory to tournament theory but, while tournaments emphasize relative comparisons between workers, worklife incentive schemes are not comparison-based. Also, tournaments highlight wage increases upon promotion, which correspond to job changes whereas worklife incentives focus on pay changes that

payment scheme that resembles a contest. Workers are paid a prize that is higher for workers in upper positions within the firm: the winner is the worker with the highest productivity. This type of incentives is particularly relevant when firms face substantial monitoring costs. Additionally, compensation schemes like rank-order tournaments seem to favor long-run employment relationships between employer and employee. However, there is a drawback associated with this category of incentive schemes: they may induce excess competition among employees and damage worker cooperation. Additionally, tournament theory does not take into consideration the possibility of external competition by other workers, for the same position. Chan (1996) compares the choice between internal promotion and external recruitment within the context of a tournament. He finds that when competition is open to external applicants, internal workers reduce their chance of promotion. But he also suggests that an external applicant is only hired whenever she/he is significantly better that the internal candidate.

Manove (1997) concludes that firms can diminish incentive costs through the definition of a job ladder and offering promotion prospects. That is, it is in the interest of the employer to construct an internal job ladder that induces workers in low paying jobs (hired externally) to offer increased effort as a way of paying for promotion (internal) to high paying jobs.

Investments in human capital may also result in promotions (Becker, 1962). While general training (general human capital accumulation) raises the future marginal product of employees in the firm providing it, it would also increase the workers' marginal product in many other firms. Because of this, the wage of trainees is below their actual marginal product, meaning that employees pay for their general on-the-job training. Conversely, the accumulation of firm-specific human capital, through specific training, increases productivity more in firms providing it. Therefore, and since specific training involves investment by both firm and worker, they have an incentive to engage in a long-term employment relationship. Carmichael (1983) shows that when employers and employees invest in specific human capital, promotions are given to trained workers according to their seniority level.

According to the learning literature, firms do not know about the worker's ability when she/he enters the labor force but, as time goes by, the firm becomes aware of it. Therefore, as tenure in a job increases, the worker's productivity is known more precisely (Jovanovic,

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occur within a job instead of the change between them. But, as Lazear (1999) states, both incentive designs can be at work within the same firm.

1979) and good performances will be rewarded with higher wages. A promotion may well be the firm's response after learning about the worker's productivity.

Farber and Gibbons (1996) develop a dynamic model of learning and present it as a complement to the human capital model in the explanation of wage dynamics.

Gibbons and Waldman (1999) show that a model that combines features of job assignment, human capital acquisition and learning can capture some of the empirical findings concerning promotion dynamics and wages within firms, such as the positive association between promotions and wage increases or that workers who get large wage increases at one particular job level are more likely to be promoted to the next level.

4.3 Previous empirical findings

Empirical studies on promotion and career dynamics inside firms do not focus on testing any of the above mentioned theories in particular. Instead, previous research combines features of each of those theories to examine mobility within firms.

Summarizing the empirical results it is possible to verify that promotion rates fall with age and experience. McCue (1996) finds that age and experience are negatively associated with the promotion likelihood, while Pergamit and Veum (1999) present evidence of the statistical non-significance of these variables. However, Adams (2002) shows that in firms where older employees report that younger workers are favored in promotions, the former face lower wage growth and a greater likelihood of early retirement. Thus, promotion practices that favor younger workers are negatively correlated with wage growth of older workers and positively correlated with the retirement decision.

Tenure effects are less consistent, with evidence both for positive and negative effects. McCue (1996), Francesconi (2001) and Lima and Centeno (2003) have found that tenure and promotion probabilities have an inverse U-shaped relationship. Conversely, Abraham and Medoff (1985) suggest that within-firm mobility declines with tenure. Education effects are generally not significant (e.g. Pergamit and Veum, 1999), but when they are, promotion is positively associated with higher levels of education (McCue, 1996).

There is evidence of both higher promotion opportunities for men than for women (Olson and Becker, 1983; Pergamit and Veum, 1999) and of equal gender promotion likelihood (Booth *et al.*, 2003). Lazear and Rosen (1990) conclude that, since the ability standard for promotion is higher for women, more able women will be passed over for promotion by less able men. The fact that women face more non-market opportunities

(such as household production) than men works as a penalty, lowering females' promotion probabilities. According to Lazear and Rosen (1990), a higher expected value of home time raises the probability of separation for women which, in turn, increases the levels of ability for promotion by female employees.

Consistent with the "fast-tracks" mentioned by Baker *et al.* (1994a), there is evidence of a positive association between prior promotions and current promotions (Pergamit and Veum, 1999). Workers who have been previously promoted are more likely to be promoted once again.

As for firm characteristics, Pergamit and Veum (1999) and Francesconi (2001) find that larger firms provide better promotion prospects. A similar conclusion is suggested by Topel and Ward (1992) who argue that large firms comprise workers' movements that would otherwise take place between smaller firms. In larger organizations, the existence of an internal labor market allows for career development within the firm, where individuals progress to higher level jobs through promotions (Baker *et al.*, 1994a).

Overall, as a consequence of promotions workers are rewarded with higher wages (Topel and Ward, 1992; Baker *et al.*, 1994b; McCue, 1996; Pergamit and Veum, 1999; Francesconi, 2001).

4.4 Data

4.4.1 *Quadros de Pessoal*: a matched employer-employee data set

I use data for the Portuguese economy from eighteen waves of *Quadros de Pessoal*, a matched worker-firm longitudinal data set. Annually, the Portuguese Ministry of Labor and Social Solidarity gathers information on all firms, from the private sector, with wage-earners. Data collection is based on a mandatory response survey to firms.

Quadros de Pessoal includes information on two hundred thousand firms a year, on average, and their workers (over two million a year). Each firm and worker is uniquely identified in the data set and this allows researchers to follow them over time.

Firm level information includes the date of creation, number of establishments, number of workers, sales, industry, and region, among other. Workers' files present data such as age, gender, date of admission into the firm, date of latest promotion, education, hierarchical level, occupation and wages.

The information used in this study covers the 1986-2005 period, with the exceptions of 1990 and 2001 since no worker data is reported for these years. After merging the cross-

sectional worker's and firm's files and after some cleaning of the data set (see Appendix 4.A for a detailed description), I obtain a sample with 1,033,767 observations, for 416,170 workers, 44,920 firms and 437,498 matches firm-worker.

The sample includes only new firms. This way, there is no past history of the worker within the firm that I cannot retrieve information about. However, with a sample of new firms, a problem may emerge: new firms experience high death rates. In effect, Mata and Portugal (1994) show that 20% of the firms created in the Portuguese manufacturing industry in 1983 died during the first year and that only half survived for four years. Thus, I keep in the sample firms that survived for at least two years after their creation. Table 4.B1 in Appendix 4.B displays the distribution of these firms' survival times.

4.4.2 Promotion event data

Allison (1984: 9) defines an event as "some qualitative change that occurs at a specific point in time". In this research, the qualitative change under analysis is a promotion. To study the promotion event and its determinants, a collection of event history (or survival) data is needed. Using longitudinal data like *Quadros de Pessoal* that collects the date of promotion for workers within their firms makes such a study viable. Unlike other studies, the dates of promotion and, therefore, the promotion events are not self-reported. They are provided by the firm, thus less sensitive to measurement errors.

Since I use a sample of newly created firms, the worker's career within the firm is observed until he/she gets a promotion, and thereafter. The promotion event is defined by the variable "date of the latest promotion", which refers to the year and month of the promotion. Due to the format of the variable, time elapsed until promotion is measured in months. Using 20 years of data from *Quadros de Pessoal*, the time to event (or spell length) ranges from 0 to 238 months.[11]

Not only do I know how long it took a worker to get his/her first promotion, but I have also information concerning subsequent spells. This multiple spell data framework means that I can learn about the promotion history of the worker within the same firm. Nevertheless, if promotions measure the success of an employee within a firm, some workers fail to be successful. Effectively, for as long as data are available, some workers were not or have not yet been promoted (the spell end date is unknown), and so the total length of time is unknown. These right-censored observations are also taken into

[11] October is the month of collection for the 2005 survey, the last survey year considered.

consideration in the treatment of the data. Also, for workers with previous promotion events, subsequent spells length may be censored if the follow-up period ends before promotion. Table 4.B2 in Appendix 4.B summarizes the distribution of promotions among workers.

For uncensored observations, the spell lengths until the first promotion were computed as the difference between the date of the first promotion received and the date of admission at the firm. Subsequent spells were defined through the difference between the date of the present promotion and the date of the previously reported promotion.

For right-censored observations, distinction has to be made between those who have never experienced a promotion and those who have previous events. As for the former, the length of the uncompleted spell is given by the date of collection of the survey minus the date of admission at the firm, while for the latter that length is obtained by the difference between the date of collection of the last survey and the date of the last reported promotion.

The final structure of the data considers only one observation per worker and per event[12], since it does not include time varying covariates. Because of this, the sample used in the empirical setting contains 479,308 observations, including 91,214 promotion events (complete spells). The observations refer to 402,463 workers and 44,728 firms. Summary statistics of the all events are shown in Table 4.1.

Table 4.1: Descriptive statistics of events

Spells	Frequency	Percent	Survival time		
			25%	50%	75%
Completed	91,214	19.03	12	16	30
Right-censored	388,094	80.97			
Total	479,308	100			

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: Survival time is measured in months.

4.4.3 Promotions and workers' characteristics

Of the 91,214 promotion events considered, more than 70% were awarded to workers aged less than 35 years at hire while only 10% were given to older workers (with 45 or more years of age). The distribution of promotions by age group at hire is presented in Table 4.2 and it also displays gender differences in the distribution. One fact depicted in Table 4.2 is that men obtained more than half of the promotions and this distribution

[12] For instance, a worker that did not receive any promotion during the observation period (right-censored observation) contributes with a single "censored" observation to the survival data. For a worker with multiple events, each event represents an observation, and it is assembled as pooled data.

towards men increases with the age group at hire (see column (1)). Moreover, it shows that older workers are promoted less often and this evidence is even stronger for older women (column (3)).

Table 4.2: Distribution of promotion (%) by age group at hire and gender

Age group at hire	All (1)	Men (2)	Women (3)
15-24	38.23	35.94 (49.84)	40.81 (50.16)
25-34	35.24	34.59 (52.03)	35.97 (47.97)
35-44	16.49	17.07 (54.89)	15.83 (45.11)
45-54	7.70	9.13 (62.81)	6.10 (37.19)
55-75	2.34	3.27 (74.10)	1.29 (25.90)
Number of events (percent of total)	91,214 (100)	48,352 (53.01)	42,862 (46.99)

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Notes: 479,308 observations. In parentheses, columns (2) and (3) show the gender distribution of promotions within age group at hire.

The suspicion of fewer chances for promotion for older individuals is reinforced by the data in Table 4.3 where promotion rates are summarized. Promotion rates decrease with age for both men and women but, with the exception of the 55-75 age group, women have a higher incidence of promotions than men. For instance, almost 21% of the women in the 25-34 age group at hire receive a promotion against 17% of the men. Higher promotion rates for women are also found in the data for Britain used by Booth *et al.* (2003).

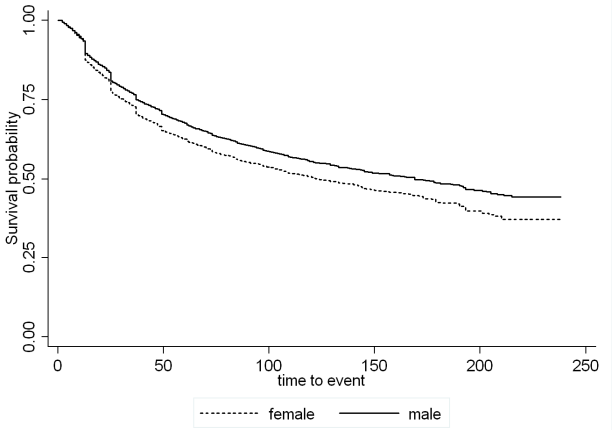
Table 4.3: Promotion rates by age group at hire and gender

Age group at hire	All (1)	Men (2)	Women (3)
15-24	22.70	21.04	24.62
25-34	18.78	17.29	20.71
35-44	16.44	14.89	18.82
45-54	15.18	14.63	16.23
55-75	12.76	13.26	11.52

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: 479,308 observations. Columns (1) to (3) report percentages.

Analysis of the duration data also reveals differences in the survival probability by age group at hire and gender. Figure 4.1 compares survival probabilities for men and women.

Figure 4.1: Kaplan-Meier survival curves, by gender

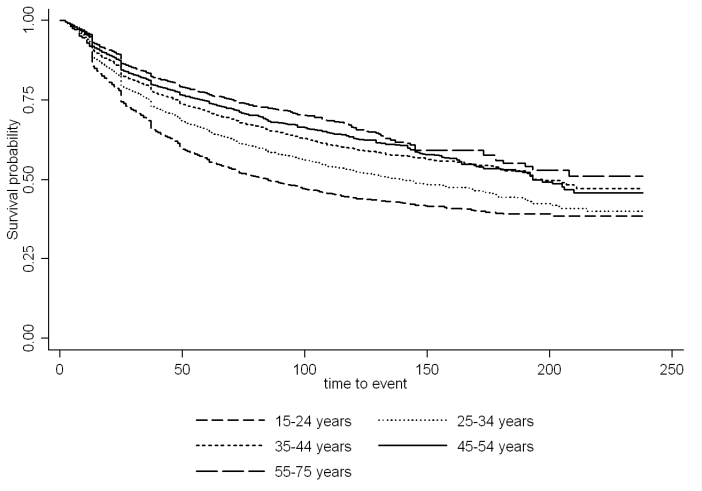


Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: 479,308 observations. 'Time to event' measures the time to promotion, in months.

Survival curves by gender, presented in Figure 4.1, show that women face shorter survival times than men, although data from Table 4.2, column (2), indicates that men get more promotions than women.

Figure 4.2 plots the Kaplan-Meier survival curves for each age group, showing that younger workers are more likely to receive a promotion than those who are older.

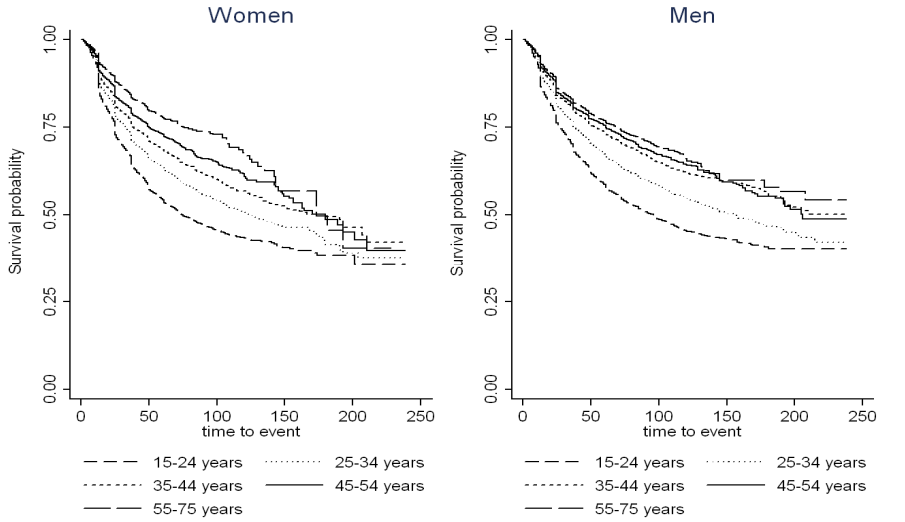
Figure 4.2: Kaplan-Meier survival curves, by age group at hire



Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: 479,308 observations. 'Time to event' measures the time to promotion, in months.

Figure 4.3 also displays the fact that those who are older are less likely to be promoted than those who are younger, regardless of gender.

Figure 4.3: Kaplan-Meier survival curves, by gender and age group at entry



Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: 479,308 observations. 'Time to event' measures the time to promotion, in months.

It is plausible to think that firms promote younger workers because older workers have been promoted earlier in their careers and are already at higher levels in the hierarchy. However, in this sample of new firms the hierarchical level of entry into the firm is known and in accordance with the previous statement, older workers should be overrepresented at higher hierarchical levels. Table 4.4 displays the age distribution of employees by hierarchical level at hire and shows that higher levels (such as top managers or other managers) are predominantly occupied by employees aged 25 to 34.

Table 4.4: Age distribution (%) by hierarchical level at hire

Age group at hire	Hierarchical level at hire							
	Top managers	Other managers	Foremen/ supervisors	Highly skilled workers	Skilled workers	Semi-skilled workers	Unskilled workers	Apprenctices
15-24	7.65	12.80	10.04	18.20	25.98	32.85	31.69	67.17
25-34	48.82	47.38	36.59	50.40	38.95	34.69	30.04	22.53
35-44	24.33	22.25	29.30	18.57	21.42	19.40	20.30	7.11
45-54	13.60	12.51	17.23	9.36	10.29	9.82	12.25	2.50
55-75	5.60	5.05	6.84	3.47	3.37	3.25	5.73	0.89
Total	100	100	100	100	100	100	100	100

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: 479,308 observations.

Additional descriptive statistics of selected variables is presented in Table 4.5. The sample comprises individuals mainly hired at younger ages where men account for more than half of the observations. Low educational levels is also a feature of the sample since, for almost 60% of the observations, 6 or less years of schooling is the highest attained level

of education. Workers enter the firm mainly at lower levels of the hierarchy and, on average, wait 27 months to be promoted.

Table 4.5: Definition and summary statistics of selected variables

	Definition	Mean (standard deviation)	Percent
Age	Age of the worker, in years	33.244 (10.821)	--
Age group at hire	Age interval, at the time of hiring		
15-24	=1 if the worker aged 15 to 24, inclusive	--	32.06
25-34	=1 if the worker aged 25 to 34, inclusive	--	35.71
35-44	=1 if the worker aged 35 to 44, inclusive	--	19.09
45-54	=1 if the worker aged 45 to 54, inclusive	--	9.66
55-75	=1 if the worker aged 55 to 75, inclusive	--	3.49
Gender	Gender		
Male	=1 if men	--	57.76
Female	=1 if women	--	42.24
Education	Higher attained educational level		
No schooling	=1 if the worker has not attended school	--	.42
2 years	=1 if the worker has two complete years	--	.82
4 years	=1 if the worker completed 4 years	--	29.86
6 years	=1 if the worker completed 6 years	--	27.50
9 years	=1 if the worker completed 9 years	--	18.71
12 years	=1 if the worker graduated from high school	--	16.90
15 years	=1 if the worker completed 15 of education	--	1.35
16 years	=1 if the workers completed 16 or more years	--	4.42
Hierarchical level at entry	Hierarchical level when the workers entered the firm		
Top managers	=1 if top managers	--	3.75
Other managers	=1 if other managers	--	2.52
Foremen/supervisors	=1 if foremen or supervisors	--	2.32
Highly skilled personnel	=1 if highly skilled workers	--	3.99
Skilled personnel	=1 if skilled workers	--	45.06
Semi-skilled personnel	=1 if semi-skilled workers	--	14.03
Unskilled personnel	=1 if unskilled workers	--	13.68
Apprentices	=1 if apprentices	--	14.65
Hierarchical level	Current hierarchical level		
Top managers	=1 if top managers	--	3.83
Other managers	=1 if other managers	--	2.73
Foremen/supervisors	=1 if foremen or supervisors	--	2.99
Highly skilled personnel	=1 if highly skilled workers	--	4.46
Skilled personnel	=1 if skilled workers	--	47.95
Semi-skilled personnel	=1 if semi-skilled workers	--	14.77
Unskilled personnel	=1 if unskilled workers	--	12.54
Apprentices	=1 if apprentices	--	10.73
Previous events	Number of prior promotions	.176 (.586)	--
Tenure (in months)	Tenure at the firm, in months	32.518 (32.834)	--
Time to event (in months)	Survival time to promotion, in months	26.944 (27.829)	--
Firm size (log of number of employees)	Size of the firm, as the logarithm of the number of employees	2.836 (1.531)	--

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: 479,308 observations.

4.5 Parametric models for survival analysis

4.5.1 Choosing a model

Parametric models for event data may assume two forms: accelerate failure time (AFT) models or proportional hazard (PH) models.[13]

Consider t to be the survival time to an event. An AFT model starts by modelling ln t rather than t. In a log linear form, the regression model can be written as:

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

where $\boldsymbol{x}$ is a vector of covariates, $\boldsymbol{\beta}$ is the vector of regression 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. A generalized gamma model (that assumes a gamma distribution), nesting the Weibull or lognormal models, is also a parametric possibility.[14]

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. Under AFT, the impact of the regressors is assumed to act additively on the log time scale and, thus, multiplicatively on the time scale itself. The parameters represent the effect of the covariates on the log time scale.

AFT models measure the direct effect of the independent variables on the survival time instead of the hazard as in the PH models. This allows for an easier interpretation of the results because the parameters measure the effect of the correspondent covariate on the mean survival time.

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[13] A comparison between proportional hazards and accelerate failure time models is provided by Patel *et al.* (2006).

[14] The generalized gamma distribution has two ancillary parameters: sigma and kappa. The Weibull distribution is a special case of the generalized gamma when kappa equals 1. When kappa equals zero, it reflects the lognormal distribution.

In the PH model, the regressors 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. $g(\boldsymbol{x})$ is a non-negative function of regressors. The model includes an intercept term β_0, and since letting $g(\boldsymbol{x}) = \exp(\boldsymbol{x}\boldsymbol{\beta})$ is a common option, $h_0(t) = \exp(\beta_0)$ is the baseline hazard function. Thus, the baseline hazard function is the hazard when all covariates are zero. That is, the intercept term can be used to scale the baseline hazard. Nevertheless, if the function $h_0(t)$ is not specified it yields the Cox proportional hazard model. The hazard of the event of interest in one group is a constant multiple of the hazard in the other group. In these models, the parameters represent the log hazard ratios which, exponentiated, provide the hazard ratios.

Patel *et al.* (2006) underline that although the PH and AFT metrics are often thought of two distinct frameworks, they are connected since the exponential and the Weibull models can be implemented as both AFT and PH models. The authors additionally point out that the Weibull model often gives similar results to the more general PH model as for the effects of the covariates and, so, the AFT model can be considered as a very general approach that contains a specific class of PH models.

Since there is an array of possible distributional forms and corresponding parametric models, how can selection be made? When parametric models are nested, likelihood-ratio or Wald tests may be used to choose between alternatives. This can be done to discriminate between Weibull versus exponential or between gamma versus lognormal or Weibull.

Nonetheless, when nesting is not evidenced, likelihood-ratio or Wald tests are not appropriate and an alternative statistic has to be used. A popular one 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.

4.5.2 Models with frailty and shared frailty[15]

The above parametric models are able to explain the variability in observed time to failure. However, both observed and unobserved heterogeneity affect survival times. Due to omitted variables, some unexplained variability or overdispersion may remain and,

[15] Gutierrez (2002), Cameron and Trivedi (2005) and Stata (2007) provide a good explanation of these models.

hence, standard parametric survival models will not take into consideration why individuals with shorter times to failure are more frail than others. That is, controlling for observed heterogeneity, individuals with unobserved characteristics associated with shorter times to failure leave the state more quickly than others; in the presence of unobserved heterogeneity even subjects with the same values of all regressors may experience different hazards. In this case, the estimate of the hazard will be an underestimate of the 'true' one (see Jenkins, 2004). When unobserved heterogeneity (also called 'frailty' in survival literature) is not account for, its effect is confounded with the baseline hazard.

A frailty model is a survival model with unobserved heterogeneity for it attempts to measure that overdispersion. The frailty is included, in each row, as an unobservable multiplicative effect, α, on the hazard function:

$$h(t \mid \alpha) = \alpha h(t)$$

$h(t)$ is a nonfrailty hazard function, α is a random positive effect that, for identification, is assumed to have mean 1 and variance θ.

Conditional on the frailty, the survivor function is now given by

$$S(t \mid \alpha) = \exp\left[-\int_0^t h(u \mid \alpha)du\right] = \exp\left[-\alpha\int_0^t \frac{f(u)}{S(u)}du\right] = [S(t)]^{\alpha}$$

where $S(t)$ is the survivor function corresponding to the hazard function $h(t)$.

Because α is unobservable, it has to be integrated out of the conditional survivor function $S(t \mid \alpha)$ in order to achieve the unconditional survivor function. Considering that the probability density function of α is given by $g(\alpha)$, a frailty model can be estimated following

$$S_{\theta}(t) = \int_0^{\infty} S(t \mid \alpha)g(\alpha)d\alpha = \int_0^{\infty} [S(t)]^{\alpha} g(\alpha)d\alpha$$

The unconditional hazard and density functions can be obtained from the unconditional survivor function as $h_{\theta}(t) = \frac{f_{\theta}(t)}{S_{\theta}(t)}$ and $f_{\theta}(t) = -\frac{dS_{\theta}(t)}{dt}$, respectively.

Therefore, compared to a standard parametric model, a frailty survival model additionally estimates the parameter θ, which is an overdispersion parameter.

For mathematical tractability, the choice of the frailty distribution $g(\alpha)$ rests on either the inverse-Gaussian distribution, with parameters 1 and $\frac{1}{\theta}$, or the gamma distribution with $\frac{1}{\theta}$ and θ as distributional parameters.

In spite of the frailty distribution chosen, $\lim_{\theta \to 0} S_\theta(t) = S(t)$. This means that, when there is no unobservable heterogeneity, the frailty model reduces to $S(t)$.

Using frailty models, distinction has to be made between the hazard faced by the individual, $\alpha h(t)$, and the hazard for the population, $h_\theta(t)$. Correspondingly, an individual has a probability of survival past time t equal to $[S(t)]^\alpha$, whilst $S_\theta(t)$ measures the proportion of the population that survives past time t.[16]

A shared frailty model is a generalization of the frailty models, where the frailty is considered to be group specific. Thus, in shared frailty models, where individuals are allowed to share the same frailty value, the frailty can be used to model intragroup correlation. It is the equivalent to a random effects panel data model (Gutierrez, 2002).

For each observation from the ith group, in a shared frailty model the hazard becomes

$$h(t \mid \alpha_i) = \alpha_i h(t \mid \boldsymbol{x})$$

where α_i represents the frailty shared among group i and $h(t \mid \boldsymbol{x})$ is the individual hazard given regressors $\boldsymbol{x}$.

Therefore, the subjects within a group are correlated since they share a common frailty. In this research I consider three possible "groups": the worker, the firm, and the match worker-firm.

Under an omitted variables scenario, a frailty model could be used when suspecting for the existence of unobserved heterogeneity within the group, while a shared frailty model could be specified in the presence of a latent common group effect.

4.5.3 Occurrence dependence

Dealing with multiple record/multiple events brings some concerns to the analysis. Specifically, it stresses the problem of event dependence. Hence, one assumption that has to be made is that the dependence of the hazard on time since last promotion has the same

[16] Using the Stata 11 command – `streg` – to fit parametric survival models, when specifying the option – `distribution( )` – a model for an individual with frailty equal to 1 will be specified; recall that when $\alpha = 1, [S(t)]^\alpha = S(t)$. However, specifying – `frailty(distribution)` – determines which of the two above forms for $S_\theta(t)$ is used.

distributional form for each successive promotion. A second assumption required is that, for each individual, the multiple events must be independent.

As suggested by Allison (1984), the consequences of violating the occurrence independence assumption can be minimized through the consideration, in the model, of covariates that capture the workers' previous promotion history. To do so, I include in the specification a variable that accounts for the number of prior promotions: *Previous events*. Also, the length of the previous spell is set to zero when no previous spell is observed.

For comparison, I estimate duration models for the first promotion as well as models for all promotions. This is done in order to examine potential differences between the distributions of time to first promotion and of all events.

4.6 Estimation results

4.6.1 First promotion

The effect of selected covariates on the hazard (PH models) and on the survival time to first promotion (AFT models) is, respectively, exhibited in Tables 4.6 and 4.7.[17] In the PH form, each regression coefficient indicates the proportional effect on the hazard of absolute changes in the respective covariate. Thus, a negative coefficient reflects a smaller hazard while a positive coefficient represents a higher hazard of promotion. Table 4.6 presents the results for three different specifications: exponential, Weibull, and Gompertz.

From Table 4.6, I conclude for the inappropriateness of the exponential model after performing a test (t-statistic=69.64, p-value=0) on the hypothesis that the ancillary parameter (the shape parameter) in the Weibull model is equal to 1. Additionally, the Weibull model performs better than Gompertz since the former shows both a higher log-likelihood and a smaller AIC value.

AFT metrics comparison is made in Table 4.7. In these models, positive coefficients reveal higher survival times or, which is the same, longer time elapsed until a promotion. On the other hand, negative coefficients mean shorter survival times. Additionally, an AFT regression coefficient relates proportionate changes in survival time to a unit change in a given covariate, *ceteris paribus*, since $\beta_k = \frac{\partial \ln(t)}{\partial x_k}$.

[17] I have also estimated a semi-parametric Cox proportional hazards model. No significant differences in the coefficients were encountered.

Table 4.6: Proportional hazard models' coefficients: first promotion

Variables	Exponential (1)	Weibull (2)	Gompertz (3)
Age group at hire			
[15,25)	.0538	.0621	.0560
	(.0100)	(.0100)	(.0100)
[35,45)	-.0615	-.0729	-.0653
	(.0120)	(.0120)	(.0120)
[45,55)	-.1112	-.1281	-.1163
	(.0161)	(.0161)	(.0161)
[55,75]	-.2326	-.2565	-.2399
	(.0258)	(.0256)	(.0258)
Male	-.0538	-.0528	-.0542
	(.0087)	(.0087)	(.0087)
Education			
No schooling	-.2542	-.2695	-.2580
	(.0758)	(.0758)	(.0758)
2 years	-.1555	-.1340	-.1492
	(.0521)	(.0521)	(.0521)
6 years	.1624	.1863	.1707
	(.0111)	(.0111)	(.0111)
9 years	.3076	.3629	.3244
	(.0131)	(.0131)	(.0131)
12 years	.4279	.4756	.4434
	(.0139)	(.0139)	(.0139)
15 years	.4782	.5526	.5022
	(.0357)	(.0357)	(.0357)
16 years	.5038	.5952	.5331
	(.0262)	(.0262)	(.0262)
Hierarchical level at hire			
Top managers	-.2978	-.3457	-.3118
	(.0263)	(.0263)	(.0263)
Other managers	-.2101	-.2537	-.2224
	(.0287)	(.0287)	(.0287)
Foremen/ supervisors	-.1291	-.1700	-.1416
	(.0272)	(.0273)	(.0273)
Highly skilled	.1591	.1489	.1562
	(.0202)	(.0202)	(.0202)
Semi-skilled	.1244	.1407	.1282
	(.0125)	(.0125)	(.0125)
Unskilled	.1705	.2088	.1803
	(.0138)	(.0138)	(.0138)
Apprentices	.4562	.4852	.4635
	(.0116)	(.0116)	(.0116)
Firm size	.2319	.2468	.2352
	(.0029)	(.0029)	(.0029)
Constant	-7.2673	-8.2459	-7.3831
	(.0200)	(.0255)	(.0213)
Ancillary parameter	--	1.2223	.0027
		(.0035)	(.0002)
Log-likelihood	-188,523.53	-186,342.78	-188,387
AIC	377,151.1	372,791.6	376,880

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Notes: Reference groups: [25-35) for the *Age group at hire*; female; 4 years of *Education* and skilled workers. All coefficients are statistically significant. Standard errors are shown in parentheses. AIC: Akaike information criterion. All models include *Industry*, *Region* and *Year* dummies. Number of observations: 422,738 observations. Number of failures: 64,239. Promotion events other than the first are not considered in this estimation.

Table 4.7: Accelerate Failure Time models' estimates: first promotion

Variables	Weibull (1)	Lognormal (2)	Log-logistic (3)	Generalized gamma (4)
Age group at hire				
[15,25)	-.0508	-.0494	-.0504	-.0509
	(.0082)	(.0089)	(.0086)	(.0086)
[35,45)	.0597	.0467	.0493	.0516
	(.0098)	(.0103)	(.0101)	(.0101)
[45,55)	.1048	.0853	.0928	.0939
	(.0132)	(.0136)	(.0135)	(.0134)
[55,75]	.2098	.1647	.1880	.1863
	(.0211)	(.0212)	(.0213)	(.0212)
Male	.0432	.0501	.0494	.0489
	(.0071)	(.0077)	(.0074)	(.0075)
Education				
No schooling	.2205	.1991	.2113	.2117
	(.0620)	(.0605)	(.0617)	(.0611)
2 years	.1096	.0832	.1016	.0972
	(.0426)	(.0422)	(.0428)	(.0424)
6 years	-.1524	-.1458	-.1534	-.1520
	(.0091)	(.0098)	(.0095)	(.0095)
9 years	-.2969	-.2759	-.2908	-.2882
	(.0107)	(.0115)	(.0112)	(.0112)
12 years	-.3891	-.3546	-.3769	-.3749
	(.0114)	(.0124)	(.0119)	(.0120)
15 years	-.4521	-.3920	-.4105	-.4180
	(.0292)	(.0317)	(.0302)	(.0306)
16 years	-.4870	-.4582	-.4770	-.4752
	(.0214)	(.0227)	(.0220)	(.0221)
Hierarchical level at hire				
Top managers	.2828	.2563	.2783	.2727
	(.0215)	(.0220)	(.0218)	(.0218)
Other managers	.2076	.2065	.2116	.2096
	(.0234)	(.0242)	(.0238)	(.0239)
Foremen/ supervisors	.1391	.0886	.1169	.1144
	(.0223)	(.0233)	(.0230)	(.0229)
Highly skilled	-.1218	-.0905	-.1233	-.1107
	(.0166)	(.0183)	(.0173)	(.0175)
Semi-skilled	-.1151	-.1061	-.1182	-.1130
	(.0102)	(.0109)	(.0106)	(.0106)
Unskilled	-.1708	-.1536	-.1714	-.1636
	(.0113)	(.0118)	(.0115)	(.0116)
Apprentices	-.3969	-.3675	-.3956	-.3894
	(.0095)	(.0107)	(.0100)	(.0101)
Firm size	-.2019	-.1824	-.1984	-.1950
	(.0024)	(.0025)	(.0024)	(.0025)
Constant	6.7462	6.4372	6.4237	6.6037
	(.0177)	(.0176)	(.0174)	(.0180)
Ancillary parameter	1.2223	1.3491	.7035	1.0901
	(.0029)	(.0038)	(.0021)	(.0071)
Kappa	--	--	--	.4644
				(.0115)
Log-likelihood	-186,342.78	-186,064.71	-185,597.68	-185,341.33
AIC	372,791.6	372,235.4	371,301.4	370,790.7

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005

Notes: Reference groups: [25-35) for the *Age group at hire*; female; 4 years of *Education* and skilled workers. All coefficients are statistically significant. Standard errors are shown in parentheses. AIC: Akaike information criterion. All models include *Industry*, *Region* and *Year* dummies. Number of observations: 422,738 observations. Number of failures: 64,239. Promotion events other than the first are not considered in this estimation.

Relating the Weibull model, that can be specified both in the PH and the AFT metric, with other AFT models like the lognormal, the log-logistic or the generalized gamma allows for the conclusion that the generalized gamma is the preferred model (showing the highest log-likelihood and the smallest AIC values). The generalized gamma is useful for testing model specification. Hence, a Wald test on the hypothesis that the shape parameter in the generalized gamma model is equal to 1 (or, in other words, a test on the appropriateness of the Weibull) is rejected (Chi-squared=2163.12, p-value=0). Also, the lognormal does not provide a satisfactory fit to the data since the hypothesis that the shape parameter in the generalized gamma model equals zero is rejected.

Coefficients on the categorical variable of interest *Age group at hire*, column (4) in Table 4.7, show that the time to first promotion increases with age: relative to the 25-34 reference age group, the survival times are lengthened by 5.2%, 9.4% and 18.6%, respectively, for the age groups 35-44, 45-54 and 55-75. Therefore, younger employees are promoted at a faster pace than less younger ones.

Another conclusion taken is that, compared to men, the time to first promotion is shortened by almost 5% for women. Also, the time to first promotion is reduced monotonically with the educational level: higher levels of education are associated with shorter survival times. McCue (1996) also reports a positive impact of education on the promotion hazard, but for all promotions not just the first one.

Results suggest that entering the firm at low levels of the hierarchy provides more opportunities for promotion which is consistent with the existence of internal labor markets (Baker *et al*, 1994a).

Finally, the firm size elasticity highlights the positive impact of the size on the promotion prospects: a 1% increase in firm size shortens by around 0.2% the survival time. Similar findings are presented by Pergamit and Veum (1999) and Francesconi (2001).

To account for unobserved heterogeneity, I also attempted to estimate the generalized gamma model with gamma or inverse-gaussian distributed frailty. However, convergence was not obtained in either case. Therefore, I retried the same procedure using the log-logistic model (which is the "second best" specification). The likelihood ratio test on the hypothesis that the overdispersion parameter equals zero presents a p-value of one. Thus, the frailty effect is not significant. Since the frailty variance is estimated to be near zero, the individual hazard function will resemble the population hazard function. In this situation, as Gutierrez (2002) suggests, the heterogeneity may be attributed to the passage of time. With the passage of time, the impact of the independent variables on the population hazard

will diminish in favor of the frailty effect; for instance, gender (or other covariate) becomes less significant and the frailty gains relevance in determining the chance of promotion.

4.6.2 All promotions

As in the previous subsection, for a multiple event framework, I start by comparing the PH with the AFT metric to determine the model that best fits the data. Therefore, Table 4.8 shows the appropriateness of PH models while Table 4.9 presents AFT specifications.

New to these tables is the introduction of the variables *Previous events*, *Tenure* and *Tenure squared*, compared to the covariates present in Tables 4.6 and 4.7. The variable *Previous events* is included to account for event dependence as described in Section 4.5.3.

A concern using repeated events is that the hazard rate is expressed as a function of time since last event. Sometimes, it may be more adequate to let the hazard vary as a function of some common starting point. However, Allison (1984) refers that models for multiple events in which the hazard is a function of time since some fixed starting point may be inconvenient to estimate. As suggest by the author, to overcome this empirical inconvenience, I include in the model *Tenure* and its squared as independent variables. Also, its inclusion in the model intends to capture the influence of specific human capital accumulation and learning effects.

Again, Table 4.8 indicates that the Weibull is the preferred model in the PH form. Since the Weibull satisfies both the PH and the AFT assumptions, Table 4.9 displays Weibull model results in the AFT form together with the other AFT models. This allows for the comparison between models and it reveals that the log-logistic specification shows the highest log-likelihood and the lowest AIC value. Therefore, the log-logistic model is the preferred one and, for this reason, I will comment only on the results presented for this particular model.

Table 4.8: Proportional hazard models' coefficients

Variables	Exponential (1)	Weibull (2)	Gompertz (3)
Age group at hire			
[15,25)	.0003†	-.0109†	-.0034†
	(.0084)	(.0084)	(.0084)
[35,45)	-.0290	-.0146†	-.0117†
	(.0102)	(.0102)	(.0102)
[45,55)	-.0670	-.0624	-.0635
	(.0137)	(.0137)	(.0137)
[55,75]	-.2127	-.2075	-.1926
	(.0229)	(.0229)	(.0229)
Male	-.0468	-.0600	-.0564
	(.0073)	(.0073)	(.0073)
Education			
No schooling	-.2131	-.2494	-.2570
	(.0624)	(.0625)	(.0626)
2 years	-.1963	-.1777	-.1602
	(.0450)	(.0450)	(.0450)
6 years	.0912	.1218	.1317
	(.0093)	(.0093)	(.0093)
9 years	.1580	.2185	.2193
	(.0112)	(.0112)	(.0112)
12 years	.2629	.3257	.3284
	(.0118)	(.0119)	(.0118)
15 years	.2460	.3088	.3161
	(.0304)	(.0304)	(.0304)
16 years	.2332	.3041	.3196
	(.0228)	(.0228)	(.0228)
Hierarchical level at hire			
Top managers	-.1794	-.2178	-.2070
	(.0235)	(.0245)	(.0234)
Other managers	-.0978	-.1166	-.1141
	(.0248)	(.0248)	(.0248)
Foremen/ supervisors	-.0127†	-.0458	-.0429
	(.0233)	(.0233)	(.0233)
Highly skilled	.1869	.1713	.1832
	(.0175)	(.0175)	(.0175)
Semi-skilled	.1054	.1231	.1160
	(.0105)	(.0105)	(.0105)
Unskilled	.1012	.1426	.1295
	(.0116)	(.0116)	(.0116)
Apprentices	.3043	.3257	.3195
	(.0095)	(.0095)	(.0095)
Previous events	.6088	.7391	.7693
	(.0038)	(.0036)	(.0037)
Tenure	-.0118	-.0407	-.0236
	(.0003)	(.0003)	(.0003)
Tenure squared x 10-2	-.0037	.0068	-.0043
	(.0002)	(.0002)	(.0002)
Firm size	.1600	.1752	.1682
	(.0023)	(.0024)	(.0023)
Constant	-5.8953	-7.7968	-6.1421
	(.0189)	(.0224)	(.0190)
Ancillary parameter	--	1.7812	.0271
		(.0023)	(.0002)
Log-likelihood	-238,714.73	-220,292.33	-229,505.04
AIC	477,539.5	440,696.7	459,122.1

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Notes: Reference groups: [25-35) for the *Age group at hire*; female; 4 years of *Education* and skilled workers. All coefficients are statistically significant with the exception of those signalled with †. Standard errors are shown in parentheses. AIC: Akaike information criterion. All models include *Industry*, *Region* and *Year* dummies. Number of observations: 479,308 observations. Number of failures: 91,214.

Table 4.9: Accelerate Failure Time models' estimates

Variables	Weibull (1)	Lognormal (2)	Log-logistic (3)	Generalized gamma (4)
Age group at hire				
[15,25)	.0061†	.0001†	-.0021†	.0013†
	(.0047)	(.0051)	(.0045)	(.0048)
[35,45)	.0082†	.0161	.0167	.0148
	(.0057)	(.0059)	(.0053)	(.0056)
[45,55)	.0350	.0363	.0381	.0375
	(.0077)	(.0078)	(.0071)	(.0075)
[55,75]	.1165	.1039	.1079	.1127
	(.0129)	(.0124)	(.0115)	(.0122)
Male	.0337	.0279	.0264	.0291
	(.0041)	(.0044)	(.0039)	(.0041)
Education				
No schooling	.1400	.1532	.1423	.1451
	(.0337)	(.0348)	(.0322)	(.0340)
2 years	.0998	.1097	.1123	.1089
	(.0252)	(.0247)	(.0230)	(.0242)
6 years	-.0684	-.0504	-.0451	-.0542
	(.0052)	(.0056)	(.0050)	(.0053)
9 years	-.1227	-.0850	-.0798	-.0951
	(.0063)	(.0066)	(.0059)	(.0063)
12 years	-.1829	-.1392	-.1296	-.1513
	(.0066)	(.0071)	(.0063)	(.0067)
15 years	-.1734	-.1185	-.1138	-.1355
	(.0171)	(.0182)	(.0160)	(.0171)
16 years	-.1707	-.1162	-.1109	-.1318
	(.0128)	(.0132)	(.0118)	(.0126)
Hierarchical level at hire				
Top managers	.1223	.0634	.0824	.0911
	(.0132)	(.0129)	(.0118)	(.0126)
Other managers	.0655	.0383	.0476	.0523
	(.0139)	(.0139)	(.0127)	(.0135)
Foremen/ supervisors	.0257	-.0119†	-.0026†	.0053†
	(.0131)	(.0133)	(.0121)	(.0128)
Highly skilled	-.0961	-.0638	-.0670	-.0762
	(.0098)	(.0106)	(.0093)	(.0100)
Semi-skilled	-.0691	-.0444	-.0453	-.0537
	(.0059)	(.0062)	(.0055)	(.0065)
Unskilled	-.0800	-.0439	-.0479	-.0552
	(.0065)	(.0068)	(.0061)	(.0065)
Apprentices	-.1828	-.1560	-.1568	-.1699
	(.0054)	(.0059)	(.0052)	(.0055)
Previous events	-.4149	-.5639	-.5454	-.4939
	(.0022)	(.0030)	(.0027)	(.0027)
Tenure	.0228	.0291	.0295	.0265
	(.0002)	(.0002)	(.0002)	(.0002)
Tenure squared x 10-2	-.0038	-.0071	-.0071	-.0054
	(.0001)	(.0001)	(.0001)	(.0001)
Firm size	-.0984	-.0864	-.0848	-.0911
	(.0013)	(.0014)	(.0013)	(.0013)
Constant	4.3773	4.0048	3.8266	4.1227
	(.0113)	(.0118)	(.0110)	(.0117)
Ancillary parameter	1.7812	.8930	.4388	.6948
	(.0045)	(.0023)	(.0013)	(.0031)
Kappa	--	--	--	.5184
				(.0073)
Log-likelihood	-220,292.33	-220,046.37	-216,118.36	-217,950.62
AIC	440,696.7	440,204.7	432,348.7	436,015.2

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.

Notes: Reference groups: [25-35) for the *Age group at hire*; female; 4 years of *Education* and skilled workers. All coefficients are statistically significant with the exception of those signalled with †. Standard errors are shown in parentheses. AIC: Akaike information criterion. All models include *Industry*, *Region* and *Year* dummies. Number of observations: 479,308 observations. Number of failures: 91,214.

Relative to younger workers, aged 25 to 34 at hire (the reference group), workers hired at older ages face longer times to promotion. In effect, column (3) in Table 4.9 shows that workers aged 35 to 44 at hire experience a 1.7% higher survival time than the reference group. Also, survival times monotonically increase with age at hire. Compared to employees hired at ages 25 to 34, workers in the 45 to 54 age group and those in the 55 to 75 years cohort at hire present longer times to promotion (3.8% and 10.8%, respectively). These results suggest that firms seem to favor younger workers in promotions. Stronger effects were obtained when considering the distribution of time to first promotion. This preference in promotion opportunities towards younger employees may influence older workers' motivation as well as their employment status. Effectively, evidence shows that age discrimination practices at the firm level are consistent with lower wage growth for older workers, with early retirement behavior and job separations (Adams, 2002; Johnson and Neumark, 1997).

Considering gender, men are found to have a 2.6% higher survival time than women, meaning that women are more likely to receive a promotion than men. Ferreira (2009), using the same data set, reports similar results for overall promotions.

Better educated individuals see their survival times to promotion shortened. This is consistent with the returns to education associated with human capital theory. However, if education can be considered an indicator of general human capital accumulation, tenure may also be regarded as a characteristic of specific human capital accumulation and of learning. Results suggest that time to promotion increases with tenure but at a decreasing rate. McCue (1996) finds a similar result regarding the effect of tenure on the promotion hazard.

Considering the *Hierarchical level at hire*, estimates show that compared to employees hired as skilled workers, those getting into the firm at lower hierarchical levels (apprentices, unskilled and semi-skilled workers) experience shorter times to promotion. Nevertheless, although at a higher hierarchical level, highly skilled workers also present a 6.7% smaller survival time in comparison with skilled workers at hire.

The occurrence dependence variable *Previous events* clearly suggests that past promotions are a stronger indicator of subsequent ones. Previous promotions contribute to significantly shorten survival times: the receipt of one (previous) promotion reduces by 54.5% the time to promotion. Thus, previously promoted workers are more likely to be promoted once again which is consistent with the promotion fast-tracks documented in the literature (Baker *et al.*, 1994a; Pergamit and Veum, 1999).

As for firm characteristics, *Firm size* is negatively associated with survival times, as the elasticity of the survival time relative to the number of firm employees presents a negative sign. Workers in large firms face shorter periods to promotion than those in small firms. Firms with a larger workforce have overall structured hierarchical levels that open to the set of an internal labor market. In the existence of an internal labor market, medium to high levels of the hierarchy are filled in through promotions from lower levels. This result is in agreement with previous empirical findings (Pergamit and Veum, 1999; Francesconi, 2001).

Table 4.10 shows the results for log-logistic models with frailty and shared frailty. Columns (1) and (2) report the estimates for the frailty models with gamma and inverse-gaussian distribution for the frailty, respectively. Comparing these with the results presented in Table 4.9 for the log-logistic model no striking differences occur: coefficients are very similar in each of the models. Nonetheless, the frailty effect is always statistically significant considering the results of the likelihood ratio tests.

The model that best fits the data is the one with the gamma distributed frailty and it is also the preferred model because it has the lowest AIC value. This is the reason why in the shared-frailty models I use the gamma distribution for the frailty.

In a shared-frailty model, the frailty is specific to a particular group. Columns (3), (4) and (5) in Table 4.10 present the estimates for models where the frailty is shared by the match worker/firm, by the worker and by the firm, respectively. The results of columns (3) and (4) do not differ substantially and both are similar to the results obtained for a non-frailty specification. The major difference occurs when allowing for correlation within firms. In effect, considering the overall specifications, the one that uses a frailty shared at the firm level is the one producing the best fit (it presents the largest log-likelihood and the smallest AIC value).

Table 4.10: Estimates from the log-logistic models with frailty

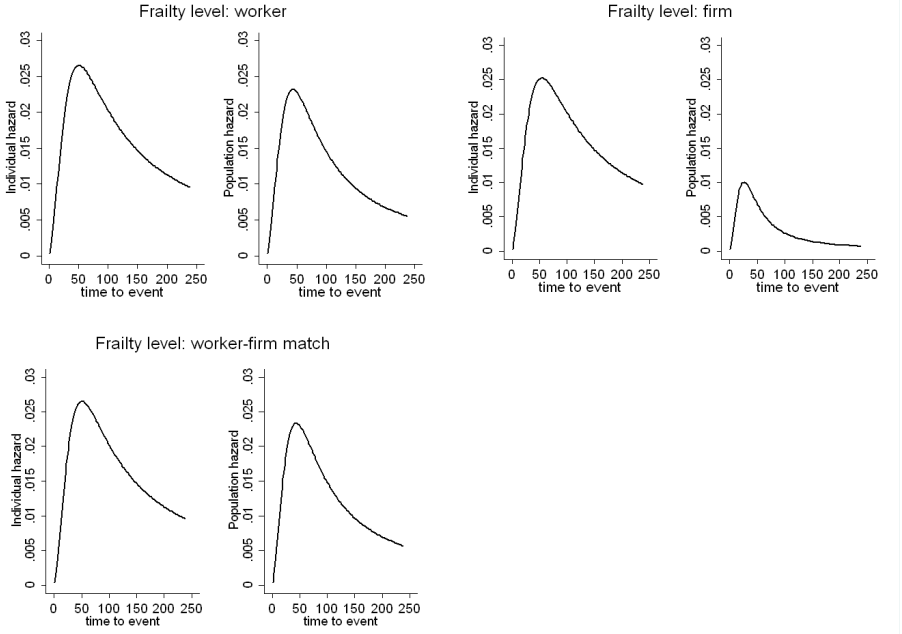
Variables	Frailty		Shared-frailty (Gamma)		
	Gamma	Inverse gaussian	Match	Worker	Firm
	(1)	(2)	(3)	(4)	(5)
Age group at hire					
[15,25)	-.0025†	-.0024†	-.0029†	-.0030†	-.0132
	(.0045)	(.0045)	(.0046)	(.0046)	(.0044)
[35,45)	.0168	.0168	.0173	.0175	.0227
	(.0053)	(.0053)	(.0054)	(.0054)	(.0052)
[45,55)	.0381	.0381	.0384	.0386	.0517
	(.0071)	(.0071)	(.0072)	(.0072)	(.0071)
[55,75]	.1064	.1067	.1066	.1068	.1357
	(.0114)	(.0114)	(.0116)	(.0116)	(.0114)
Male	.0260	.0261	.0255	.0256	.0430
	(.0039)	(.0039)	(.0040)	(.0040)	(.0044)
Education					
No schooling	.1420	.1422	.1466	.1474	.0370†
	(.0320)	(.0320)	(.0327)	(.0328)	(.0326)
2 years	.1105	.1109	.1131	.1132	.0177†
	(.0229)	(.0229)	(.0233)	(.0234)	(.0241)
6 years	-.0440	-.0443	-.0440	-.0439	-.0141
	(.0050)	(.0050)	(.0051)	(.0051)	(.0052)
9 years	-.0775	-.0780	-.0772	-.0768	-.0334
	(.0059)	(.0059)	(.0060)	(.0061)	(.0063)
12 years	-.1260	-.1268	-.1252	-.1248	-.0169
	(.0063)	(.0063)	(.0064)	(.0065)	(.0068)
15 years	-.1095	-.1104	-.1075	-.1068	-.0203†
	(.0160)	(.0160)	(.0163)	(.0163)	(.0154)
16 years	-.1075	-.1082	-.1072	-.1066	-.0283
	(.0118)	(.0118)	(.0120)	(.0120)	(.0124)
Hierarchical level at hire					
Top managers	.0791	.0797	.0767	.0761	.0949
	(.0118)	(.0118)	(.0120)	(.0120)	(.0121)
Other managers	.0461	.0464	.0451	.0444	.0960
	(.0127)	(.0127)	(.0129)	(.0129)	(.0127)
Foremen/ supervisors	-.0043†	-.0039†	-.0052†	-.0060†	-.0024†
	(.0121)	(.0121)	(.0123)	(.0123)	(.0119)
Highly skilled	-.0638	-.0644	-.0641	-.0642	.0699
	(.0093)	(.0093)	(.0094)	(.0095)	(.0096)
Semi-skilled	-.0433	-.0437	-.0424	-.0424	.0078†
	(.0055)	(.0055)	(.0056)	(.0057)	(.0060)
Unskilled	-.0458	-.0462	-.0456	-.0454	.0148
	(.0060)	(.0060)	(.0062)	(.0062)	(.0068)
Apprentices	-.1534	-.1541	-.1566	-.1565	-.1031
	(.0052)	(.0052)	(.0053)	(.0053)	(.0054)
Previous events	-.5593	-.5566	-.5227	-.5202	-.2521
	(.0030)	(.0029)	(.0035)	(.0036)	(.0025)
Tenure	.0301	.0300	.0301	.0302	.0290
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
Tenure squared $\times 10^{-2}$	-.0076	-.0075	-.0075	-.0075	-.0082
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Firm size	-.0833	-.0836	-.0845	-.0845	.0021†
	(.0013)	(.0013)	(.0013)	(.0013)	(.0034)
Constant	3.7815	3.7900	3.7957	3.7934	3.5514
	(.0115)	(.0114)	(.0112)	(.0112)	(.0150)
Ancillary parameter	.4291	.4308	.4306	.4301	.4231
	(.0014)	(.0014)	(.0013)	(.0013)	(.0013)
Overdispersion parameter	.1119	.0961	.1768	.1902	3.5156
	(.0098)	(.0101)	(.0115)	(.0117)	(.0503)
Log-likelihood	-216,037.94	-216,054.8	-215,849	-215,819.67	-175,232.38
AIC	432,189.9	432,223.6	431,812	431,753.3	350,578.8
Number of groups	--	--	422,738	402,463	44,728

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.

Notes: Reference groups: [25-35) for the *Age group at hire*; female; 4 years of *Education* and skilled workers. All coefficients are statistically significant with the exception of those signalled with †. Standard errors are shown in parentheses. AIC: Akaike information criterion. All models include *Industry*, *Region* and *Year* dummies. Number of observations: 479,308 observations. Number of failures: 91,214

Figure 4.4 shows the estimated individual and population hazard functions for the three different levels of frailty.

Figure 4.4: Estimated individual and population hazard functions



Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.
Note: 'Time to event' measures the time to promotion, in months.

When the frailty is significant, the population hazard will tend to begin falling past a certain time, independently of the shape of the individual hazard. This is explained by the frailty effect: with the passage of time, the frailer individuals will fail and only the less frail will remain in the population hence generating a more homogeneous population. This is reflected in Figure 4.4.

The stronger firm frailty effect shows that firms' unobservable characteristics are relevant in the determination of the promotion process. Controlling for firms' unobservable heterogeneity, the magnitude of the impact of the *Age group at hire* on the time to promotion is even stronger. Within firms, compared to workers hired with 25 to 34 years old, when workers are hired above the age 34 threshold they find their time to promotion lengthened and this length is amplified with age: workers aged 35 to 44 at hire experience a 2.3% higher survival time than the reference group, with times to promotion enhanced to 5.2% and 13.6%, respectively, for workers aged 45 to 54 and older than 55.

Overall results[18] suggest that older individuals have less promotion opportunities than younger workers, controlling for firm, worker or match effects.

4.7 Conclusion

Using a sample of new firms and their workers, this research shows that age harms workers' promotion opportunities. Duration models' results suggest that older individuals experience longer survival times to promotion than their younger counterparts. The magnitude of this effect is even stronger when considering just the time to first promotion. Older employees are left for last in promotion.

Facing uneven promotion prospects, older employees may face discouragement in the workplace, less appreciation and become more attracted by early retirement schemes.

These results seem to demonstrate that active aging policies should be more focused at endorsing labor market opportunities for older workers. If the aim is to delay the exit from the labor force, in order to raise the employment rate of older workers, then attention must be given to the improvement of older individuals' chances in all employment related dimensions.

Left for future research is the analysis on how the employment history of older individuals influences their future career development. That is, knowing if older workers entering new firms are "job changers" or individuals that come from a spell of non-employment should have an impact on their promotion prospects. Moreover, the study of how uneven promotion opportunities influence the labor market outcomes of older workers, with particular interest on the exit decision, remains a topic for future research. This can be tested within a competing risks framework in which retirement is one of the alternative paths. Knowing the factors that influence the decision of leaving the labor force is crucial for the development of policy measures that aim at postponing the exit from the labor market.

[18] I have also estimated the models for a sample of workers aged 15 to 65, since 65 is the legal retirement age in Portugal. Nevertheless, results remain the same: older workers experience greater times to promotion than younger workers do.

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Appendices to Chapter 4

Appendix 4.A Construction of the sample

To get the sample used in the study I started by creating a panel of firms merging the cross-sectional 1986 to 2005 files available on *Quadros de Pessoal*. The aim was to obtain a panel including just new firms. Thus, the variable *Year of Creation* available on each cross-sectional file for firms is crucial.

From the above panel I started by eliminating the firms reporting two or more different years of creation (4% of the observations dropped), to avoid misinterpretations. After identifying the year in which the firm firstly appears in the dataset and signalling the moment when the firm is created, I kept the firms for which the year of creation coincides with the first year of appearance in the dataset (Panel A).

Next, I turned my attention to the workers' panel. In situations where there existed more than one observation for worker/year I kept just the observation related to the main job (the one with higher reported hours of work). Workers with 30[19] or less hours/week of work were removed from the sample. This was done in order to assure some attachment to the labor market. Also I keep just employees aged 15 to 75[20]. A relevant variable in this panel is the *Date of Admission at the Firm* since it is used to create the *Promotion* indicator as well as the *Tenure* variable. Therefore, I checked for inconsistencies in the variable such as: *Date of Admission* higher than the year of the survey. Also, if the reported *Date of Admission* for the pair worker/firm was always the same, missing values on *Date of Admission* for that pair were replaced by the reported non-missing value. I have also replaced inconsistencies (like decreasing *Date of Admission* over time) with the value reported more than half of the times. The remaining inconsistencies and missing values on this variable were dropped (Panel B).

Afterwards, sorted by firm and year, I merged Panel A with Panel B obtaining a panel of new firms and their workers. Firms that did not present information on workers from the year of creation and firms that had workers hired (*Date of Admission*) before the year of

[19] In Van Bastelaer *et al.* (1997) a definition of part-time work is presented for international comparison. In some countries, like the United States, 35 hours of work a week is the normal threshold for a worker to be classified as a part-timer. That is the benchmark in the papers by Blank (1988) and Hirsch (2005). In other countries, like the United Kingdom, working 30 or fewer hours per week is the boundary in the definition of part-time employment. I consider this 30 hours threshold to define part-time employment in Portugal.

[20] For comparison, in the empirical analysis I have also used a subsample of workers aged 15 to 65.

creation were excluded. Finally, I include firms with more than two years of survival in the market. The above exclusions resulted in a sample with 1,033,767 observations, for 416,170 workers, 44, 920 firms and 437,498 spells firm/worker.

Appendix 4.B Tables

Table 4.B1: Distribution of firms' survival times

Number of years of survival	Frequency	Percent
3	9,407	20.94
4	9,685	21.56
5	2,285	5.09
6	5,231	11.64
7	3,941	8.77
8	3,530	7.86
9	2,862	6.37
10	2,245	5.00
>10	5,734	12.77
Total	44,920	100

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.

Table 4.B2: Distribution of promotions

Number of promotions	Frequency	Percent
0	352,473	84.69
1	46,158	11.09
2	11,817	2.84
3	3,619	.87
4	1,255	.30
5	470	.11
6	204	.05
7	85	.02
8	36	.01
9	32	.01
10	7	.00
11	6	.00
12	3	.00
13	2	.00
14	1	.00
15	2	.00
Total	416,170	100

Source: Computations from the author based on *Quadros de Pessoal*, 1986-2005.

Chapter 5

Flexible hours of work and retirement behavior

5.1 Introduction

Facing the challenge of population aging, policy makers find measures that postpone labor market exit of older individuals attractive. These are expected to relieve the burden on Social Security systems. The ratio of population aged 65 and over to the total population was 14% in OECD countries in 2005, a 2 percentage point increase over a ten year period. Since population aging is increasing the ratio of retirees to workers, sustainability issues arise to Social Security systems as well as potential labor supply shortages. In fact, the ratio of inactive population aged 65 or older to the total labor force was as high as 26% in 2005 for the OECD countries (OECD, 2007). Johnson and Zimmermann (1993) address those two concerns related to an aging population and, additionally, stress that an aging labor force will place upward pressure on labor costs, due to the positive association between age and earnings, and may have a negative impact on productivity. Börsch-Supan (2003) considers that labor productivity will have to grow to compensate the impact of population aging on domestic production.

To ease the pressure on Social Security and to increase the participation rates of older individuals, governments have been promoting the expansion of working lives. This has been enforced through the elimination of mandatory retirement, the adoption of age discrimination legislation[21] and/or increasing the legal retirement age. All these measures aim at raising the employment of older individuals. What are their effects in the labor market? Shannon and Grierson (2004), based on legal differences in mandatory retirement in Canada, 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

[21] 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.

the problems associated with an aging population and the consequent reduction in the share of the population employed. Nevertheless, for the United States, Ashenfelter and Card (2002) study the effect of the elimination of mandatory retirement at age 70 on faculty retirement patterns and conclude that such elimination decreased by approximately 67% the retirement rates of 70 and 71 year olds.

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. Nonetheless, according to Lazear (1979) these sorts of measures would endure efficiency losses that affect all workers and firms. In Lazear's model of long-term incentive contracts, older workers earn more than their marginal product and more than their reservation wage, whereas younger workers receive less than their marginal product (steep age-earnings profile); hence the need for mandatory retirement. Even so, 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 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. The authors also find that firms employing older women reduced their hirings in a significant way, especially of younger women.

There seems to be no unique and effective recipe to achieve a longer and higher participation of older individuals in the labor force. This research brings another variable to the discussion surrounding active aging policies. The aim of this chapter is to examine the impact of the reduction of hours of work before retirement on the age of exit from the labor force. 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. But, as Hutchens and Grace-Martin (2006) suggest, that decision is not always up to the worker: employers play a relevant role.

Overall, retirement decisions are influenced by financial incentives, individual characteristics, demographic factors and labor market constraints. This chapter examines the influence of working hours' reduction before retirement on the retirement decisions of older individuals. I aim at answering 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?

I 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 evaluate the relevance of working hours' reduction on the retirement behavior of older individuals. Older workers may want to withdraw gradually from the labor force through the reduction of hours of work towards the end of their working lives. It is thought that reduced working hours would help increase employment levels among older people (European Commission, 2007). The literature on the impact of working hours flexibility on the labor supply of older individuals is very recent (Gielen, 2009; Blau and Shvydko, 2007; Gustman and Steinmeier, 2004) and finds that working hours flexibility generates only small net increases in older worker's labor force participation. As far as I am aware, no such study exists for Portugal. Therefore, besides the novelty of this research for the Portuguese labor market it is also a new contribution to the incipient literature on the subject.

I take advantage of a recent and, to my knowledge, not yet used inquiry called "Transition to Retirement", conducted simultaneously with the 2006 Portuguese Labor Force Survey. To study the effect of working hours' reduction before retirement on the age of retirement I initially use a sample that includes only retired individuals and then use another sample which considers both retirees and nonretirees.

The chapter proceeds as follows. The next section provides an overview of the major legislation changes on retirement benefits eligibility in Portugal. Section 5.3 reviews the literature related to the retirement behavior of older individuals with major focus on the influence of hours of work on their labor force participation. Section 5.4 describes the data and Section 5.5 presents the model and the empirical strategy. Results are shown in Section 5.6. Sensitivity analysis is performed in Section 5.7. A summary and discussion conclude the chapter.

5.2 Legal setting on retirement in Portugal

Over the last 15 years, the Portuguese government has approved several legislation changes concerning retirement. These were made to accommodate demographic changes, namely population aging, and its impact on Social Security's sustainability. 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 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 a modification 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 have the right 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.

All these institutional changes certainly had an influence on the retirement behavior of Portuguese older individuals. Therefore, in the empirical analysis, I control for the year of retirement to capture the effect of changes in the institutional setting.

A comprehensive synopsis of retirement legislation changes in Portugal is presented in Appendix 5.A.

5.3 Previous literature on retirement behavior

5.3.1 General studies

Financial incentives are major determinants of retirement (Mitchell and Fields, 1984 and Dugan, 1984). The worker's retirement age depends on his wage and pension benefits. According to the theory, high-wage workers have larger opportunity sets and would prefer to consume more leisure, so that they will want to retire earlier. Simultaneously, higher

wages imply that the price of retirement is also higher, and hence the worker will want to postpone retirement. The final impact on the age of retirement will depend on which effect dominates: the substitution or the income effect. An increase in pension benefits, however, generates income and substitution effects that work in the same direction; the increase in benefits expands the worker's opportunity set, raises the demand for leisure and induces early retirement. It additionally reduces the price of retirement, increasing the demand for leisure and thus inducing early retirement. Belloni and Alessie (2008), using data for Italy, find that when workers become eligible for pension benefits, changing their financial incentives, they experience a considerable increase in their retirement probability.

The seminal work by Mitchell and Fields (1984) studies the influence of economic factors in determining retirement behavior. The authors use a subsample of the Benefit Amounts Survey, developed by the United States (US) Department of Labor, which includes only individuals who have reached the age of mandatory retirement by the time of the survey in 1978. The dataset contains 8,733 males in 10 firms who have retired between the ages 60-68, meaning that it surveys workers from different firms covered by different pension plans. Data show that different pension plans provide different retirement incentives. They estimate two equations: the age of retirement is the dependent variable in the first regression (estimated by OLS) and the probability of choosing a given retirement age is the outcome of interest in the second one (estimated by the use of conditional logit models). Independent variables such as the present value of income or base wealth and the gain in the present value of income obtained from a longer working life were included in the first equation. Variables like the present discounted value of expected lifetime income and the number of leisure years were included as covariates in the second equation. Results suggest that those individuals with higher base income retire earlier and that people who have more to gain by postponing retirement retire at later ages. Additionally, income and leisure are both relevant determinants of retirement ages. A 10% increase in earned income is predicted to raise the average retirement age by slightly more than a month. Also, increasing retirement benefits by 10% would lower the retirement age by less than a month, on average.

Using 238 observations from pooled time-series cross-section taken from the US Current Population Survey (1978-80), Dugan (1984) examines the impact of economic and demographic influences on the labor force participation rate of older individuals. The focus rests on the effects of cohort crowding and social security incentives on the labor supply of the elderly. This research concludes that a relative increase in young individuals leads to a

decline in relative wages and living standards of older female workers and, consequently, to an increase in female labor force participation. Furthermore, retirement incentives have a negative effect on female and male labor force behavior. As for the impact of individual characteristics, higher educational levels result in higher participation rates of people aged 65 and over and of women aged 55-64. The differential found between men's and women's participation rates was largely a result of the female response to marital status and retirement incentives.

The decision to retire or the decision to remain in the labor force may be seen as a simple individual and voluntary decision that is influenced by economic and demographic factors. However, the voluntary nature of that decision may not be as straightforward as it appears. Labor demand constraints and/or technological change sometimes push older individuals towards involuntary retirement (Osberg, 1993; Bartel and Sicherman, 1993 and Friedberg, 2003). Using international microdata for 19 industrialized countries, Dorn and Sousa-Poza (2009) find that 'involuntary' early retirement is particularly widespread in Continental Europe; countries facing economic recessions and having rigid employment protection laws show higher shares of 'involuntary' retirement amongst early retirees. Also, early retirement incentive schemes induce both individuals to 'voluntary' early retirement and firms to push employees into early retirement.

To study the effects of technological change on the careers of older people, especially in what concerns the decision to retire, Bartel and Sicherman (1993) combine data from the 1966-83 US National Longitudinal Survey of Older Men, data from Jorgenson *et al.* (1987)[22] and the Panel Study of Income Dynamics. Using logit models they estimate the probability of retirement against measures of technological change (expected and unexpected), the amount of training required, individual characteristics (like age, health status, education, tenure and self-employment), industry unemployment rate and output growth (to capture industry cyclical changes). The authors find that workers in industries with high rates of technological change will retire later if there is a net positive correlation between technological change and on-the-job training; also, individuals in industries undergoing technological change have longer working careers. An unexpected change in the rate of technological change will induce older workers to retire sooner because the required amount of retraining will be an unattractive investment. Finally, there is a negative correlation between on-the-job training and the likelihood of retirement, i.e. training delays retirement. In the same line of research, but using the US Current Population Survey and

[22] Cited from Bartel and Sicherman (1993).

the Health and Retirement Study, Friedberg (2003) uses evidence from computer use to infer the effect of technological change on older workers employment, and concludes that computer users retire later than non-users.

Osberg (1993) examines the importance of labor demand for hours of work and labor force participation among older workers. Using data from the 1986 Labour Market Activity Survey of Statistics Canada, findings on the probability of retirement suggest that there is a lower propensity for university educated men to retire before 55 and that the availability of jobs is a significant determinant of retirement for males under 65. Moreover, a significant fraction of retirement decisions are influenced by the belief that there are no jobs available, hence affecting labor supply decisions.

Focusing on the period between the end of a career and permanent retirement, Ruhm (1990) examines the employment patterns of older individuals in the near end of their working lives. Using data from a Social Security Longitudinal Survey and introducing the possibility of partial retirement, the author studies the age at which career job ends, the postcareer labor force participation and the number of years of postcareer labor market participation. He finds that highly paid and better educated individuals remain in career jobs until later ages, have low rates of postcareer labor force participation and infrequently reverse retirement status. Conditional on remaining in the labor force, educated workers present long durations of partial retirement. Married individuals tend to work in career positions until later ages, hold bridge jobs (the job between career job and permanent retirement) longer, more frequently partially retire and are more likely to reverse retirement status. Finally, departures from career jobs may be induced by the economic incentives in private pension plans or due to involuntary layoffs.

5.3.2 Hours of work and the retirement decision

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.[23]

[23] 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).

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 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 (representing 10% of the employment in 2007) and, nevertheless, older workers present high employment rates (above the 50% threshold of the Stockholm target) (European Commission, 2007).

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. 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). Based on an establishment-level telephone survey, the authors model the probability that an employer permits phased retirement and they 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. There are also industry and region differences in opportunities for phased retirement.

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.

5.4 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". 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.

These data were collected by the Portuguese Statistics Office (INE) as part of the Labor Force Survey 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. Table 5.1 shows the sample values for the Labor Force Survey (second quarter of 2006) and the "Transition to Retirement" module.

Table 5.1: 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 I 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, I 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.

I include in the sample just the 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.

The above exclusions led to the sample sizes depicted in Table 5.2.

Table 5.2: Study sample

	Sample	
Labor market status	Total	%
Employed	3,319	62.94
Retired [a]	1,954	37.06
Total	5,273	100

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Note: [a] These have completely withdrawn from the labor force.

The questionnaire of the "Transition to Retirement" module is presented in Appendix 5.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 dimension 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 5.3 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 5.3: 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 author 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 5.3 shows, one in five retirees have 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. Tables 5.C1 to 5.C3 in Appendix 5.C display the average age of the respondents and the mean retirement age for retirees, according to the reduction status (reduced hours, intends to reduce and did/will not reduce).

Since both those who did and did not reduce hours of work present the same age average, 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.[24]

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 5.A) a legal diploma suspended all early retirement schemes, making the collection of pension benefits only possible at age 65 or later, retirement expectations of active individuals are surely influenced.

Table 5.4 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 5.4 also shows that a reduction of hours of work is not very common in the Portuguese labor market: less than 10%[25] 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 men, and this difference is more pronounced for those still in the labor force (i.e, employed).

[24] Tables 5.C1 to 5.C3 in Appendix 5.C present detailed descriptive statistics by gender and labor market status, according to the reduction status.

[25] 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.

Table 5.4: 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[a]	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[a]	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[b] (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[c]	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 author 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. [a]Continuous variables: standard deviations are presented in parenthesis. All other variables are dummies and values reported are percentages. [b]Answers (b), (c) and (d) of Question 2 were gathered into a single category "Did not reduce". [c]There are 2,670 observations for the variable *Active spouse*.

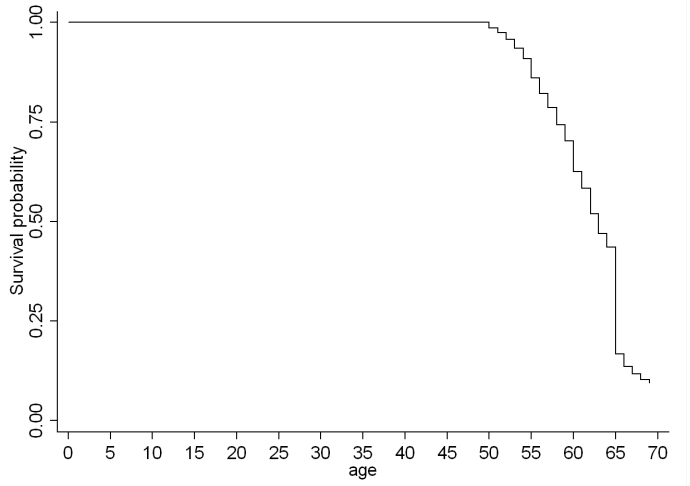
Almost 2/3 of the individuals in the sample work in Services, which is also the activity sector where a reduction in hours of work before retirement is more prevalent, both for men and women (see Tables 5.C1 to 5.C3 in Appendix 5.C). For 54% of the individuals the occupation held was classified as blue-collar. The definitions of blue/white collar and the industries included in each of the activity sectors are presented in Appendix 5.C (Tables 5.C4 and 5.C5). Moreover, Table 5.C6 in Appendix 5.C shows the distribution of employment, by occupation held for the Portuguese labor force.

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.[26] However, almost 12% of the individuals show higher education attainment, with women reporting a higher incidence of this higher educational level. For comparison with the sample, Table 5.C7 in Appendix 5.C displays the distribution of active population by educational level, age group and gender, for the second quarter of 2006. Around 11% of the individuals aged 45 to 64 have a university degree while this is the scenario for only 3% of individuals aged 65 or older.[27] Unfortunately, I could not get information on the 50-69 age group in particular in order to obtain a more accurate comparison.

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 5.1, shows that, as expected, the estimated survival curve declines sharply with age, facing a considerable drop at age 65. Also, the cumulative hazard[28] in Figure 5.2 is rising with age at an increasing rate. As shown in Table 5.5, 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 5.1: Kaplan-Meier survival function estimates



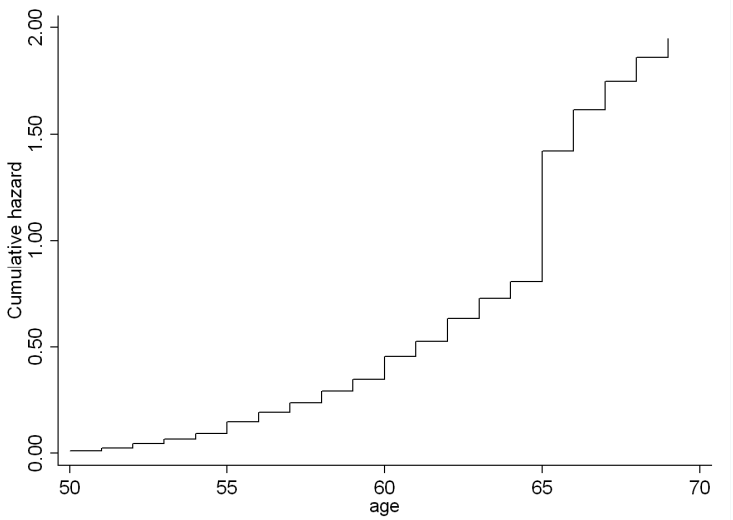
Source: Computations from the author based on the "Transition to Retirement" module data, 2006.

[26] 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.

[27] Aggregating the two age groups (45-64 and 65 or more), 10% have a university degree.

[28] 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.

Figure 5.2: Nelson-Aelen cumulative hazard estimates



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

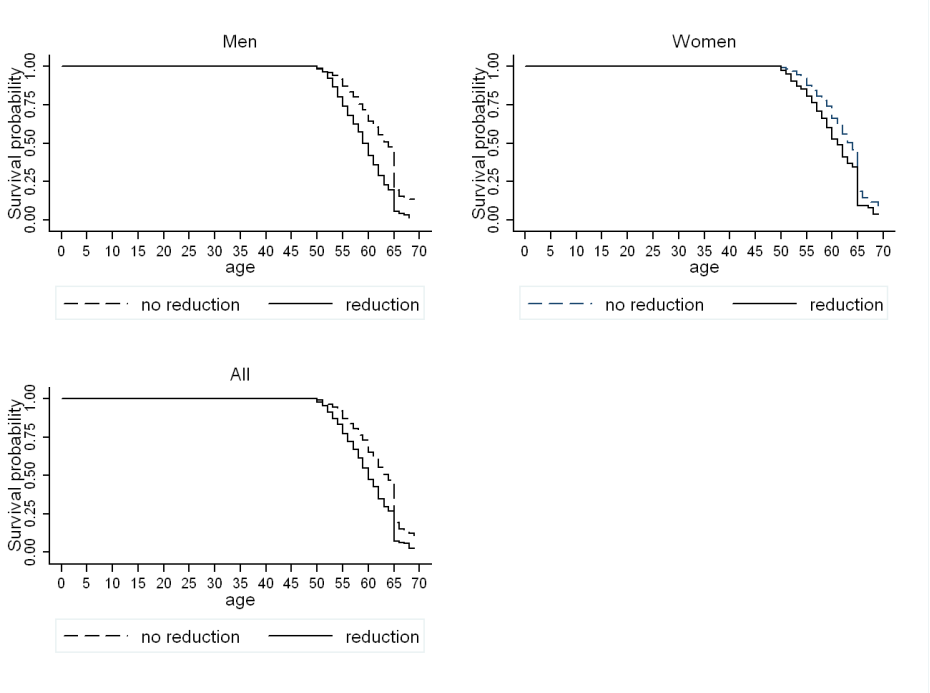
Table 5.5: Kaplan-Meier survival and Nelson-Aalen cumulative hazard functions

Age	Beginning total	Failures	Survivor function	Standard error	Cumulative hazard	Standard error
50	5,273	70	.9867	.0016	.0133	.0016
51	4,868	57	.9752	.0022	.0250	.0022
52	4,471	83	.9571	.0029	.0435	.0030
53	4,066	90	.9359	.0036	.0657	.0038
54	3,638	101	.9099	.0043	.0934	.0047
55	3,261	179	.8600	.0055	.1483	.0062
56	2,803	124	.8219	.0062	.1926	.0074
57	2,465	108	.7859	.0068	.2364	.0085
58	2,159	117	.7433	.0075	.2906	.0099
59	1,877	105	.7017	.0081	.3465	.0113
60	1,623	177	.6252	.0090	.4556	.0140
61	1,282	88	.5823	.0095	.5242	.0158
62	1,097	119	.5191	.0101	.6327	.0186
63	874	83	.4698	.0105	.7277	.0213
64	694	54	.4333	.0108	.8055	.0238
65	565	346	.1679	.0098	1.4179	.0406
66	164	32	.1352	.0095	1.6130	.0533
67	98	13	.1172	.0094	1.7456	.0648
68	53	6	.1040	.0098	1.8588	.0796
69	23	2	.0949	.0108	1.9458	.1006

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

Relating the *Age* of exit from the labor force with the *Reduction* variable, Figure 5.3 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 5.3: Kaplan-Meier survival function estimates, by reduction status and gender



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

The Nelson-Aalen cumulative hazard functions, by reduction status, shown in Table 5.6, 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 5.6: Nelson-Aalen cumulative hazard functions, by reduction status

Age	No reduction	Reduction
50	.0120	.0251
52	.0378	.0928
54	.0824	.1838
56	.1762	.3191
58	.2655	.4710
60	.4169	.7135
62	.5730	.9986
64	.7329	1.2380
66	1.5332	2.0601
68	1.7280	2.7030

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

5.5 Econometric setup

5.5.1 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 I 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 I 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 I will call this duration a "spell of activity" (although it does not measure the number of working years).

I 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 (see Table 5.C8 in Appendix 5.C).

Transition or survival data are usually censored since some spells are incompletely observed. A complete spell of activity can be seen for retirees[29] but for subjects that are still in the labor force I 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

[29] A subsample of retirees does not face censoring issues.

a hazard function given by $\lambda(t) = \gamma\alpha t^{\alpha-1}$,[30] 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

$$\Pr[T > t] = \int_t^{\infty} f(u \mid \mathbf{x}, \boldsymbol{\theta})du = 1 - F(t \mid \mathbf{x}, \boldsymbol{\theta}) = S(t \mid \mathbf{x}, \boldsymbol{\theta}) \tag{5.1}$$

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

$$\ln L(\boldsymbol{\theta}) = \sum_{i=1}^{N} [\delta_i \ln f(t_i \mid \mathbf{x}_i, \boldsymbol{\theta}) + (1 - \delta_i) \ln S(t_i \mid \mathbf{x}_i, \boldsymbol{\theta})] \tag{5.2}$$

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

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

Then, the likelihood function in (5.2) becomes

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

$$\ln L = \sum_i \left[\delta_i \left\{ \mathbf{x'}_i \boldsymbol{\beta} + \ln \alpha + (\alpha - 1) \ln t_i - \exp(\mathbf{x'}_i \boldsymbol{\beta}) t_i^{\alpha} \right\} - (1 - \delta_i) \exp(\mathbf{x'}_i \boldsymbol{\beta}) t_i^{\alpha} \right] \qquad (5.3).$$

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

5.5.2 Variables used in the estimation

To study the effect of a reduction in hours of work (before leaving the labor force) on the moment of retirement, I start by using a subsample of retired individuals. This implies the absence of censoring problems while employing transition data techniques. Then, I evolve to a sample that considers both retired and active individuals, with the associated censoring considerations.

5.5.2.1 Uncensored observations

In this uncensored subsample, almost 21% of the retirees report the use of a reduction in hours of work as a deliberate strategy to gradually retire.

I 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.[31] 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.

Working hours' reduction is the explanatory variable of interest in a model that aims at studying the length of activity through the age of exit from the labor force. *Reduction* is a binary variable that equals 1 if the retiree did reduce his/her hours of work before retirement, and 0 otherwise. Other control variables were also introduced in the model. Mean values and standard deviations of all the variables are depicted in Table 5.7.

The main reason for retirement was mandatory retirement; poor health was the next most common reason. Almost 49% of the retirees reported mandatory retirement as the reason for leaving the labor force, of whom 19% reduced hours of work before retirement.

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

Moreover, one in ten individuals reported favorable financial conditions as the cause of retirement. Job loss was the motive for 2% of the retirees.

Table 5.7: Definition of the variables and mean characteristics: uncensored observations

Variable	Definition	Mean or percentage	Standard deviation
Retirement age	Age of exit from the labor force, in years; the age of start of pension benefits is used as a proxy for the retirement age	59.02	4.84
Age	Age of the individual, in years	63.72	4.35
Years of work	Number of working years	39.74	8.07
Reduction	=1 if the individual reduced his/her hours of work before exiting the labor force (dummy variable)	19.49	--
Male	=1 if the individual is a men (dummy variable)	56.30	--
Education	Dummy variable		
0 years	=1 if the person has no complete degree of education	16.38	--
4 years	=2 if the person completed 4 years of education	43.84	--
6 years	=3 if the person completed 6 years of education	6.16	--
9 years	=4 if the person completed 9 years of education	12.83	--
High school	=5 if the person a high-school diploma	8.04	--
University	=6 if college degree	12.75	--
Blue-collar	=1 if the individual works or has worked in an occupation classified as blue-collar (dummy variable)	47.03	--
Activity sector	Dummy variable		
Agriculture	=1 if the person worked in the agriculture sector	5.65	--
Industrial	=2 if the person worked in the industrial sector	27.68	--
Services	=3 if the person worked in the services sector (omitted category)	66.67	--
Reason for retirement	Dummy variable		
Lost job	=1 if retirement was induced by job loss	2.25	--
Mandatory retirement	=2 if the person reached the mandatory age of retirement	48.99	--
Poor health	=3 if the individual retired because of poor health	16.59	--
Childcare or other dependents	=4 if retirement was due to child care or other dependents' care	0.80	--
Problems at work	=5 if the person retired because of problems at work	2.25	--
Favorable financial conditions	=6 if favorable financial conditions was the reason for retirement	10.94	--
Other reasons	=7 if other reasons were the cause of retirement	18.19	--
Region	Dummy variable		
North	=1 if the person resides in the North of Portugal (omitted category)	18.55	--
Centre	=2 if the person resides in the Centre	10.43	--
Lisbon	=3 if resides in Lisbon	27.32	--
Alentejo	=4 if he/she resides in Alentejo	17.61	--
Algarve	=5 if he/she resides in Algarve	10.72	--
Azores	=6 if he/she resides in Azores	8.26	--
Madeira	=7 if he/she resides in Madeira	7.10	--

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Note: In the estimation model, I also introduce dummies for the *Year of Retirement* to capture institutional changes on retirement incentives. Number of observations: 1,380.

At the moment of the survey, individuals averaged almost 64 years of age having started collecting retirement pension at 59 years old, on average. Pension benefits were obtained at relatively early ages, which gives some hints on the attractiveness of early retirement schemes. However, notice must be made to the fact that individuals have a close to complete working career: 40 years.

Most of the retirees had white-collar occupations and 2/3 worked in the services' sector. Also, the majority of retirees are men with low educational levels. Nevertheless, it is somewhat surprising that almost 13% of these subjects have a university degree. Recalling Table 5.C7 in Appendix 5.C, only 3% of the individuals aged 65 or more in 2006 had a college degree. Despite the fact that the average age of the retirees is slightly smaller than that interval, this difference may raise some concerns about sample selection. Perhaps those with higher levels of education were the ones more willing to answer the written questionnaire.

5.5.2.2 Censored observations

To overcome the possible selection bias from the exclusion of nonretirees, next I use a sample that combines both retired and employed individuals.

Question 2 of the survey allows four possible answers (see Table 5.3). I 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 I use three different classifications for it. First, I consider just the actions that have occurred so far, that is, treat the intentions as non-actions. I 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. *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.[32] This is done in order to capture the approximate moment of failure (exit) for retirees.

[32] Once again, I use the age of start of pension receipt as a proxy for the retirement age.

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;[33] 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, as a second alternative, I 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 not reduce hours of work and 1 if the individual did reduce or intends to do so. Answering to 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.

As a last alternative, I could separate intentions from actions through a variable that I name *Reduction C* that includes three categories: it equals 0 if the individual will not reduce her/his hours of work before leaving the labor force, 1 if the individual has already reduced her/his hours of work, and 2 if the person intends to reduce her/his hours of work in the next five years. There is, however, a problem concerning the use of this variable: the category associated to intentions possesses only censored observations.

I expect that using these alternative *Reduction* variables will enable me to see how sensitive the age of exit from the labor force is to the assumptions made for the variable of interest.

Besides the R*eduction* variable I also include in the model regressors like gender, activity sector, type of occupation, education and region of residence. Additionally, for married (or cohabiting) people I include the spouse/partner labor force status (active or retired). Table 5.8 shows some descriptive statistics of the variables used.

[33] Cited from Ajzen (2005).

Table 5.8: Definition of the variables and mean characteristics: censored observations

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)[a]	58.66 (5.85)[a]	58.59 (5.96)[a]
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[b]	=1 if the individual did reduce or intends to reduce hours of work	20.12	19.20	21.21
Reduction C				
Will not reduce	=0 if the individual will not reduce her/his hours of work before leaving the labor force (omitted category)	82.65	84.29	80.69
Did reduce	=1 if the individual has already reduced her/his hours of work	9.82	8.45	11.46
Intends to reduce	=2 if the person intends to reduce her/his hours of work in the next five years	7.53	7.26	7.85
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[c]	=1 if the spouse is still in activity	62.58	67.73	59.48

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

There are 37% of failures (retired individuals) 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. In effect, 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. As benchmark, Table 5.C7 in Appendix 5.C shows the educational level by gender for the Portuguese labor force and Table 5.9 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 5.8, both the likelihood of retirement and the probability of reducing hours of work rise with age.

Table 5.9: Distribution of employed population by regular hours of work, activity sector and gender (second quarter, 2006)

Regular hours of work	Activity sector											
	Agriculture			Industrial			Services			Total		
	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.

5.6 Results

5.6.1 Effect of hours' reduction on the retirement hazard: uncensored observations

Table 5.10 reports the results of the Weibull model and also estimates from an ordinary least squares (OLS) model.[34]

Table 5.10: Results on the age of retirement (coefficients)

Variable	Weibull (1)	Weibull (2)	OLS[(a)] (3)	OLS[(a)] (4)
Reduction	.016	.042	-.122	-.093
	(.071)	(.057)	(.246)	(.213)
Male	.101*	-.006	-.391*	.042
	(.061)	(.049)	(.208)	(.182)
Education				
0 years	-.322***	-.331***	1.558***	1.644***
	(.087)	(.067)	(.309)	(.253)
6 years	.123	.123	-.814*	-.709*
	(.124)	(.106)	(.427)	(.390)
9 years	.285***	.319***	-.895***	-.964***
	(.098)	(.085)	(.343)	(.315)
High school	.281**	.268***	-1.420***	-1.182***
	(.115)	(.103)	(.405)	(.390)
University	.248**	.164**	-1.079***	-.484
	(.103)	(.091)	(.361)	(.341)
Blue-collar	-.271***	-.155**	1.417***	.872***
	(.077)	(.065)	(.280)	(.246)
Activity sector				
Agriculture	-.183	-.182*	.799*	.777**
	(.134)	(.101)	(.477)	(.383)
Industrial	-.211***	-.082	.832***	.223
	(.069)	(.056)	(.248)	(.215)
Reason for retirement				
Lost job	.503***	--	-2.276***	--
	(.193)		(.666)	
Bad health	.651***	--	-3.076***	--
	(.084)		(.289)	
Childcare or other dependents	.178	--	-1.926*	--
	(.312)		(1.091)	
Problems at work	.501***	--	-2.464***	--
	(.191)		(.661)	
Favorable financial conditions	.637***	--	-2.479***	--
	(.098)		(.336)	
Other reasons	.499***	--	-2.011***	--
	(.080)		(.276)	
α	20.545	19.840	--	--
	(.0442)	(.364)		
Observations	1,380	1,954	1,380	1,954
Log likelihood	1,988.749	2,724.788	--	--
R-squared	--	--	.48	.38
Root mean squared error	--	--	3.53	3.75

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Note: [(a)] The dependent variable in the OLS regression model is the age of retirement. Standard errors are presented in parentheses. ***/**/* means significance at 1%/5%/10% level, respectively. The model includes 18 dummies for the *Year of retirement* and 6 *Region* dummies.

[34] I present OLS estimates because the procedure has been used in the literature to model the age of retirement (e.g. Mitchell and Fields, 1984; Ruhm, 1990).

The problem with using OLS lies in the assumed distribution of the residuals. In linear regression, the residuals are assumed to be normally distributed. However, the normality of time to an event is not a reasonable assumption when the event is retirement. Effectively, the risk of retirement increases with age. One other drawback is that age of failure (retirement) occurrence is always positive, while in theory the normal distribution supports all possible real values (Cleves *et al.*, 2008). Linear regression results are not robust to these violations. Considering this I will comment only on Weibull results.

Estimates on the Weibull parameter α suggest that the hazard is increasing over time $\alpha > 1$, at an increasing rate ($\alpha > 2$).[35]

Results show that those who have reduced hours of work before leaving the labor force have higher hazard rates, *ceteris paribus*, that is higher conditional early exit rates and hence shorter survival times in the labor force. Nevertheless, this result is not statistically significant. Thus, a reduction in hours of work before retirement seems to produce no effect on the moment of exit from the labor force, with no contribution for delaying 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, 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 (see Table 5.C2 in Appendix 5.C). Therefore, the fear of a potential endogeneity problem can be mitigated.

As an additional check to the robustness of this result I looked at Question 4 of the survey that asks "Would the possibility of a more flexible working schedule contribute (or would it have contributed) to make you work longer?". 94% of the retirees answered negatively to this question meaning that flexible hours of work is not attractive enough to induce an increase in labor force participation of older individuals.

The coefficient for *Male* is statistically significant in model (1), Table 5.10, indicating that men exit at earlier ages than women from the labor force. Weibull estimates show that men face a 11% ($\exp(.101)$-1) higher hazard of retirement than women. Recall that men have longer working careers than women suggesting that men start working earlier. Therefore, women become eligible to retirement benefits at later ages than men.

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

Contrary to what has been reported in the literature (Bartel and Sicherman, 1993; Osberg, 1993; Ruhm, 1990) higher levels of education are associated with retirement at earlier ages. Compared to individuals with 4 years of education, the reference category, only those with zero years of education stay longer in the labor force. At each survival time, the hazard rate for those with no years of education is only 72% of the hazard rate for the subjects with 4 years of education. Those with compulsory schooling (9 years), high school and university degrees experience a 33%, 32% and 28% higher hazard rate, respectively, than the reference group. A test on the equality of coefficients for 9 or more years of completed education does not reject the null hypothesis.[36] Since education is positively correlated with labor earnings and, hence, with Social Security pension benefits (variables that I cannot observe within the survey) this result may be capturing the effect of financial incentives on the retirement age. Mitchell and Fields (1984) find that retirement benefits are negatively associated with the retirement age. Also, Dugan (1984) concludes that retirement incentives have a negative effect on labor force participation and that the decline is stronger for men than for women.

As documented in the literature, health conditions are a strong determinant of retirement (Burtless and Quinn, 2000; Bartel and Sicherman, 1993; Hanoch and Honig, 1983; Quinn, 1977): the hazard rate for those with health problems is 92% ($\exp(.651)$-1) higher than the hazard for those who are compulsory retired. The *Reason for retirement* variable additionally shows that if an older worker loses his/her job he/she will tend to retire earlier; this finding is consistent with previous literature that shows that when the elderly experience job loss they face major difficulties in getting back to work, due to reduced hiring opportunities (Daniel and Heywood, 2007; Heywood *et al*, 1999; Hutchens, 1986, 1988), and this pushes older workers to premature retirement (Osberg, 1993). Relative to people that were compulsory retired, those with "Favorable financial conditions" have a 89% ($\exp(.637)$-1) higher hazard of retirement.

Finally, consistently with the findings of Dorn and Sousa-Poza (2005), white-collar workers or individuals formerly employed in the services' sector also withdraw sooner from the labor force.

Given the potentially endogenous nature of the *Reason for retirement* variable, I have also estimated the models without it (models (2) and (4)). The effect of the key policy variable,

[36] The p-value for the null hypothesis that the coefficient for 9 years of education equals the one for 12 years is 0.9746 (Chi-squared=0.00); for the equality between the 9 years and the university coefficients the p-value equals 0.7388 (Chi-squared=0.11); finally, 0.7918 is the p-value for the test on the equality between the 12 years and university education estimates (Chi-squared=0.07).

Reduction, remains unchanged but the *Male* variable becomes not statistically significant. In general, the models present similar estimates for the effect of each covariate on the hazard. Nonetheless, the retirement hazard increases for individuals with 9 years of education and diminishes for subjects with a university degree. Also, the statistical significance of the categories of the activity sector variable is altered. In effect, while not significant in model (1), the category agriculture becomes statistically significant in model (2). Here, those working in the agricultural sector face a hazard rate that is 83% of the hazard rate experienced by an individual employed in services (the reference category). There is no statistical difference in the hazard rate between those employed in the industrial and services sectors.

From the subsample of retirees, 59 years old is the average age at which an individual started receiving a retirement pension. This suggests that early retirement was common in the Portuguese labor market. Nevertheless, until 2007, workers were allowed to combine old-age pension income with work income (in the same firm) which made early retirement schemes very attractive.[37] Older individuals could remain in the labor force past the age of starting collecting their retirement pension and, therefore, the age of start of pension collection may not be a good proxy for the actual retirement age. This constitutes a limitation of the data that will still remain in the presence of censored observations.

5.6.2 Effect of hours' reduction on the age of retirement: with censored observations

Tables 5.11 and 5.12 present the results for the Weibull model in the presence of censoring. 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 5.11 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

[37] Especially since, until 1999, there was no penalty on early retirement pensions. Reduction factors on early retirement pensions were only introduced by a 1999 law.

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 I use is more limited and less informative than the approaches used in literature. I use only an indicator variable and other studies use hours of work to assess the reduction. Additionally, these studies take advantage of longitudinal data while I use cross-sectional data. Also, previous literature focuses on the labor force participation and not on the age of retirement.

For blue-collar workers the hazard rate is only 72% of the hazard for white-collar workers.

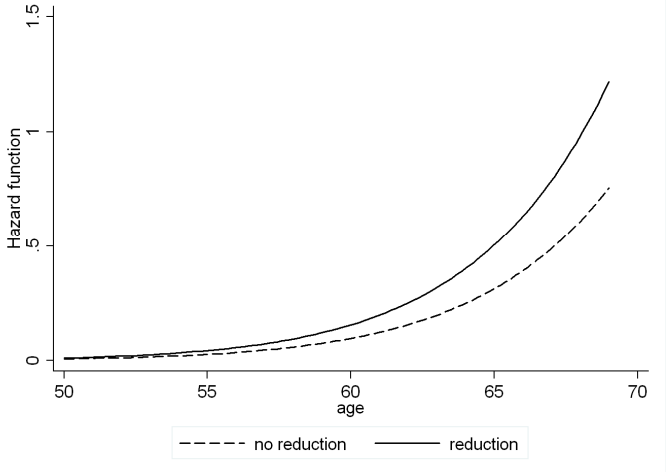
Table 5.11: Weibull regression coefficients using *Reduction A*

Variable	All (1)	All (2)	All (3)	Men (4)	Women (5)
Reduction A	.477***	.330***	.343***	.637***	.330***
	(.057)	(.079)	(.082)	(.080)	(.083)
Male	.018	.068	-.036	--	--
	(.049)	(.069)	(.054)		
Reduction A x Male	--	--	.265**	--	--
			(.112)		
Activity sector					
Agriculture	.018	.020	.012	-.397***	.359***
	(.098)	(.133)	(.098)	(.153)	(.133)
Industrial	.255***	.291***	.248***	.026	.620***
	(.056)	(.082)	(.056)	(.072)	(.088)
Blue-collar	-.330***	-.331***	-.324***	-.437***	-.154
	(.062)	(.094)	(.062)	(.079)	(.102)
Active spouse	--	-.886***	--	--	--
		(.077)			
α	15.749	15.615	15.760	15.475	16.275
	(.251)	(.365)	(.251)	(.334)	(.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 author 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.

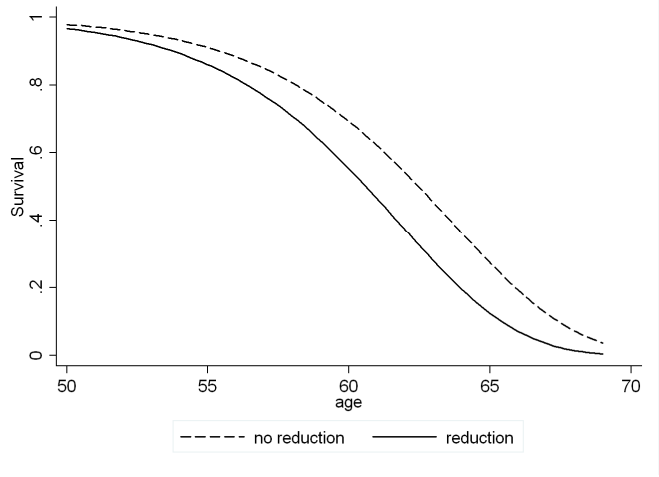
Figure 5.4 clearly shows that the hazard of retirement increases with age at an increasing rate and that it is higher for individuals that reduced hours of work. The same pattern is obviously reflected in the survival curve in Figure 5.5. Those that do not reduce working time on average stay longer in the labour market.

Figure 5.4: Retirement hazard, by reduction status (*Reduction A*)



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

Figure 5.5: Survival curve, by reduction status (*Reduction A*)



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

Looking at column (2) in Table 5.11, 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. 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 5.11. Both for men and women, a reduction in hours of work before retirement is associated with a higher retirement hazard. A Chow test[38] 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-

[38] Chi-squared statistic for 15 degrees of freedom is equal to 90.91 (p-value=0).

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 5.11, 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 5.11, I 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 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 5.12 reports the same effect of the *Reduction* variable on the retirement hazard as in the previous analysis.

Table 5.12: Weibull regression coefficients using *Reduction B*

Variable	All (1)	All (2)	Men (3)	Women (4)
Reduction B	.124***	.145**	.133**	.162**
	(.048)	(.070)	(.067)	(.070)
Male	.033	.041	--	--
	(.041)	(.045)		
Reduction B x Male	--	-.041	--	--
		(.096)		
Activity sector				
Agriculture	-.026	-.026	-.224*	.101
	(.084)	(.084)	(.126)	(.117)
Industrial	.098**	.099**	-.012	.316***
	(.048)	(.048)	(.061)	(.078)
Blue-collar	-.277***	-.277***	-.402***	-.099
	(.053)	(.053)	(.069)	(.083)
α	15.290	15.290	15.170	15.686
	(.203)	(.234)	(.315)	(.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 author 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 5.12, 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. These results are reflected in Figures 5.6 and 5.7 for the estimated hazard and survival curves, respectively.

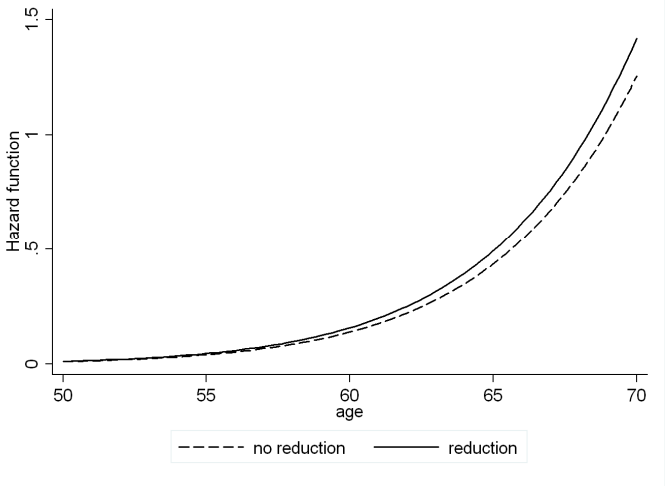
When intentions are treated as effective actions (*Reduction B*, Table 5.12) the retirement hazard declines by 48 percentage points compared to the hazard in column (1) of Table 5.11 (*Reduction A*), but it is still higher for those who reduced hours of work. Therefore, working hours' flexibility will 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 5.11 columns (3) and (4), Table 5.12, show separate estimates by gender. Once again, a Chow test[39] performed on these models rejects the null hypothesis of the equality 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=.09 and p-value=.7634). This is in accordance with the statistical significance of the coefficient of the interaction term.

[39] Chi-squared statistic for 15 degrees of freedom is equal to 53.96 (p-value=0).

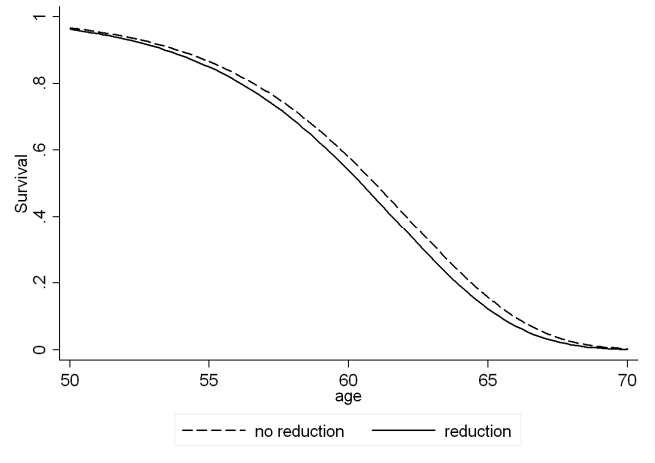
As in Table 5.11, being employed in the industrial sector reduces the likelihood of remaining in activity: Columns (1) and (2) in Table 5.12 suggest that the hazard of retirement is 10% higher for those working in the industrial sector compared to those employed in services. However, the coefficients on this variable are smaller in Table 5.12; in fact, the hazard is reduced by 18-19 percentage points[40] when considering *Reduction B* rather than *Reduction A*. Once again, this difference is mainly due to women.

Figure 5.6: Retirement hazard, by reduction status (*Reduction B*)



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

Figure 5.7: Survival curve, by reduction status (*Reduction B*)



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

I have also used the *Reduction C* variable to study its effect on the retirement hazard. Empirical results of the use of this variable are presented in Appendix 5.C (Table 5.C9).

[40] The difference results from comparing estimates for the "Industrial" category in Columns (1) and (2), Table 5.12, with columns (1) and (3) of Table 5.11.

Previous conclusions remain unchanged.[41] Compared to the workers who did not reduce hours of work, those who reduced experience a 45% higher retirement hazard. The effect of the category "Intends to reduce" on the hazard is not statistically significant and it shows an extremely high standard deviation. This is due to the fact that for those who report the intention to reduce there are only uncensored observations. Therefore, for this category, there is no possible comparison between the likelihood functions for censored and uncensored observations. Hence, results on the *Reduction C* variable are not the most appropriate and must be read with care.

The evidence discussed so far indicates that a reduction in hours of work before retirement seems to be associated with retirement at earlier ages. 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 5.4 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 (see Table 5.C3 in Appendix 5.C). 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.

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, that

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

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.

5.7 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.

Tables 5.13 and 5.14 display the log-likelihood and the AIC statistics for PH and AFT models, respectively, both for the models where the covariate of interest is *Reduction A* and for the models with *Reduction B*.

In Table 5.13, 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.

Table 5.13: Proportional hazard models, selected statistics

Selected statistics	*Reduction A* model			*Reduction B* model		
	Exponential	Weibull	Gompertz	Exponential	Weibull	Gompertz
Log likelihood	-3,661.597	1,000.678	964.849	-2,746.811	3,128.664	3,123.951
AIC	7,357.193	-1,965.355	-1,893.697	5,527.621	-6,221.329	-6,211.902
Observations	5,273	5,273	5,273	2,738	2,738	2,738

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Note: AIC, Akaike information criterion.

Since the Weibull can be specified both in the PH and AFT forms I can compare it with other AFT distributional forms. Table 5.14 performs this comparison and it reveals that 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, I have also computed estimates using the lognormal and also the log-logistic but it produced no relevant differences compared to the Weibull estimates (Table 5.15). This is why I report the estimates on the PH Weibull model, measuring the effect of each covariate on the hazard and not on the survival time.

Table 5.14: Accelerated failure time metric, selected statistics

Selected statistics	*Reduction A* model			*Reduction B* model		
	Weibull	Lognormal	Log-logistic	Weibull	Lognormal	Log-logistic
Log likelihood	1,000.678	1,034.287	1,004.726	3,128.664	3,004.129	2,925.192
AIC	-1,965.355	-2,032.574	-1,973.452	-6,221.329	-5,972.267	-5,814.385
Observations	5,273	5,273	5,273	2,738	2,738	2,738

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Note: AIC, Akaike information criterion.

Table 5.15: Comparison between parametric specifications: selected estimates

	Weibull	Lognormal	Log-logistic	Weibull	Lognormal	Log-logistic
	(1)	(2)	(3)	(4)	(5)	(6)
Reduction A	-.030	-.037	-.038	--	--	--
	(.004)	(.004)	(.004)			
Reduction B	--	--	--	-.008	-.009	-.010
				(.003)	(.004)	(.004)
Log-likelihood	1,000.678	1,034.287	1,004.726	3,128.664	3,004.129	2,925.192
AIC	-1,965.355	-2,032.574	-1,973.452	-6,221.329	-5,972.257	-5,814.385
Observations	5,273	5,273	5,273	2,738	2,738	2,738

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Note: AIC, Akaike information criterion. Selected variables are statistically significant.

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, I 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. These and the Cox model results for selected variables are presented in Table 5.C10 in Appendix 5.C.

5.8 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. However, until 2007, older people could accumulate retirement benefits, at a small pension penalty, with labor earnings from the same employer. With these data I 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 me 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 would allow me 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 I am to be granted access to anonymous Social Security data (that I have already asked for), I 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 I 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 to Chapter 5

Appendix 5.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 5.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

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

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 5.C Tables

Table 5.C1: Descriptive statistics, by reduction status and gender

Variable	Reduced			Intents to reduce[b]			Did not/Will not reduce		
	All	Men	Women	All	Men	Women	All	Men	Women
Age[a]	62.50	62.84	62.22	57.27	58.14	56.31	58.29	58.29	58.30
	(4.94)	(4.54)	(5.25)	(5.12)	(5.40)	(4.62)	(5.90)	(5.85)	(5.96)
Retired	79.19	88.84	70.65	0.00	0.00	0.00	35.52	35.69	35.10
Activity sector									
Agriculture	6.94	4.96	8.70	4.53	5.77	3.17	5.55	5.13	6.02
Industrial	31.79	41.74	23.19	27.71	37.98	16.40	28.07	37.06	16.93
Services	61.27	53.31	68.12	67.76	56.25	80.42	66.38	57.81	77.05
Blue-collar	58.38	54.55	61.96	55.67	67.79	42.33	53.85	58.96	47.50
Education									
0 years	19.85	11.16	27.54	9.57	10.10	8.99	11.16	8.24	14.72
4 years	49.33	54.13	44.93	52.64	59.13	45.50	51.67	56.36	45.96
6 years	5.78	7.02	4.71	5.54	4.81	6,35	6.99	7.41	6.48
9 years	10.02	14.05	6.52	10.08	8.17	12.17	11.30	11.59	10.86
High school	2.89	2.89	2.90	6.05	6.73	5.29	7.49	7.08	7.98
University	12.14	10.74	13.41	16.12	11.06	21.69	11.39	9.32	14.00
Region									
North	30.44	33.88	27.17	31.99	33.65	30.16	22.57	24.02	20.79
Centre	14.84	16.94	13.04	12.59	12.98	12.17	12.67	12.80	12.56
Lisbon	26.78	28.51	25.36	20.15	15.38	25.40	22.27	21.20	23.62
Alentejo	12.33	9.09	15.22	10.83	9.62	12.17	16.82	15.11	18.89
Algarve	6.94	5.37	8.33	10.08	12.02	7.94	10.20	9.77	10.65
Azores	3.08	4.13	2.17	8.31	9.13	7.41	7.29	8.86	5.35
Madeira	5.59	2.07	8.70	6.05	7.21	4.76	8.18	8.24	8.13
Active spouse[c]	36.96	46.81	32.04	78.40	73.61	80.85	64.22	69.57	60.94

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

Notes: (a) *Age* is the only continuous variable in the table; standard deviations are presented in parenthesis. All other variables are dummies and values reported are percentages. (b) Statistics refer to employed individuals. (c) There are 2,670 observations for the variable *Active spouse*.

All: 5,273 observations; Men: 2,865 observations; Women: 2,408 observations.

Table 5.C2: Descriptive statistics, by reduction status and gender (retired individuals)

Variable	Reduced			Did not reduce		
	All	Men	Women	All	Men	Women
Age[a]	63.50	63.28	63.75	63.69	63.55	63.85
	(4.25)	(4.22)	(4.28)	(4.32)	(4.41)	(4.21)
Retirement age[a]	58.85	58.70	59.01	58.82	58.66	59.22
	(4.62)	(4.46)	(4.80)	(4.74)	(4.75)	(4.73)
Number of years of work[a]	39.04	40.76	37.12	39.74	40.82	38.39
	(8.04)	(7.06)	(8.64)	(7.92)	(7.27)	(8.46)
Activity sector						
Agriculture	7.56	5.12	10.26	7.32	4.87	10.41
Industrial	34.63	42.33	26.15	31.09	38.17	22.14
Services	57.80	52.56	63.59	61.59	56.96	67.45
Blue-collar	54.88	55.35	54.36	53.63	55.10	51.76
Education						
0 years	20.00	11.63	29.23	19.69	13.23	27.86
4 years	46.83	54.42	38.46	46.89	55.45	36.07
6 years	5.61	6.51	4.62	5.76	6.61	4.69
9 years	11.46	14.88	7.69	11.14	11.95	10.12
High school	3.41	3.26	3.59	7.25	7.77	6.60
University	12.68	9.30	16.41	9.26	4.99	14.66
Region						
North	29.51	33.02	25.64	20.92	22.85	18.48
Centre	14.63	16.28	12.82	9.26	8.70	9.97
Lisbon	26.34	28.84	23.59	25.58	25.52	25.66
Alentejo	13.17	8.84	17.95	19.11	16.59	22.29
Algarve	7.32	6.05	8.72	10.43	11.02	9.68
Azores	3.66	4.65	2.56	8.48	9.86	6.74
Madeira	5.37	2.33	8.72	6.22	5.45	7.18
Reason for retirement[b]						
Lost job	1.49	2.80	0.00	2.43	2.21	2.73
Mandatory retirement	47.58	41.96	53.97	49.32	46.37	53.25
Poor health	18.59	16.08	21.43	16.11	14.51	18.24
Childcare or other dependents	1.12	0.00	2.38	0.72	0.32	1.26
Problems at work	2.97	4.90	0.79	2.07	2.52	1.47
Favorable financial conditions	11.52	14.69	7.94	10.80	13.88	6.71
Other reasons	16.73	19.58	13.49	18.54	20.19	16.35
Active spouse[c]	25.35	44.19	12.60	22.93	38.44	11.50

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Notes: (a) Continuous variables: standard deviations are presented in parenthesis. All other variables are dummies and values reported are percentages. (b) There are 1,380 observations for this variable. (c) There are 998 observations for the variable *Active spouse*.
All: 1,954 observations; Men: 1,077 observations; Women: 877 observations.

Table 5.C3: Descriptive statistics, by reduction status and gender (employed individuals)

Variable	Reduced			Did not reduce		
	All	Men	Women	All	Men	Women
Age [a]	58.74	59.30	58.56	55.57	55.70	55.42
	(5.53)	(5.41)	(5.59)	(4.49)	(4.52)	(4.45)
Number of years of work [a]	38.16	41.11	37.16	36.94	38.35	35.23
	(9.77)	(8.32)	(10.07)	(7.68)	(7.01)	(8.11)
Activity sector						
Agriculture	4.63	3.70	4.94	4.55	5.34	3.59
Industrial	21.30	37.04	16.05	26.60	36.63	14.41
Services	74.07	59.26	79.01	68.86	58.04	82.00
Blue-collar	72.22	48.15	80.25	54.19	61.90	44.83
Education						
0 years	19.44	7.41	23.46	6.82	6.02	7.79
4 years	58.33	51.85	60.49	54.16	57.13	50.55
6 years	6.48	11.11	4.94	7.41	7.50	7.31
9 years	4.63	7.41	3.70	11.18	11.02	11.38
High school	0.93	0.00	1.23	7.41	6.70	8.28
University	10.19	22.22	6.17	13.02	11.64	14.69
Region						
North	33.33	40.74	30.86	24.54	25.72	23.10
Centre	15.74	22.22	13.58	14.33	14.82	13.72
Lisbon	28.70	25.93	29.63	20.43	18.40	22.90
Alentejo	9.26	9.26	8.64	14.95	13.74	16.41
Algarve	5.56	0.00	7.41	10.03	9.43	10.76
Azores	0.93	0.00	1.23	6.85	8.40	4.97
Madeira	6.48	0.00	8.64	8.88	9.48	8.14
Reason for work [b]						
Increase pension benefits	32.76	17.65	39.02	22.69	21.19	24.49
Obtain sufficient household income	53.45	76.47	4.90	67.85	68.96	66.52
No financial reasons	13.79	5.88	17.07	9.46	9.85	8.99
Active spouse [c]	77.42	75.00	77.78	86.27	88.04	85.29

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Notes: (a) Continuous variables: standard deviations are presented in parenthesis. All other variables are dummies and values reported are percentages. (b) There are 1,041 observations for this variable. (c) There are 1,672 observations for the variable *Active spouse*.
All: 3,319 observations; Men: 1,788 observations; Women: 1,531 observations.

Table 5.C4: 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	.43	.27

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

Table 5.C5: 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.

Table 5.C6: Population in employment, by occupation (second quarter, 2006 estimates)

Worker defined as:	Occupation reported in the survey	Total	%
		5,180,800	100
White-collar	1. High-level managers	409,000	7.89
	2. Specialists from intellectual and scientific occupations	447,100	8.63
	3. Technicians and medium-level professionals	459,800	8.88
	4. Administrative personnel and similar	490,000	9.46
	5. Services and sales personnel	741,900	14.32
Blue-collar	6. Farmers and skilled workers from agriculture	567,900	10.96
	7. Blue-collar workers, craftsmen and similar workers	1,021,200	19.71
	8. Equipment and machine operators and assembly line workers	413,300	7.98
	9. Unskilled workers	600,600	11.59

Source: INE. Labor Statistics, 2007.
Note: There are 30,200 individuals (0.58%) employed in the Armed Forces that are not reported in the table.

Table 5.C7: Distribution of active population (%), by educational level, age group and gender

Educational level	Age group																	
	Total			15-24			25-34			35-44			45-64			>64		
	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women
0 years	5	5	6	0	1	--	1	2	1	2	3	1	**6**	4	8	**41**	30	57
4 years	28	31	26	5	6	3	8	10	7	25	28	22	**50**	52	49	**49**	57	39
6 years	19	21	18	23	27	18	25	28	23	27	28	25	**11**	12	11	**3**	4	2
9 years	18	19	17	43	45	41	22	25	18	16	16	16	**12**	13	12	**2**	3	1
High school	15	14	16	23	19	28	22	21	24	16	15	17	**9**	9	9	**1**	2	--
University	13	10	17	6	2	10	21	15	27	15	11	19	**11**	12	12	**3**	4	2

Source: INE. Labor Force Survey, 2nd quarter 2006. Obtained from www.ine.pt

Table 5.C8: Transitions between economic states for older workers (55-64), 2005-2006

	Economic status in 2006					
	Employed		Unemployed		Inactive	
Economic status in 2005	PT	EU27 [a]	PT	EU27 [a]	PT	EU27 [a]
Employed	94.1	90.2	1.4	1.5	4.5	8.3
Unemployed	12.8	12.8	64.5	37.7	22.7	49.4
Inactive	0.4	3.0	0.1	0.7	99.4	96.3

Source: European Commission (2007).
Note: (a) EU27 covers the EU Member States excluding Belgium, Ireland, The Netherlands, and Sweden, for which data is not available in 2006 on status one year earlier.

Table 5.C9: Weibull regression coefficients using *Reduction C*

Variable	(1)	(2)
Reduction C		
Reduced	.372***	.244***
	(.057)	(.079)
Intends to reduce	-17.215	-17.321
	(416.563)	(653.338)
Male	.045	.087
	(.049)	(.069)
Activity sector		
Agriculture	-.042	-.002
	(.098)	(.134)
Industrial	.221***	.274***
	(.056)	(.081)
Blue-collar	-.275***	-.299***
	(.062)	(.094)
Active spouse	--	-.817***
		(.077)
Observations	5,273	2,670
Log likelihood	1,163.118	702.331

Source: Computations from the author 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.

Table 5.C10: Alternative models, selected estimates

Variable	Cox[a] (1)	Cox (2)	Cox (3)	Piecewise-constant Exponential[a] (4)	Piecewise-constant Exponential (5)	Piecewise-constant Exponential (6)
Reduction	.040	--	--	.023	--	--
	(.057)			(.057)		
Reduction A	--	.494***	--	--	.539***	--
		(.057)			(.057)	
Reduction B	--	--	.132***	--	--	.098**
			(.048)			(.048)
Male	-.009	.023	.033	-.005	.044	.028
	(.049)	(.049)	(.040)	(.049)	(.048)	(.040)
Observations	1,954	5,273	2,738	4,124	9,522	6,325
Log likelihood	-12,758.771	-14,340.832	-19,623.166	901.566	-674.489	1,173.275

Source: Computations from the author based on the "Transition to Retirement" module data, 2006.
Note: (a) Estimates refer to models with uncensored (retirees only) observations. Standard errors are presented in parentheses. ***/** means significance at 1%/5% level, respectively. The increase in the number of observations in the Piecewise-constant exponential models is due to episode splitting at 55, 60 and 65 years of age.

Chapter 6

Conclusion

Since people live longer with better health care, while births are declining, shifts in the size of younger cohorts are smaller than the growth in the size of older cohorts. Active aging, as a set of guidelines and policy actions that intend to increase the labor force participation of older cohorts, emerges from the need to reduce the social and economic impacts of demographic trends on Social Security systems and on labor markets. Labor supply shortages are another concern guiding active aging policies. With the prospect of shortfalls in Social Security's funding and the potential for a real labor shortage when the economies expand, countries cannot afford to lose older workers in the years ahead.

For active aging policies to become effective, older workers have to find attractive remaining in the labor force. They have to be granted hiring and promotion opportunities as well as flexible work arrangements.

This thesis studies older workers labor market opportunities and the determinants of their exit from the labor force. Results echo that there is still much to be done in order to promote labor market attractiveness for older individuals.

In Chapter 3, the use of a fractional logit model applied to longitudinal data, a methodological novelty in the study of older workers' hiring opportunities, shows that Portuguese firms prefer long term commitments with their employees. Hence, firms which usually engage in long term employment relationships will hire younger workers. If all other covariates remain unchanged, a 10 percentage points increase in the share of the firm's workforce with more than 5 years of tenure reduces the share of older workers' hiring by 0.4 percentage points.

Given that firms have a preference towards hiring younger individuals, unemployed older workers will find it very difficult to get back into employment. Moreover, this barrier may work as an incentive to exit from the labor market due to the perception that there are no jobs available. Therefore, creating labor market opportunities for older workers that

allows them access, in terms of hiring, to comparable jobs as other age groups of workers should be a political concern. This is a matter of particular interest in order to achieve the goals set under active aging policies.

There are other issues concerning labor market opportunities of older individuals that must be explored. The study of the promotion prospects for elderly workers provides additional insights on the lack of labor market opportunities open to them. Chapter 4 findings show that age harms workers' promotion prospects since time to promotion increases with age. Compared to 25-34 age group, survival times to first promotion are lengthened by 5%, 9% and 18%, correspondingly, for the age groups 35-44, 45-54 and 55-75. Thus, younger employees are promoted at a faster pace than less younger workers. Considering all promotions, and not just the first one, survival times' differences are smaller but still reproduce the same disadvantage. In effect, workers aged 35-44, 45-54 and 55-75 at hire experience, respectively, 1.7%, 3.8% and 10.8% higher times to promotion than workers aged 25-34 at hire. Chapter 4 additionally shows that women, better educated workers and individuals entering the firm at lower hierarchical levels face shorter times to promotion.

The preference in promotion opportunities for younger employees may influence older workers' motivation as well as their employment status. There is evidence suggesting that age discrimination practices at the firm level are consistent with early retirement behavior. Once again, these results seem to demonstrate that active aging policies should be more focused on endorsing labor market opportunities for older workers. If the aim is to postpone their exit from the labor force, in order to raise the employment rate of older individuals, then attention must be given to the improvement of older individuals' chances in all employment related dimensions.

Finally, Chapter 5 discusses the influence of flexibility in hours of work on the retirement decision. Results from duration models suggest that, for a sample of retirees, there is no statistical difference in the retirement hazard between individuals that have reduced hours of work and those who have not. Nevertheless, considering a sample of both retirees and non-retirees, estimates show that reducing hours of work increases the hazard rate by 61% compared to that of subjects who did not reduce hours of work. This means that, at least for the Portuguese labor market, flexible working schedules are not positively associated with the decision to delay retirement, quite the opposite.

Left for future research is the study of how uneven promotion opportunities influence the labor market outcomes of older workers, with particular interest on the exit decision.

This can be tested within a competing risks framework in which retirement is one of the alternative paths. Knowing the factors that influence the decision to leaving the labor force is crucial for the development of policy measures that aim at postponing the exit from the labor market.

Also, the consideration of financial incentives on the retirement decision will deserve further attention. The use of panel data with information on income and wealth variables, on Social Security benefits, and on employment characteristics should provide new insights on the determinants of the complete withdrawal from the labor force. Knowing how much a worker would receive of pension in each moment of time would be valuable in the study of retirement decisions.