Essays on labour market behaviour at the beginning and end of the active life-cycle

by

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Abstract

This thesis is focussed on the behaviour of the old and the young when exiting and entering the labour market. The self-contained chapters are looking at the correlation of transition into inactivity and pensioner state after the transition in Hungary, the effect of financial incentives on retirement behaviour, the role of extraversion in higher education participation and the possibility to infer the correlation of old and young employment using limited data. All chapters are based on the empirical analysis of data, chapters 2-4 using microeconometric methods. The second chapter shows various pieces of evidence that the availability of pension in the post-transition Hungary did contribute to the very low employment levels observable in the country, and the 1997 pensions reform was mitigating this effect. The third chapter separates the effect of financial incentives from the availability of pension and shows that despite being significant, the former is weaker than the latter. Estimates of the fourth chapter show that extraversion has a significant effect on higher education participation and that the gender difference in this role is explained by the gender differences in the benefit, rather than the cost of this choice. The fifth chapter uses simple theoretical findings and empirical estimates to show the effect of using limited data on the ability to infer the connection between old and young employment.

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Although I sign this thesis as a sole author, I certainly could have not completed my doctoral studies and this work alone. Throughout these years, I was helped and supported by various individuals and institutions to whom I owe respect and gratitude.

My supervisor, Gábor Kézdi has treated my approach and attachment to my work with great flexibility and offered a support that respected my choices. Despite the inevitable expenses involved, I think that this approach has allowed this long process to bear its potential fruits.

The institutions and colleagues to which and whom I was connected helped me greatly in my progress. Central European University was always receptive and have allowed me to find my way across the errors I made to construct a more valuable product. It also created an academic environment which allowed this thesis to become what it is now. Being a scholar and a junior fellow at the he Institute of Economics, Hungarian Academy of Sciences allowed me to access data and intellectual heritage that was indispensable for discussing the topics of my dissertation and created a continuity from the decision to pursue a PhD to the possibility of working as a researcher. The University College London where I have started my graduate studies has given be a solid basis in my primary areas of interest. Colleagues, professors and friends at all these institutions have helped as much or perhaps even more than the institutions themselves. Special thanks to them for starting, supporting and stopping me at the necessary points.

Ultimately I would like to thank to every member of my family for they have endured and supported this process what often appeared to be a never ending journey to an unknown place. Without them, there would have been no means and actually no reason to carry on with this work.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

This dissertation focuses on labour market behaviour of the young and the old and the connection between them with emphasis on related employment policy issues. These topics are recently gaining more and more interest partly due to financial difficulties of welfare systems, partly due to the increased efficiency pressure on economies. Labour market participation, wage formation and industrial relations of prime age workers are topics that are extensively researched, and are built on standard models and supported by a huge body of empirical evidence. The behaviour of prime age workers and especially men is not only relatively easy to look at due to the lowest number of features that are not directly related to economic behaviour (such as family formation), but are the most numerous among the working age population. Research of non-prime age persons on the other hand is more difficult for the same reasons and many aspects of their behaviour are less researched accordingly.

My dissertation is motivated by the need to understand labour market chances of the young and older people better in order to design welfare systems. Being far apart within the life cycle, these two groups are similar in one respect: both are often unskilled relative to prime age workers, either because the lack of time to accumulate on the job experience, or because of the depreciation of human capital due to secular or individual changes. These peculiarities make the two groups similar in more than one way. Both are vulnerable on the labour market and accordingly, both are often the target of institutions trying to remedy this situation. Vulnerabilities and institutions are likely to come about in times of large-scale changes and it turns out that the two groups indeed compete sometimes for policy attention and resources. The chapters of this dissertation look at mechanisms that play important role in such situations: the financial motivation to work coming from pension systems, the effect of increasing older employment activity on the young and the role non-cognitive skills, which are often not directly developed by schools, in securing a better labour market position.

The shock of the economic transition of post-socialist countries was absorbed differently by each of them. Along with Poland, Hungary "chose" to let the pension system absorb the previous workers of destroyed workplaces. Although we know certain aspects of this process, the way through which the pension system contributed to the creation and sustaining of the large pensioner stock is not documented in a coherent way. We do not know clearly how much the pensioner stock contributes to inactivity, how it was built up and what happened after the initial increase. Was behaviour changing over time or is it only the composition of people meeting the system that generates the observed differences over time? The first chapter aims at providing descriptive evidence to answer these questions in the case of Hungary. After laying out the institutional framework, microdata from the Hungarian Labour Force Survey is used to describe the interaction of labour market behaviour and transitions to pension both over historic time at different ages. The results indicate that the pension reform in 1997 has had considerable effect on retirement ages. This was, however, not the only contributor to the rising employment of older individuals. Behaviour has changed too, captured by transition probabilities and also the composition of workers has changed in a way that made coping with labour market difficulties easier.

The first chapter provided details on the changes of retirement behaviour and labour market participation in Hungary after the economic transition. Based on this evidence, the role of the pension system seems to be important. Still, the descriptive evidence is not enough to separate the impact of different features of the system, in particular that of replacement rates and availability of the pension option. This chapter focuses on estimating financial incentives built into the system by estimating a structural probit equation of the transition to pensioner state with pensioner and non-pensioner income included. Our case is both simpler and more difficult than estimating a full option value model of retirement, with which this problem is usually analysed. Because we can use only household survey data lacking information on work-histories, we have to use the populations choosing a certain option (ie. to claim pension or not) to predict expected income for those not choosing that option. In order to deal with the possible selection into both pensioner and nonpensioner state on the basis of attributes not observable to us, a switching income model with selection to both states is employed. The results enrich the stylised fact we have seen in the first chapter and are in line with that. Using predicted incomes successfully separates the indirect effect of explanatory variables, such as personal and family characteristics, current income and regional effects, from their direct impact on the retirement decision. It appears that financial incentives do have a significant and independent effect on the retirement decision, inducing those with larger expected pensioner income to retire and holding back from retirement those whose chances are better on the labour market. Still, even controlling for financial incentives directly, the effect of the availability of the pension option seems to be a very strong predictor of retirement.

Factors shaping the human capital and thus the labour market performance of individuals are of central importance in labour economics, especially in estimating wage functions. Although initially much of the interest was centered upon the effect of schooling, later also the effect of cognitive and recently that of noncognitive characteristics became an object of research. This chapter contributes to the central question of this line of research, asking which traits are important and why in determining higher education participation. Using unique data that follow some 380 individuals from their early childhood until the age of 23, we are looking at the choice of higher education and the effect of the dominant factor of the so called Big five test scores. Participation in higher education is a significant dividing line between individuals on the labour market, an important determinant of labour market success. The Big Five scores are one of the most often used personality measures in psychology, gaining in popularity, but not routinely used in economics. It is the combination of this measure, the schooling outcome and the unique data that allows us to look at the conditional effect of extraversion on higher education participation (versus work). Based on multinomial probit estimation technique, this chapter shows that besides the strong and gender-neutral effect of cognitive scores, the extraversion measure reduces the probability of higher education attainment of young men in a robust fashion, but the same is not true for women. By using proxies for the cost of higher education in terms of personality traits, we can separate the cost effect of past behavioral problems from the current effect of personality traits. Results suggest that extraversion lowers the returns on the labor market for men, rather than raising the costs of education.

Early retirement policies of the eighties in Europe were partly motivated by the idea that taking the old out of the labour market could help the young to avoid unemployment. Such an intervention is theoretically questionable, but thorough empirical research is missing on its workings. With the ageing of industrialised societies, we are expecting the reverse of this trend after 2000 and thus governments are tightening retirement rules which make an increased employment rate of old plausible. This chapter aims at discussing the possibility of measuring crowding out effect using readily available aggregate data on EU member states. Relying on a factor demand framework, the chapter provides an analysis on the increasing difficulty of identifying the true underlying effect of increased older employment. Results show that the crowding-out effect is measurable only on the very short run without wage data. Nonetheless such effect is present after the year 2000. One percent increase in the employment rate of the older is shown to be associated with an around 0.2 percent decrease in the employment rate of the young on the short run. This effect is detectable only at the quarterly, but not at the yearly frequency.

Chapter 2

Inactivity and retirement in Hungary after the economic transition

Employment policy is a central issue to governments around the world, but this is even more so in the case of the European Union than elsewhere. Policy initiatives are launched both on the level of the EU and its member states to raise their employment rates. This is no wonder: it is not only the employment rate that falls short of targets, but there is also a high degree of heterogeneity among member states. In 2000, the EU15 employment rate of the 15-64 age group was 63.2 percent, while similar rates of the transition countries (now new member states) are much below this value: Bulgaria is the last with 51.5 percent, Poland and Hungary is only better than Italy and Malta with 55.1 and 55.9 percent, respectively. The situation is no better earlier and later either. In 1998, the first year we find employment data for Poland in the Eurostat database, Hungary is third worse in terms of employment after Spain and Italy (with 53.2 percent), Poland being sixth (with 59.2 percent). 2006 results are fairly similar, indicating that the persistence is high in this ranking. The question emerges: what is the reason that low employment rates persists in certain countries even after a decade?

Firstly, we have to realise that older workers' low employment is usually a major contributor to overall low employment (the 55-64 year old are usually labelled as "older workers" and I shall do so myself) and this is no different in the case of Hungary either. Table 2.1 on the following page shows nonemployment rates in Hungary for different groups of the population in two time periods, during and after what we can consider the main part of the transition. The top panel of the table indicates that one fifth of the 25-64 population is inactive and receiving pension at the same time – the same figure is lower for the 15-64 category, but this is clearly due to many young people participating in higher education. There are a couple of other features to be observed on this table. Firstly, the share of pension recipients is higher among women than among men. Secondly, overall pension receipt declines over time. Thirdly, despite of the overall decline, the share of disability pension receipt increases over time.

Table 2.1: Share of nonemployed persons in Hungary within the 15-64 and the 25-64 age groups

	15-64		25-64	
	1993	2006	1993	2006
Together				
Share: nonemployed	45.32	42.69	39.63	34.65
Share: unemployed	7.50	4.64	6.83	4.54
Share: receiving pension	17.22	15.66	21.92	19.19
Receiving old-age pension	11.10	7.44	14.22	9.11
Receiving disability pension	6.12	8.22	7.70	10.08
Share: receiving parental benefit	3.57	3.81	3.06	4.04
Share: other	17.03	18.58	7.82	6.89
Men				
Share: nonemployed	39.73	36.24	32.75	27.03
Share: unemployed	9.46	4.94	8.52	4.79
Share: receiving pension	14.92	13.69	19.08	16.90
Receiving old-age pension	8.07	5.61	10.42	6.93
Receiving disability pension	6.85	8.08	8.66	9.97
Share: receiving parental benefit	0.17	0.12	0.13	0.12
Share: other	15.19	17.49	5.03	5.23
Women				
Share: nonemployed	50.59	48.85	46.04	41.82
Share: unemployed	5.65	4.36	5.26	4.30
Share: receiving pension	19.39	17.54	24.59	21.35
Receiving old-age pension	13.96	9.18	17.77	11.17
Receiving disability pension	5.43	8.36	6.82	10.18
Share: receiving parental benefit	6.77	7.33	5.78	7.73
Share: other	18.78	19.62	10.42	8.44

Own calculations from Hungarian Labour Force Survey microdata

An immediate explanation to these numbers is to be found in the historical backdrop. The transition was a sizeable shock to all: employment of individuals below the statutory retirement age fell from 75.9 percent in 1990 to 59.7 percent in 1995 (see table 3.4 in Fazekas and Kézdi (2008)). The huge, 16 percentage point drop was absorbed in various ways in different countries and also in Hungary. Unemployment was up at 7.5 percent in 1993 from nonexistence in 1989, but the mass of unemployed was less than half of the loss in employment. Along with the relatively low retirement age, early retirement options were opened up, many with the sole purpose of providing the newly unemployed with a labour market shelter. Today or back in the 1990s, there are many who would be reluctant to accept the idea that disability retirement was or is a labour market shelter. It is true that actually we do not know much for certain and only a thorough investigation of governmental memoranda could provide factual evidence, but there are indirect ones too. One of these is the over-time increase of the share of disability pension recipients. It is clear that the health condition of the Hungarian population is worse than what we find in the EU, especially in the EU15, and this would explain a different level of disability benefit receipt. An *increasing* share of disability pensioners over time is however inexplicable by the health-deteriorating heritage of the past, especially if we consider the slowly, but steadily improving expected lifetime at birth, which has increased by 4 years from 1990 to 2006, according to WHO data. Indeed, as both the number and share of nonemployed old-age pensioners have decreased over time, it is mostly the increase in disability pension that explains why overall inactivity rate in Hungary has diminished only by 3 percentage points over 13 years. But this is only one piece of evidence of the many that we have to assemble to see the way the employment situation of older workers came about and remained unchanged in Hungary.

Although there exist papers looking at one or the other aspect of inactivity and pensioner status in Hungary, even some of the stylised facts are not laid out clearly. We do not know from what sources the pensioner stock was built up and how its decrease came about. We do not know how strongly transition into pensioner status and inactivity are related and how this relation has changed over time. We also do not know if changes in employment rates affect changes in pensioner stock, or vica versa. Finally, we do not really know what the importance of individual characteristics is in governing these changes and how they have changed over time. The aim of this chapter is to look at these questions empirically using Hungarian Labour Force Survey data.

The section after this introduction looks at the institutional background behind retirement, describing the regulations for calculation and availability of pensions. It appears from this that in the beginning of the 1990s, there was no need to put huge efforts into using the system as a labour market refuge: these regulations were very much in favour of early retirement through either channel. The second section describes the LFS microdata that allows us to identify trends in various forms of pensioner inactivity and also track over-time transitions between states to a certain extent. The third section explores the connection between inactivity and pensioner status. Combined transfer and labour market states are created and using these statuses, over time and over-age changes are presented to show the contribution of different groups to pensioner inactivity. Results show that inflow to pensioner status is not connected to exit from state-owned employment in this time period, and is strongly dependent on age. It is also apparent that individuals do not claim pension in order to continue working in a safer environment, but to retire in the true sense of the word. It is also apparent that after the 1997 pension reform, outflow to old-age pensioner status lessens, and that into disability pension increases, suggesting the substitutability of the two institutions. Finally the over-time changes are decomposed into overall flows between different states. This analysis shows that it is not only the tightening retirement channel that causes the increase in employment rates, but also the increased flexibility plays an important part, especially the (perhaps related) improved outflow from unemployment back to employment. The fourth section estimates the effect of individual characteristics on transitions probabilities between one of the combined states using multinomial logit model. It appears that both individual and family characteristics affect the propensity of transition to pension and with the exception of education, in a mostly uniform fashion during all time periods.

2.1 Retirement after the transition: rules and possibilities

In this section, we shall be looking at institutional background of retirement, with emphasis on features of the system supporting early exit from the labour market. There are detailed descriptions available of the pension system itself (such as the one found in (Burns and

Cekota, 2002) or more recently in Simonovits (2008), focusing on the 1997 reform of the system), with which I have no wish to compete. My aim is to highlight the features connected to labour market participation.

2.1.1 Old-age pension

The Hungarian old-age pension system is a dominantly pay-as-you-go system with a funded pillar introduce in 1998. Out of total pension contribution paid (declining from 31 to 28 percent of gross wages from 1998 to 2002 and even further down thereafter), roughly three quarter goes to public, and one third goes to the funded pillar. To ease the burden on the state pension budget, payment to the private pillar was phased in gradually: in 1998, 1999 and 2000, 6, 7 and 8 percent of gross wages went towards the private pillar and 25, 23, 20 percent went towards the public pillar, respectively. One year before the funded pillar was put in place, the year 1997 brought about an equally important change. Before 1997, the earliest legal retirement age was 55 years of age for women and 60 for men. After 1997, both of these ages have been gradually increasing to 62 years of age, in two year steps for both sexes. Men faced the new legal age already in 2001, while women do so only in 2009. The legal retirement age in 2001 was 62 years for men and 58 for women. Steps of the gradual increase and the actual statutory retirement ages are shown in the Appendix in Table A.1 on page 129 and Table A.2 on page 130 for women and men, respectively. Since 1992, the entry pension is calculated on the basis of wages for employment back to 1988.

Although legal retirement ages are increasing after 1997, there is an important exception during the transition period. This exception, covering almost every new retiree, rendered the rise in retirement ages ineffective for a long period. With a sufficiently long work history, it is possible to take advantage of a scheme what I shall call “transitional early retirement” without deduction from the pension, available 3 years before the legal age, at the pre-1997 legal ages the earliest. For this type of early retirement the conditions are exactly the same as for normal retirement (except for the work history requirement), that is there was no penalty involved. If the employee does not have the necessary work history, early retirement is still possible, the difference being a 0.1 percent decrease in the pension for every month in the first year, 0.2 percent for every month in the second year, and so on. For example, in 2001 a woman could retire through old-age retirement if she was at least 55 year old. With the required work history (38 years of service), she can retire without deductions from her pension. If she does not have this work history, she either has to accumulate more years and retire later (also facing the fact that the legal age is increasing) or forgo part of her pension. Supposing that she has 2 years less service than required, she can retire with a $2 \times 12 \times 0.2 = 4.8$ percent penalty (years × months × monthly penalty). Table 2.2 and Table 2.3 on page 12 contain important data on retirement from official registers, not available from surveys. Table 2.2 shows that the effective retirement age did not change between 1997 and 2002, which suggests that the accumulated length of employment was sufficient in the case of most older workers. The two-year cycles generated by the rising of the legal retirement age in female retirement are apparent, too.

Table 2.2: Distribution of pension claimants by the form of old-age pension claimed

Men	1997	1998	1999	2000	2001	2002
Retirements after the legal age	13.4	6.8	5.0	4.8	2.0	0.9
With bonus	6.7	4.5	3.2	3.0	1.0	0.5
Without bonus	6.7	2.3	1.8	1.8	1.0	0.4
Retirement at the legal age	77.9	1.9	14.8	2.6	6.2	8.1
Retirement before the legal age	8.7	91.4	80.1	92.6	91.8	91.0
Pure pre-retirement	1.1	1.1	1.2	1.6	0.9	0.8
Tr. early retirement without deduction	7.3	85.7	75.0	84.9	86.2	85.1
Tr. early retirement with deduction	0.3	4.6	3.9	6.1	4.7	5.1
Together (number, 100%)	10,729	9,092	11,914	12,749	23,684	20,747
Women						
Retirements after the legal age	23.5	11.1	4.5	3.7	6.5	2.8
With bonus	22.1	10.6	4.1	3.4	6.1	2.6
Without bonus	1.4	0.5	0.3	0.3	0.4	0.1
Retirement at the legal age	4.3	0.0	21.9	1.8	32.8	1.2
Retirement before the legal age	72.1	88.9	73.6	94.5	60.7	96.0
Pure pre-retirement	0.6	0.3	0.2	0.1	0.2	0.1
Tr. early retirement without deduction	66.7	83.1	68.9	85.8	55.8	88.9
Tr. early retirement with deduction	4.8	5.5	4.5	8.6	4.7	7.0
Together (number, 100%)	16,170	14,922	21,765	25,325	11,675	17,912

Table reproduced from (ONYF, 2004), page 17

In contrast to the penalty for insufficient length of employment, there was basically no bonus for retirement later than the legal age until 2004. Although a 3.6 percent increase is available after the first year of the legal retirement age, the transitional regulations do not play a part here. The bonus is thus not extremely large and even most men would have to work for an extra 3 year after the first possible opportunity for retirement (60). Women would have to work an extra 8 years if otherwise qualified for early retirement in 1997. Although one would think that this option is as good as absent, Table 2.2 on the preceding page also shows that retirement after the legal age was non-negligible before 2000, but it decreased to almost zero thereafter. As we do not know the age distribution of "late retirees", there is no clear-cut explanation for this change. The high proportion of those retired with bonus shows nevertheless that most of them remained in the labour market for a fairly long time. Late retirement in an environment which does not give incentives for it is an interesting question to look at, but in our case this proves to be very difficult because of the lack of appropriate data and hence I shall not pursue this question.

Being the dominant form of old-age retirement, transitional early retirement is worth a closer look. Table 2.3 on the next page shows details on this form of retirement both with and without deduction (first and second columns for every year, respectively). Firstly, note that there is only a fraction of those who retire early with deduction from their pension (first column). Secondly, if there is a deduction, its amount is quite substantial (and so is the shortfall in the length of employment history). There are important gender differences to observe here: although maternity and child care leave is accounted as "labour market service", women appear to experience much larger deductions than men. All in all, although we do not see behind these aggregate numbers, it seems to be the case that people are willing to retire at the earliest possible age in general, some of them doing so even at relatively high expenses.

Because the entry pension formula is not linear, it is difficult to say what exact replacement rate the old-age pension provides. A further complication is that the formula changed over time, leaving some cohorts better, others worse off. A comprehensive report by the Ministry for Youth and Opportunity (2005) shows both theoretical replacement rates and empirical ones for the year 2005 and beyond (although methodology for the latter is not clear: it seems that the empirical replacement rates are calculated from aggregate data). This time period is ahead of the one we are looking at here, but it is valid for the entire post-1997 period, as most rules remain the same, except for the progressivity of the pension formula. Theoretical rates for internationally comparable pensioner types (by the EU SPC/ISG - In-

Table 2.3: Main characteristics of retirements before the legal age (“transitional early retirement”) without (1) and with (2) deduction

Men	1997		1998		1999		2000		2001		2002	
	1	2	1	2	1	2	1	2	1	2	1	2
Number	785	34	7,790	414	8,938	462	10,826	776	20,405	1,105	17,659	1,062
Average age	56.1	57.0	59.7	59.8	59.7	59.7	59.7	60.0	59.9	60.0	59.8	60.0
Diff. from legal age	4.9	4.0	1.4	1.3	2.3	2.2	2.3	2.0	2.1	2.0	2.2	2.0
Labour service	38.6	32.4	41.1	33.7	41.3	34.4	41.7	35.3	41.1	35.3	41.6	35.4
Deduction (percent)		5.7		3.7		7.0		5.8		5.6		5.6

Women	1997		1998		1999		2000		2001		2002	
	1	2	1	2	1	2	1	2	1	2	1	2
Number	10,788	774	12,401	818	14,994	977	21,728	2,174	6,518	546	15,922	1,255
Average age	55.1	55.1	55.1	55.1	55.1	55.2	55.2	55.2	55.9	56.1	56.1	56.2
Diff. from legal age	2.0	1.9	2.8	2.8	3.7	3.6	4.7	4.6	4.0	3.7	4.8	4.6
Labour service	36.3	29.5	37.1	31.3	37.2	32.3	37.4	33.4	34.3	33.0	37.8	34.3
Deduction (percent)		7.8		11.6		14.7		17.8		14.7		17.1

Table reproduced from (ONYF, 2004), page 23 dicators Sub-group of the Social Protection Committee of the EU) are around 90 percent, which describes the system as very generous and most certainly having strong disincentive effects. The study points out however that these types are not typical for the Hungarian population and therefore do not provide a good guide: the typical retirement age is much lower in Hungary than what is used in the standardisation. Coupled with the mostly unreachable but existing bonus for extra work after the legal age, this leads to implausible results. For variants that are representative for Hungarian pensioners, a net replacement rate around 50 percent is more realistic, increasing only to a little more than 60 percent with above average earnings and long work history (see Table 3a in section 3 of the supplement to the cited study). Still, there is evidence of the system being selective, attracting more of those for whom the replacement rate is better than average: Cseres-Gergely (2005b) provides empirical evidence using Household Survey Data that the income loss after transition to pensioner status was around 25 percent after 1992 during the 1990s.

Once claimed, old age pension can not be “handed back” and the claimant will be labelled as a pensioner whatever she or he does. This fact is not very important if we look at pensions only, but has some legal consequences and possible effect on labour market chances. Pensioners are a special sort of people as far as the labour code, the law on tax and social security contribution regulations are concerned. Most importantly, although work is permitted, people who have reached the legal age (even if they are not pensioners) can be fired immediately, without the explanation normally required in such cases. Naturally, pensioners are not eligible for unemployment benefit. These factors discourage a transition to pension if someone intends to work. On the other hand, pension is not taxable in the period we are looking at, only increases the tax base, pushing income into higher brackets. Once someone is a pensioner, this regulation encourages working. Most importantly, individuals being able to keep their employment after claiming pension are especially rewarded.

2.1.2 Disability pension

Old-age and old-age type pensions always have an age requirement, and are therefore available from the age of 52 (women) or 57 (men) the earliest (until 1997). We shall see however in subsection 2.3.1 that activity of the older workers starts decreasing much earlier than that, around the age of 45. A large proportion of those parting the labour market receive disability/incapacity benefit, or as they call it in Hungary: disability pension. Table 2.2 on page 10 has shown that the number of old-age retirements are well below 50 thousand in a year. Given the fact that an 60 year old cohort has around 100 thousand individuals, retirement through channels different from old-age retirement are clearly very important. Taking up retirement pension can be motivated in different ways and a natural way to think about the problem is a health condition that limits working capacity. Although this is most certainly an important cause, there are pieces of information suggesting that this form of pension also acted as a labour market refuge, similarly to many other European countries in the 1980s. Scharle (2008) uses regional data to show that there is a correlation between applications for disability pensions and regional unemployment rates even if we control for the health condition of the population (the same correlation exists between labour market performance and disability pension *receipt*, only weaker). Disability pension does not only seem to be accessed by those unfortunate on the labour market, it also has a disincentive effect to work. According to the results of (Lelkes and Scharle, 2004), those receiving disability pension state much less frequently that they want regular employment (17 percent), those with the same self-reported health status ("not ill"), but receiving other types of benefit (70 percent, mostly receiving pre-pension unemployment benefit). Clearly, we can and should not label this as good or bad, as disabled seeking work can be a sign of the government not fighting poverty of these people well enough. We do not know the extent to which the benefit is used as a labour market refuge, but with around 55 thousand applications every year, 20 thousand of which are accepted, it is a powerful channel through which people leave the labour market. The people affected are not as numerous as those transferring to old-age pension, but they are younger, so taking into account their impact on the labour market, this number can be actually more important.

Disability pension rules have changed only partly over time. It can be claimed by any individual losing at least 67 percent of her/his "work capacity" and whose condition is not expected to improve within a year. Before 1998, eligibility was checked at application and lasted for a lifetime. In 1997-1998, an attempt was made to reform the system, because many health conditions leading to eligibility can be actually cured now and because a suspicion of misuse. Formerly permanent eligibility was abolished and health status of the recipients is set to be reviewed periodically and the earnings limit was strengthened somewhat. Gainful activity is permitted until the earnings from work reach the level before the health condition appeared.

The disability pension is calculated in relation to recent earnings and accumulated length of employment. A person with at least 25 years of employment receives disability pension at the same level as if it was set as a regular old-age pension. This means that if a person with secondary education successfully applies for disability pension, she or he can obtain a fixed income at the level of the old-age pension at the age of 43 (having worked continuously from the age of 18 on). Those having fully lost their work capacity receive more than the respective old-age pension. Those getting old enough to become eligible for regular old-age pension keep their pension level, but are transferred to old-age pension, which means mainly that the restrictions concerning work are lifted. These requirements and replacement rates seem reasonable if one consider an actual loss of working capacity. According to Juhász (2008) however, assessment of work capacity was seriously limited by constraints of personnel and diagnostic devices and was rudimentary at best for a long time.

2.1.3 Old-age type pensions, transitory pension types and the unemployment benefit system

Regular old-age pension does not provide retirement opportunity before the age of 60 for men, and 55 for women. However, alternatives to disability pension even before these ages were put in place. These forms of early retirement are summarised in the overview of Széman and Harsányi (2008) as early retirement, pre-retirement, anticipatory retirement and advanced pension. The institution of pre-retirement was available before 1998 for the unemployed within 3 years of the legal retirement age. It could be claimed by those having been unemployed for 180 days and having "no prospects to find a job" – a rather soft and softly assessed criterion. In case of eligibility, pension is calculated the same way as regular old-age pension. Gainful activity yielding an income more than 50 percent of the minimum wage was not allowed legally. Pre-retirement was re-labelled to unemployment benefit before retirement in 1998, and recently again, with the actual rules being essentially intact. Anticipatory retirement was a vehicle dissolving or drastically downsizing firms could use explicitly to discharge individuals without being worried about the labour market consequence of their decision. In the case of anticipatory retirement, individuals could retire up to 5 years before the legal retirement age. As exceptions to the general rule, a number of very generous sector-specific retirement schemes were available too (such as military, miner, etc.).

It is worth mentioning that along with a quite accessible pension system, regulation of unemployment benefits was never very generous but in the very first years of the transition and became tougher over time. Unemployment Insurance (UI) was available for a maximum of 360 days until 1999, 270 day thereafter. UI is liable to tax and social security contribution payment. Work was permitted only up to yielding 50 percent of the minimum wage until 1999, but none thereafter (short-term work is permitted). Gross replacement rate was 70 percent until 1997, 65 percent thereafter but is constrained to the range between the minimum wage (minimum old-age pension from 1997) and twice of that. Nagy (2000) points out that unemployment benefit claimants usually earn below-average wages. Because the unemployment benefit system imposes a minimum and maximum on benefits, actual replacement rates can be quite high compared to the theoretical one, computed on the basis of average wages and benefits. However, according to the calculations of Nagy (2000), actual replacement rates fell from 72 percent to around 50 from 1992 to 1998. Considering this and replacement rates offered by the various pension options, it is clear that for someone being able to chose between being unemployed on UI or being on pension, the latter was much more attractive. The replacement rate is at least as good as it is for the unemployed, but one can move in and out of the labour market without any further consequences. Being a pensioner seems therefore to be by far the most desirable situation.

2.2 Data

In the empirical analysis to follow, I shall be using microdata from the Labour Force Survey (HLFS) to look at the correlation between labour market and transfer status.[1] The HLFS was started in 1992 following the recommendations of the International Labour Organisation. It is collected quarterly by the Hungarian Central Statistics Office (HCSO) and reaches 70-80 thousand individuals each of them. It is similar to many LFSs both in content and structure. The sample is stratified and clustered geographically, the primary sampling units being dwellings. Dwellings are visited in every quarter and information on details of labour market activity and search are surveyed, along with demographic background. Although usually there is only one respondent, data is collected for every inhabitant of the dwelling. We have to keep in mind however that both the original focus of the survey and this method has occasionally potentially negative consequences on data quality. The HCSO has only recently started to collect information on wages, and these are unfortunately not available to researchers yet.

The survey is designed to have a rotating structure in which every dwelling participates for 6 quarters. After this period, they are “rotated out” and replaced by a similar dwelling. The fortunate side-effect of this procedure is that characteristics of both dwellings (mostly identical to households and – albeit to a lesser extent – to families) and individuals are possible to follow over time. Based on the original identifiers, the HCSO created anonymised ones for households, which enable us to actually link households’ information over time. Although the aim of the rotating procedure is to keep the sample itself “fresh” and the sample size constant, one can observe its monotonic decline over time. Based on this observation, we can conjecture that in-rotation compensates only for the theoretical loss of observations, that is only 1/6 of the sample in each quarter. Partly because of the loss of sample size, there are important breakpoints in the survey. The sample was enlarged three times, in the first quarter of 1994, 1998 and 2003. First it grew from 60 to 67, then from from 63 to 83 (reaching its peak a year later with 87), finally from 80 to 92 thousand individuals. Apart

[1] Data used for this chapter was cleaned and prepared by the Data Bank of the Institute of Economics, Hungarian Academy of Sciences.

from the changes in the sample size, we do not have detailed information on either attrition or replacement.

LFS data are weighted to maintain representativity of the sample in relation to some selected demographic reference variables. Changing demographics thus prompts the updating of weights, but an update is necessary also because of respondents are dropping out. There are regime-shifts not only in the sample, but in the weighting scheme, too. One type we do not know a lot about, but is clearly indicated by the structure of weights. Such a structural change is the transition to household-specific weights from individual-specific ones from 1994 to 1995. This, we think, does not affect the analysis. The other type is well-known and happened when the 2001 Census became available (for employees of the HCSO). After 2000, the HCSO re-weighted samples starting from the first quarter of 1998 on the basis of the new demographic data. As a result, before 1998 and after 1998 parts of aggregate series are not comparable.

Abrupt changes in weighting have to be taken into account when analysing raw data and using nonparemetric techniques. For example, if we look at employment rates of the 15-64 population, we find that the two greatest jumps are to be found from 1997 to 1998 and from 1998 to 1999 with an estimated employment rates of 52.4, 53.6 and 55.3. The implied changes, 1.2 and 1.7 percentage points, respectively, are by far the greatest observed in the sample and we have no good explanation for them. As weights are not often used for parameter estimates, these are less likely to be affected. Analysis of raw data is affected in levels, but as the variation seems to be mostly independent from the phenomenon we are looking at, it is not affected if we are looking at rates.

A non-weighting type change that is worth noting and expected to affect our analysis is the way and a change in the way the HCSO collected data on ages of individuals. Until 1998, age was calculated as the difference between year of the survey and the year of birth of the individual , while after 1998, this was changed to the actual age of the individual (ie. the number of years passed at the time of the survey). Because age plays an important role in the current analysis, the Data Bank of the IE has constructed a harmonised age variable. Age after 1997 if left unchanged, while actual age is estimated in the preceding period using information on the year and month of the survey.

The already discussed rotating structure, along with personal identifiers allow the construction of longitudinal personal identifiers. Once these are available, cross-section data sets are stacked, the resulting data set allowing for a flexible creation of panels of the length between 6 and 2 quarters. The resulting database has a little over 4.3 million (4,315,052) spells between 1993 and 2006, of which a little more than 1.5 million refers to individuals between the age of 40 and 64 (1992 is left out for changes implemented later that made compatibility questionable with the rest of the file). If we consider panels built from two adjacent quarters, we are left with around 80 percent of the cross-sectional sample, implying little, but nonzero attrition. This setup has the advantage of collecting the most transitions overall, although it can result in a somewhat smaller transition rate than year to year transitions. In the case of two quarter panels with 5 quarter gaps (implying last year's same period as a base), we are left with around 12 percent of the cross-sectional sample size. In what follows, we shall use mostly the adjacent-quarter panels. Analyses of the labour market commonly use the latter approach, that is periods a year apart to identify dynamics of employment, for instance, the reason for that is mainly to avoid seasonality and spurious transitions due to measurement error. Although a priory, we might well be worried about the presence of both problems, we will have to use quarter to quarter and hence a potentially larger number of transitions in order to look at the age profiles of certain cohorts. Seasonality does not seem to be very relevant empirically as we can control for it in the parametric estimation.

To look at match quality, I have performed simple checks based on basic demographic variables such as sex, age and schooling. A match was considered good, if an individual (identified by a household identifier and a serial number within the household) had the same sex in two consecutive waves, age that did not change by more than one year and an education level that was "nondecreasing" over time. Also, I have looked at indication of participation over the theoretical 6 months, partly to check whether the occasional recycling of individual serial numbers did not cause any false matches. Looking at the results, we see that match quality is fairly good, although there are some individuals shown to participate for more than 6 periods, while some stay for a significantly shorter time period. While the former can be a sign of false matches or actual long stays within the sample, the latter is a fairly good indication of attrition. The analysis of this problem (and others, too) is worth a separate study and will not be attempted here. In what follows, we assume that attrition does not have a decisive impact on the results. There are two periods however, where we do know that the panel can not be matched. Because of the attrition in the preceeding periods, sample size was increased in one step in 1998 and the panel was completely restarted in 2003. Becasuse of this, connection between waves 28-29 and is not possible for every individual and is not possible for any between wave 36 and 37 either, thus these period-pairs will be omitted from the analysis of flows between states.

2.3 Inactivity and pensioner status

One aim of this chapter is to analyse the interaction of the institution of pension and labour market participation of older workers. In order to do so, we omit the youngest part of the working age population. Figure 2.1 on the next page thus shows nonemployment rates of 25-64 year old men and women in every quarter between 1993 and 2006, along with the old-age and disability pension components.

All the variables being shares, simple correlations between them is straightforward to calculate and interpret. These suggest that there is a strong connection between the share of old-age pensioner inactive people and the nonemployment rate: the correlation is positive and is around 95 percent for both sexes. Using disability pension instead of old-age pension, the same correlation decreases to 0.32 in absolute value. It seems thus whatever way the causality runs, the evolution of nonemployment rate goes very closely together with that of old-age pensioner inactives. Another way to look at the same trends is that the typical below-64 nonemployed person is less likely to be old-age pensioner, and more likely to be disability pensioner in 2006, than she or he was in 1993. If we calculate correlations between the share of nonemployment on the one and the share of old-age and disability pensioners on the other hand, we can construct a time-path of the correlations too. These correlations had gone down from 0.45 to 0.4 and up from 0.4 to 0.5 over time respectively in the case of men.

In the case of women, the change was similar qualitatively, but even stronger quantitatively.

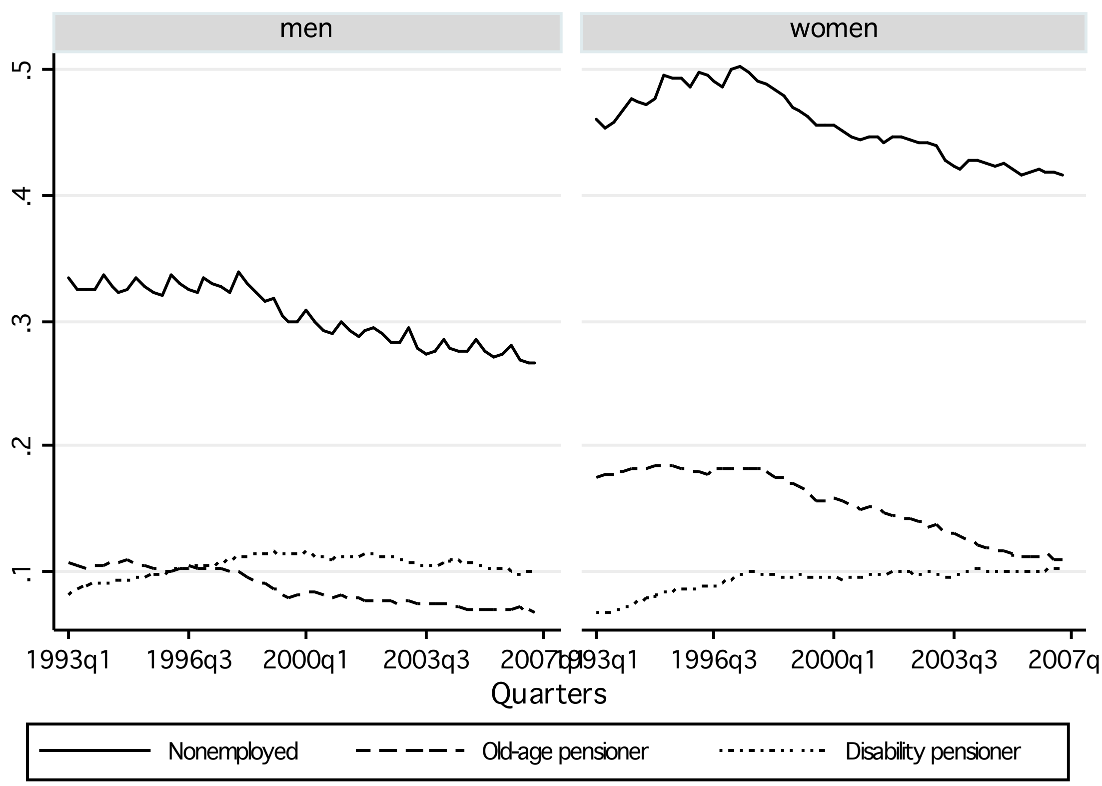

Figure 2.1: The share of the nonemployed along with the share of old-age and disability pensioner inactive people among the 15-64 year olds over time from 1993 to 2006 (quarterly, calculated from quarterly LFS microdata)

As time series data is not directly informative about causal relationships, now we turn to individual level data. Because both types of pension are connected to ageing, along with the increased incidence of illness, we shall be looking at changes over the life-cycle. To this end, figure 2.2 on page 23 shows age-activity and age-pension receipt profiles for men and women, respectively. In the case of both sexes, each panel shows two sets of lines running close to each other, tracing cross-section profiles for the 1993-1995 (P1, thin stroke) and the 2004-2006 periods (P2, stronger stroke), respectively. On the first panel, we are looking at nonemployment in a more traditional way, using the three standard ILO-defined states: 1) employment, 2) unemployment and 3) inactivity. Note that these do not imply any kind of transfer or other status per se. In particular, there are both full-time students and pension recipients to be found both among the employed and the inactive. The second panels focus only on the proportion of individuals receiving pension. Both panels show proportions relative to the size of a given age group.

The graphs show familiar life-cycle features. After reaching its peak, employment rates go down first slowly, but at an accelerating rate, while inactivity is mounting at the same time (women have a peak in their late-20s and then in their 40s, while the peak for men is already passed at the age of 30). Unemployment is steadily decreasing with age, while pension receipt is increasing. In the case of men, inactivity seems to run together with pension receipt, while there is a roughly constant gap in the case of women. Indeed, correlation between inactivity and pension receipt is almost 1 for men, and is around 0.94 in both periods. Claiming of disability pension starts in the age of 35, accelerating some ten years later up until about two years before the statutory retirement age. At the same time, the share of old-age pensioners starts increasing around five years before the statutory retirement age. In spite of the differences in absolute timings, the trajectories are similar in the case of both sexes.

In the context of this analysis, it is not only the process of transition to pensioner status that is important, but also its changes between the two time periods. The changes reflect the result of several, potentially counteracting changes, most importantly the gradual changes in old-age retirement ages, already described in subsection 2.1.1 on page 9. The fact that women are more affected by these changes of regulation is clearly reflected in the data: the start of the rise in claiming pension has shifted out to a 5-2 years older age (low and medium share level, respectively), the share rising steeper and even a bit higher than before. In the case of men, one can observe the same shift, but only by 3-1 years (low and medium share level, respectively). The age-path of disability pension claiming is practically unchanged before its peak in the first period, but continues to rise further in the second. It appears that as soon as the share of disability and old-age pensioners is the same, the share of disability pensioners starts to decline. The share of disability pensioners peak later in life in the second period. Despite the automatic transfer of disability pensioners to old-age pension gives a good reason why this is so, this is most probably not the only reason, as transfer would be much faster in that case. The net result of all is that in the second period, the share of all pension types start increasing at the same rate after 50 years of age for both sexes. Even

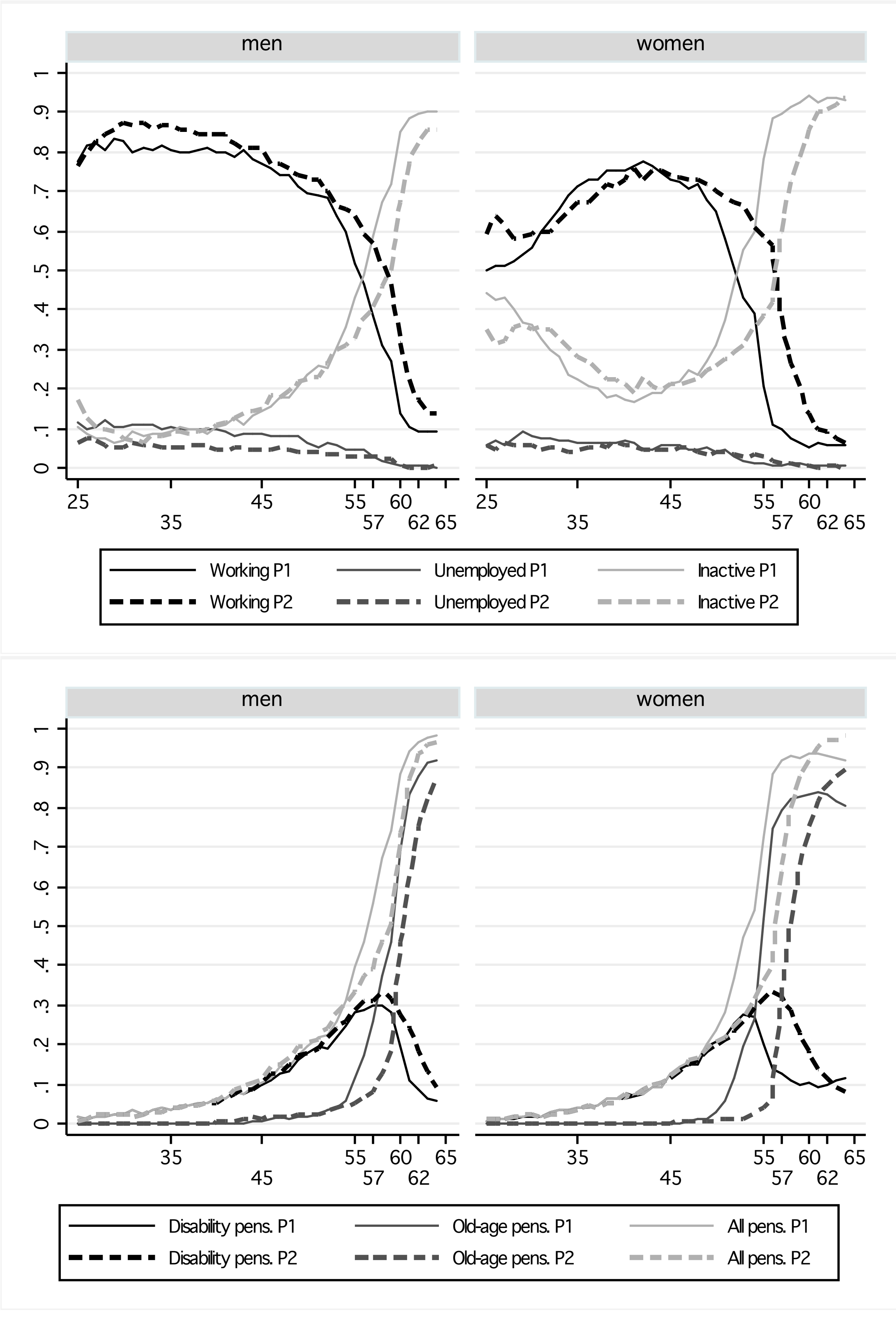

Figure 2.2: Share of individuals in activity categories (top panel) and pension receipt categories (bottom panel) by gender in the 1993-1995 (P1) and 2004-2006 (P2) period within the 25-64 year old population (by years of age, calculated from LFS microdata)

though the gap is widening again after the age of 57, women's overall pension claiming propensity decreases considerably. Inactivity rate moves in the same direction, maintaining the already mentioned correlation of almost 1 for men and 0.94 for women. The age-profile and the changes of age profiles thus suggest that there is a very strong correlation between pension claiming and inactivity across cohorts.

Having a panel of six quarters at our disposal allows us to leave the life-cycle aspect of retirement behind and to look at transitions between different labour market and transfer states and the correlation between them. We define two transition variables, one looking at transition to any type of pension from non-pensioner status (1 if a transition occured from time t to $t + 1$, zero otherwise), the other looking at the transition to nonemployment from employment (again, taking on the value 1 if the transition accured, zero otherwise). Using various lag lengths and sample sizes, I have calculated correlations between changes of the two types of statuses. Even if we restrict the sample to the over 40 and one sex (or even to a specific time period), the correlation never goes above (or much below) 0.25. Unfortunately, there is not much reference for validation of the result, except for the unpublished masters dissertation of Dobos (1998). This study is looking at a related problem, the exit from inactivity, supplying descriptive evidence too and that is in line with our findings. Given these results and the high cross-sectional correlation, this number prompts further investigations.

2.3.1 Combined labour market- and transfer-status states

In order to understand the connection between the transition to inactivity and the claiming of pension, we shall introduce combined labour force- and transfer statuses. The former distinguish those working and not working following the ILO definition (that is, having worked at least one hour for pay during the week prior to the interview). The latter distinguish between those receiving old-age pension, disability pension or none of these (but possibly other benefits or none at all). Doing so, we are able to see the transitions between employment without pension to employment along with pension, for example. Defining such combined states have other benefits too, such as separating different types of nonemployment or tracing movement between sectors. In what follows, I shall define three combined states. Firstly, I define a state space that is somewhat similar to looking at activity and transfer states separately, but not identical to it. The states in this space are defined as follows:

"st1":

1. working
2. not working and is neither on old-age nor on disability pension
3. not working, on old-age pension,
4. not working, on disability pension.

This categorisation is useful to look at transitions to different types of pensioner status. Note that here the first and the second category lump together a lot of different people. In particular, the first includes the working pensioners as well, while the second also includes all unemployed, including the pensioners. Figure 2.3 on the following page uses st1 categorisation and the emerging picture is only slightly different from Figure 2.2 on page 23: inactivity and transfer receipt appear to go together over the life-cycle.

To understand the process of transition between employment and transfer statuses during and after the economic transition, we augment the st1 categorisation to include work at state-only employers and at employers with both state- and the private ownership. We also distinguish between those working and receiving pension at the same time from those not receiving pension in order to understand better the transitions between complete activity and complete inactivity. To keep the set of states tractable, we omit the distinction between the two types of pension. Although their use varies a lot by age, we capture that with other states. Also note that unemployment does not appear here as a separate state. Although the supporting results of (Flinn and Heckman, 1983) can not be directly appied to the Hungarian case, Köllő (2001) shows that at least some groups of the inactive and the unemployed appear to have similar job-finding probabilites, so merging them can be reasonable too. A first, simpler space includes only the first distinction of different employers:

"st2":

1. working for a purely state-owned employee,

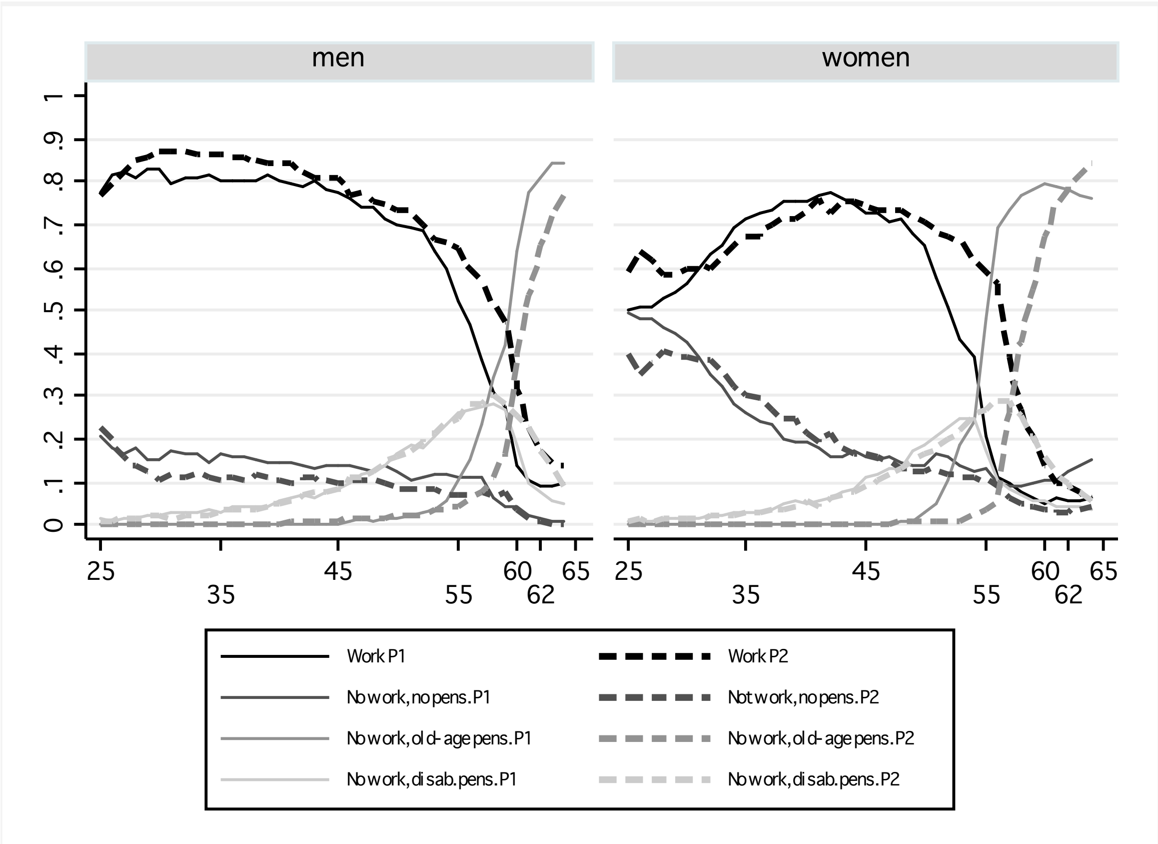

Figure 2.3: Share of individuals in the "s2" combined states (separate retirement channels) by gender in the 1993-1995 (P1) and 2004-2006 (P2) period within the 25-64 year old population (by years of age, calculated from LFS microdata)

2. working elsewhere,
3. being unemployed,
4. inactive with pension,
5. other inactive.

The second, more complicated space distinguishes different employers and work-pensioner status combinations too:

"st3":

1. working without pension in the state-only sector,
2. working with pension in the state-only sector,
3. working without pension in the mixed sector,
4. working with pension in the mixed sector,
5. not working without pension,
6. not working with pension.

Figure 2.4 on the following page shows the evolution of employment over time separately by sectors along with inactivity and unemployment, as defined by the st2 categories. We already know that the transition brought about the net destruction of many jobs in Hungary as this is well documented by Kőrösi (2003) and Commander and Köllő (2008), or focussing more on the creation side in a more international perspective by Brown and Earle (2006) and Bilsen and Konings (1998). The graph shows two major changes to be observed after the first part of the transition. One of these is the shrinking of the state-only sector and the growth of the mixed ownership sector until 1997. This is followed by a period which could be characterised as a steady state in the case of the state-only sector (except for the notable increase of women's employment) and a growth period in the case of the mixed sector - indeed, almost the entire employment growth and thus the reduction in nonemployment of the post-1997 period was due to increase in employment in this sector. Job destruction in the state only sector is more pronounced in the case of men mostly because many women worked in jobs that were and are mostly offered by the state, such as education and the health.

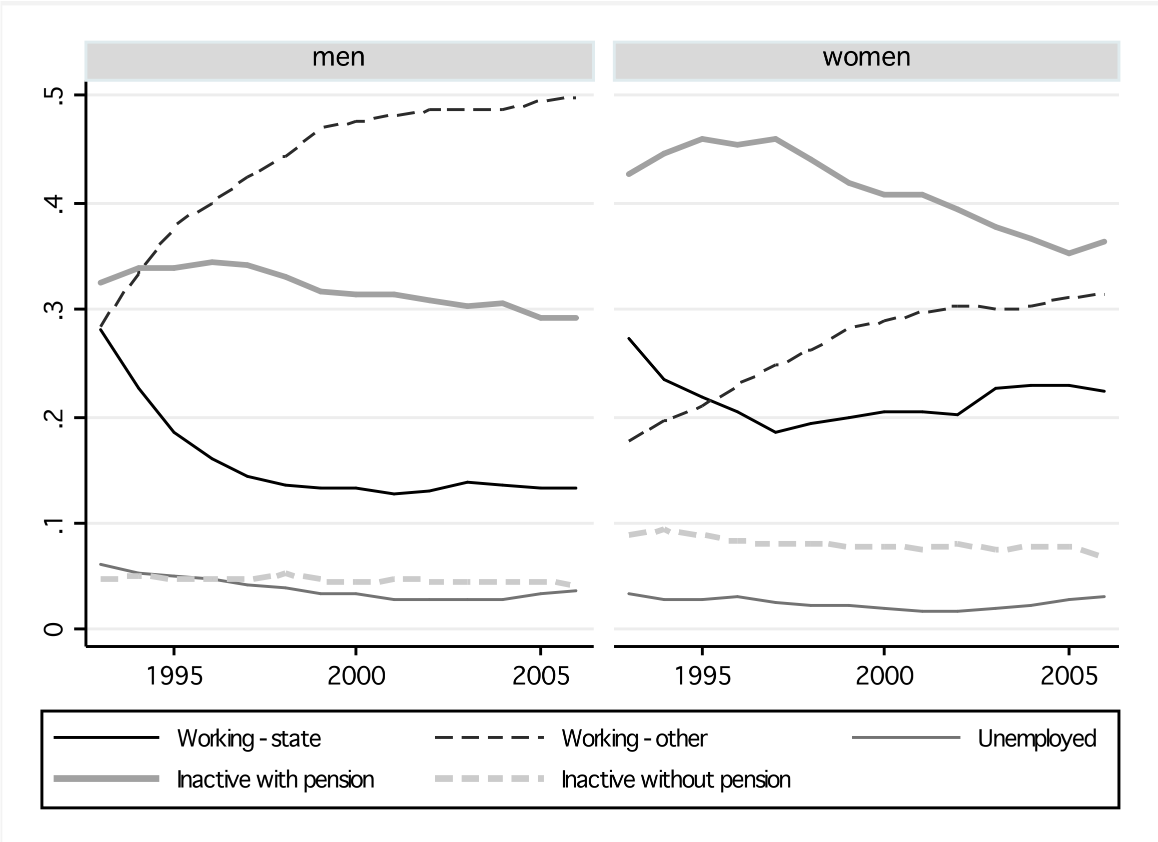

Figure 2.4: Share of individuals in the "s1" combined states (separated by ownership and type of pension) over time by gender within the 25-64 year old population (by years of age, calculated from LFS microdata)

Nonpensioner inactivity is stagnant over time as the young are excluded from the analysis and there is apparently little change in the behaviour of other affected groups. Pensioner inactivity is decreasing for both sexes after 1997, but doing more so in the case of women - in line with what we expect after the changes in retirement regulation. The time series evolution of pensioner and nonpensioner inactivity thus suggests a close connection between employment and retirement behaviour again. Due course, the increase of employment in different sectors is characteristically different in the case of men and women. While employment of men grows only in the mixed sector, that of women grows in both, although stronger in the public than in the mixed one. Knowing that there was no effective change in retirement regulation for men, this difference is easily explained by separating the employment growth for women into two components, growth coming from changes in retirement regulations (effective for women only) and autonomous employment growth driven by labour demand and supply factors (effective for both sexes).

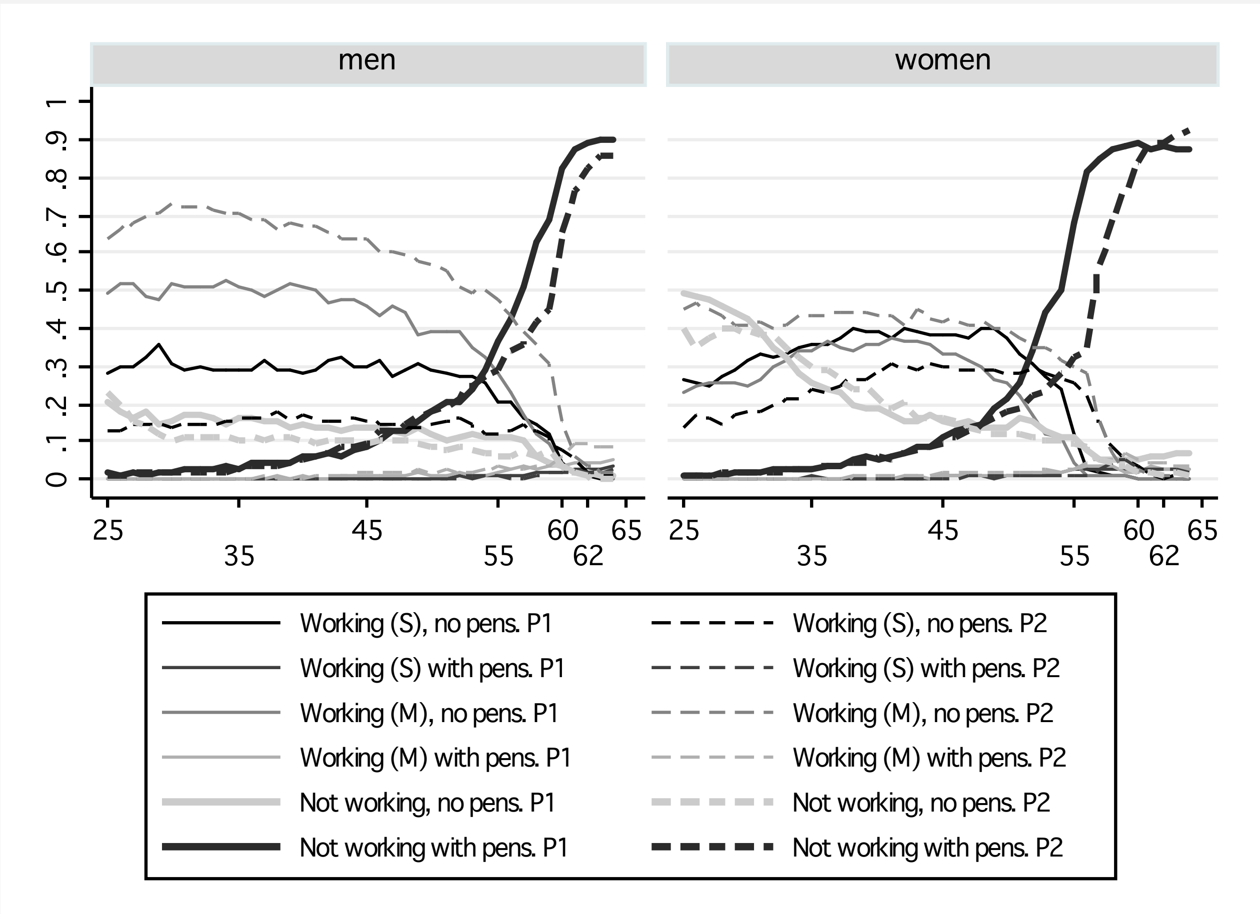

Figure 2.5: Share of individuals in the “s3” combined states (separated by ownership and type of pension, jointly) by gender in the 1993-1995 (P1) and 2004-2006 (P2) period within the 25-64 year old population (by years of age, calculated from LFS microdata)

Moving back to a life-cycle context, we can look at the above changes between the two period over each age group in the cross section based on Figure 2.5. Changes in retirement behaviour were already discussed before, so we shall not do so here again. We also know already that the number of unemployed has decreased over time, more for men than for women. It is apparent that employment along with pension is a rare event, but it occurs somewhat more often for men in the second period than for women and in the first period (it is also hard to see this because of the low incidence rate). Perhaps the most interesting information here is the way employment has changed differently for different age groups, genders and sectors. In the case of men, the decrease of public employment is almost uniform across ages except for the later ages, where in the first period men seem to have exited relatively early and almost the same is true for mixed employment. In the case of women however, the changes are rather different. Firstly, the change in private employment is quite large for those above 50 and those below 35. The difference is probably due to the prime-age group being able to transfer or enter private employment after the transition, whereas the older could not. Secondly, changes in public employment show interesting patterns after the age of 50. Instead of proportional shift in employment rates, there is actually more women employed in the public sector in this age group, than in the mid-1990s. The difference compared to men is worth noting in both cases: it corroborates the idea that the shift is a direct effect of the increased retirement ages. Although this is a most plausible and probably valid explanation, eyeballing the graph suggests that the age group around 50 is already affected by the change, whatever have caused that (keeping in mind that the retirement age regulation should have affected only those beyond the age 55).

2.3.2 Age-state profiles for cohorts

We have just seen that several characteristics of transfer and labour market status are connected to particular parts of the life-cycle, but we have also seen that these have changed differently over time for certain age groups. So far we have looked at cross-sectional data at certain time periods, where age groups actually combine the effect of life-cycle effects and differences by cohorts. Now we turn to age-status cohort-profiles, generated from a series of cross sections, to separate the two. We are looking at a period of 10 years starting in 1993 and individuals between the age of 15 and 74. Because using all possible cohorts would lead to unnecessary complications and we are most interested in changes around the retirement age, we shall restrict attention to at most 18 of them. The last cohort we use is the one aged 74 in 2006, born in 1932. Starting here, I originally used every other cohort from 1932 until 1952, then every fifth until 1987 – this gives us a total of 18 cohorts to work with. Because the picture was cluttered even using this spacing, I ended up with 5 cohort only, the ’38 ’40 ’42 ’44 ’46 in the case of men and the ’42 ’44 ’46 ’48 ’50 in the case of women. The eldest men were 59 years old in 1997, just before retirement, while the youngest were in the same position in 2005. A similar story is true for women as well. It is mostly the older generations who will contribute to characterising behaviour after and the older who do so for the time after the retirement age, but their overlap gives an idea about the extent of changes associated with a given cohort only.

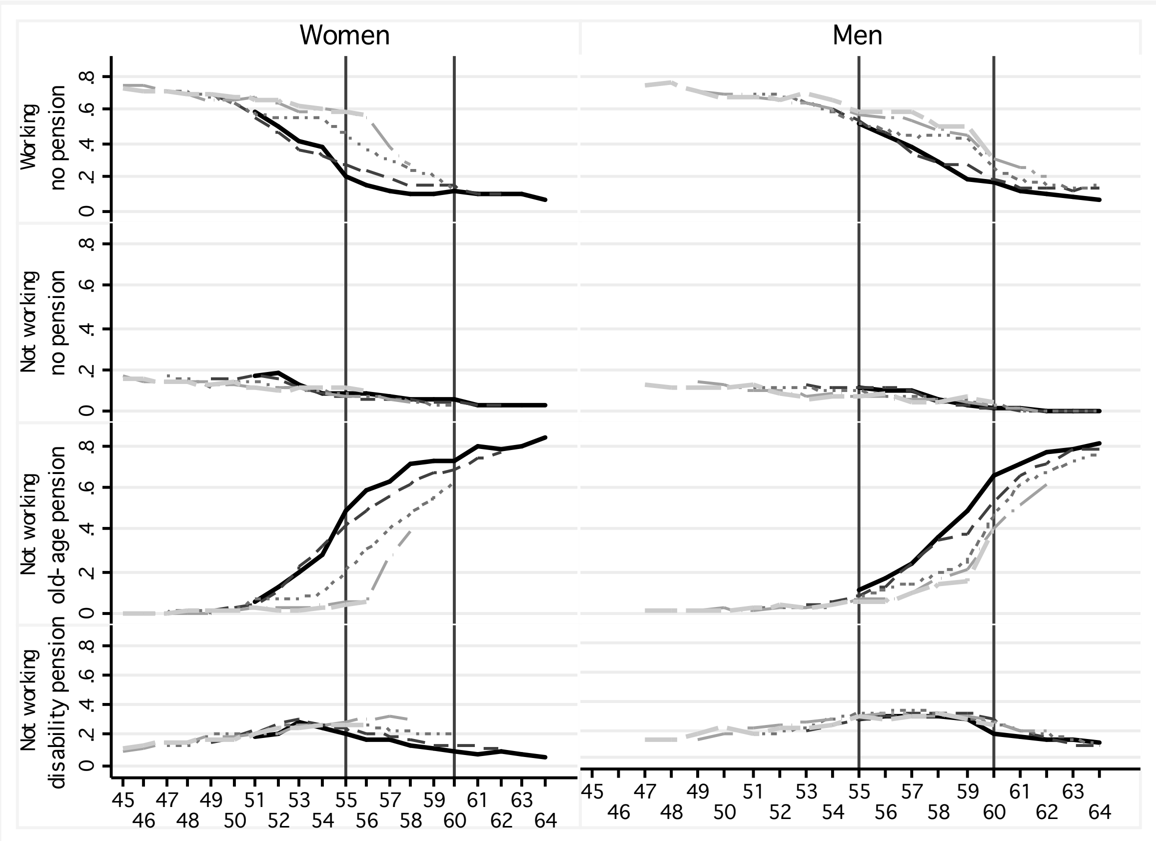

Figure 2.6: The share of individuals in “c1” states by age - cohort graphs for 1993-2006

Figures 2.6 and 2.7 on the next page show st1 and simple st2 categories (without differentiating state/mixed employment) for different cohorts for both sexes separately (omitting the not working and not receiving pension categories). Both graphs show shares against ages for each cohort separately. Cohorts are not labelled, but are drawn using different shades of grey, black indicating the eldest cohort, while the lightest grey indicating the youngest.

One feature of both graphs becomes immediately apparent: most the sometimes substantial changes in employment behaviour happens within three selected generations, that is within 5 “vintages” in real life. This includes employment and pensioner inactivity in the case of both women and men. Let us take a look at one example! Women born in 1944 (second darkest, long dashed line) are 54 years old in 1998. As Table A.1 on page 129 in the

Appendix shows, retirement ages are still practically unchanged compared to the pre-1997 period: early retirement has not changed, normal age has already increased by one year to 56 years. This latter increase, and only this one is reflected on the graph: employment of the '44 cohort has increased, but only between ages 55 and 60. In contrast, the 1946 cohort reaches the age of 59 in 2000, when normal retirement age has been raised by 2 years. Although early retirement age is unchanged, we see a strong increase in activity from age 52 on, up until age 58, with the maximum at age 55. Looked at the same thing differently, cohort-specific employment rate schedules have shifted by one year to the left between the two cohorts. Although this is almost trivial in itself, the fact that this shift is observable already from the age 52 up until 57 is interesting. This is a large spread, not easily explained by measurement error issues (each point estimate relies on 1500-2000 underlying observations). The fact that the change in activity is well centred over the ages affected by retirement regulation strongly suggest that there is a line of causality running here from the change of retirement ages. The analysis of pensioner inactivity yields a very similar result, and therefore it is omitted here.

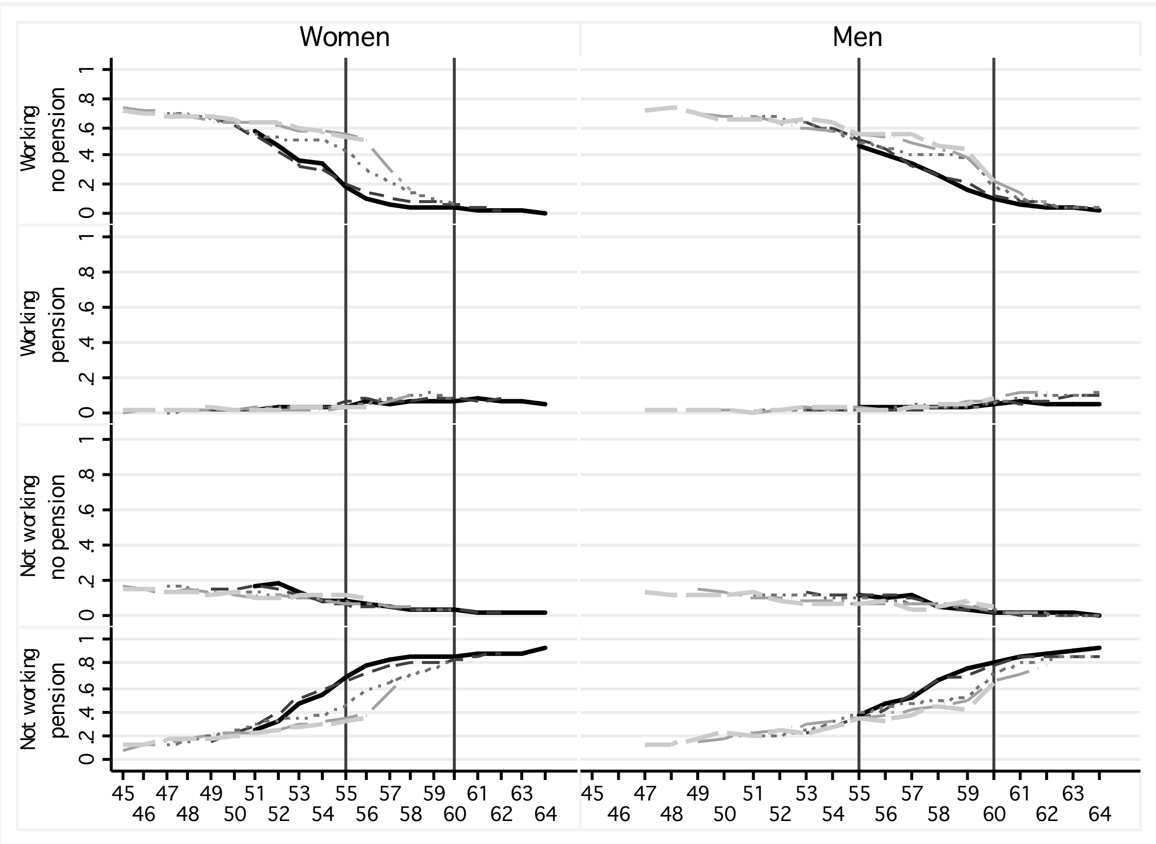

Figure 2.7: The share of individuals in simplified "c3" states by age - cohort graphs for 1993-2006

Moving along to features other than nonpensioner employement and pensioner inactivity, it appears that a) the increase in the share of older men working along pension does not decline after the age of 64, b) nonpensioner nonemployment (mostly unemployment) has not increased within the cohorts and in the period we look at, c) being able to make the transition to old-age pensioner status only at a later time, the shifts in disability pension follow the evolution of old-age pensions. There is no sign of strong effects other than the change in retirement ages.

2.3.3 Transitions between combined states

To understand further the changes in evolution of the chosen labour market stocks, we shall now dissect them into initial stocks and transition rates. The model underlying such calculations is a simple Markov chain, in which initial stocks subsequently evolve following a potentially time-varying transition matrix (following Peracchi and Welch (1994), for example). Let us define the probability of a person of age a being in a certain state in time t is given by the probability $\pi(a,t)_i$, collected in the vector $\pi(a,t)$. This set of probabilities evolve according to the transition matrix $\Lambda(a,t)$ as follows:

$$\pi(a+1,t+1) = \Lambda(a,t)\pi(a,t),$$

where $\Lambda(a,t)$ consists of conditional probabilities $\Lambda(a,t)_{i,j}$ of moving from one state i to state j over one period starting at time t at age a. This model allows for a very general model of transitions: probabilities can change by age and time freely. Unfortunately our data does not allow such a fine analysis. Transition probabilities can vary over time, as cross-sectional variation is sufficient to identify them, but variation by vintages is not possible to look at because of the lack of sufficient over-time variation. If we move to quarter to quarter transitions, looking at vintages might be possible, but experiments show that the noise introduced by quarter to quarter transitions is considerable. Using 5 year bins following Peracchi and Welch (1994) is not a real option either, as the relevant action happens within such a bin. Because of this, we shall be looking at the 40-64 age group only and transitions between states on a yearly basis.

Tables 2.4 to 2.6 on page 37 show over-time transitions between st1, st2, simple st3 states respectively for women, top and bottom panels comparing behaviour in the 1993-1995 and 2004-2006 period. Selecting women is based on relevance of the results and information acquired previously, but other tables (referring to men) can be found in the Appendix.

Firstly, we are looking at transitions between state and nonstate employment, as well as different forms of nonemployment in Table 2.5 on page 36. Transitions from employment make it clear that transition to unemployment was the least likely exit route in the first period: an 1.1 and 1.4 percent chance of becoming inactive without pension (from state- and nonstate- employment, respectively) is higher than that that attached to any other. The most remarkable is however the absolute attractiveness of inactivity of pension. Starting off as nonpensioner inactive, it is pensioner inactivity that has the highest probability (2.7 versus the second highest chance 1.7 percent of becoming unemployed), while the unemployed have a high chance to become nonpensioner inactive first and enter pension only through that state. In economic terms this means that the unemployed have a high chance to become discouraged workers, who in turn have little chance to become active again, but rather become dependent on pensions. There are noticeable signs of the labour market becoming more dynamic and the transition making progress as we move forward to the second period: transitions between employment in the state and non-state sector become less frequent and so does the transition from employment to inactivity, most notably that transition to pensioner inactivity. Given the institutional background, this change can be interpreted as the effect of tightened pension regulations. The probability of an unemployed finding employment in the non-state sector almost doubles, by 3.5 percent from 5.5 percent, showing yet another sign of the private sector gaining and the state sector losing ground. At the same time, the probability of an unemployed entering nonpensioner inactivity increases, suggesting that those unable to cope with the new situation are locked into inactivity more firmly than before.

The upper and lower panels of Table 2.4 are showing transitions in the st1-space and allow us to observe the transitions to, from and between employment and inactive states supplemented by old-age pension and one with disability pension. Those working without receiving any transfers are almost twice as likely to enter nonemployment without pension (but perhaps receiving other transfers), than nonemployment with all types of pension together (1.8 percent versus 0.68+0.31=0.99 percent). Turning to their “sending” behaviour, we find that pensioner nonemployment is a very persistent state with 99 percent chance that the individual stay there, while the nonpensioner nonemployed have some chance to enter employment (4 percent versus 1-1 percent of enterint pensioner state). Over time, persistence of employment has increased and there is a slightly increased mobility between types of pension received. The most significant increase is observable in transitions from disability pensioner nonemployment to no pensioner nonemployment, perhaps due to the increased frequency of checks upon those receiving disability pensions.

It is interesting that a relative high share of working individuals enter inactivity without pension and there is no radical change in this (or at least not different changes). There is little difference between men and women in general, and also in this regard. Along with the high probability to enter pensioner inactivity from this state, this might suggest an indirect way of transition from nonpensioner working status to pensioner inactive and explain the relative low correlation between transitions in transfer and labour market status. It does not explain however why this might be so.

A direct combination of work/nowork and pensioner/not pensioner status reinforces the previous intuition about the retirement process making a detour before completion, but this is true only in the first period and is decreasing over time. Although concerning a relatively small population, it is worth noting that the relative high exit rate from working pensioner status has decreased over time by a relatively large extent, and entry to nonpensioner working status has increased (this latter effect can be a result of disability pensioners exiting their status).

Based on these observations, we can say that although pensioner inactivity remained effectively an absorbing state, the over time increase of the employment rates of this population are due to several effects, including a) the higher stability of employment, implying less exit to nonemployed states, including the pensioner state and also unemployment and b) the unemployed being much more likely to get back to employment, especially into employment in the mixed sector. All in all, it seems that the increased retirement ages work both directly, ie. keeping individuals on their existing jobs and also act as a motivator to find a job if people lose one, instead of trying to enter pensioner status. It is because of these changes in the transition rates that we see a growing stability in the stock of people staying in work, versus the stock not working except for disabiltiy pensioners. Whereas outflows from pensioner states remain the same as before, inflows, especially from nonpensioner nonemployment have decreased considerably (the decreased flow from work to old-age pensioner nonemployment is a net result of the increased number of people working and an decreased transition rate).

Table 2.4: Transition rates using st1 states in 1993-1995 and difference between 2004-2006 and 1993-1995 values - 40-64 year old women (percentage)

1993-1995	work state	work nostate	unemployed	inact pension	inact no pension
work state	97.0	1.0	0.42	0.88	1.1
work nostate	0.74	96.0	0.78	1.1	1.4
unemployed	3.5	5.5	81.0	3.9	6.3
inact pension	0.23	0.36	0.078	99.0	0.055
inact no pension	1.3	1.6	1.7	2.7	93.0
difference	work state	work nostate	unemployed	inact pension	inact no pension
work state	1.3	−0.51	−0.11	−0.15	−0.58
work nostate	−0.47	1.7	−0.17	−0.36	−0.71
unemployed	−0.77	3.5	−3.6	−1.0	1.9
inact pension	−0.14	−0.033	0.0051	0.071	0.093
inact no pension	−0.24	0.68	0.57	0.37	−1.4

Table 2.5: Transition rates using st2 states in 1993-1995 and difference between 2004-2006 and 1993-1995 values - 40-64 year old women (percentage)

1993-1995	work	nowork nopens	nowork oldage	nowork disability
work	97.0	1.8	0.68	0.31
nowork nopens	4.0	94.0	1.0	0.91
nowork oldage	0.58	0.051	99.0	0.089
nowork disability	0.71	0.11	0.27	99.0
difference	work	nowork nopens	nowork oldage	nowork disability
work	0.95	−0.71	−0.21	−0.032
nowork nopens	1.3	−1.6	−0.05	0.31
nowork oldage	−0.27	0.049	−0.45	0.67
nowork disability	−0.056	0.16	0.89	−1.0

Table 2.6: Transition rates using st3 states in 1993-1995 and difference between 2004-2006 and 1993-1995 values - 40-64 year old women (percentage)

1993-1995	work nopens	work pens	nowork nopens	nowork pens
work nopens	98.0	0.079	1.9	0.49
work pens	0.54	91.0	0.0	8.3
nowork nopens	4.5	0.046	93.0	2.3
nowork pens	0.043	0.57	0.056	99.0
difference	work nopens	work pens	nowork nopens	nowork pens
work nopens	0.5	0.3	−0.74	−0.067
work pens	1.9	1.5	0.049	−3.5
nowork nopens	1.1	−0.01	−1.4	0.29
nowork pens	−0.014	−0.11	0.12	0.0078

2.4 Parametric estimates of transition probabilities

Nonparametric analysis is simple and requires few assumptions, but it limits the extent one can look at details governing the underlying changes. In order to do this, now we turn to parametric estimation of the effect of covariates on transition rates that could not be taken into account before. Looking at the effect of both age and schooling for example allows us to separate the effect of retirement regulation (which will show up as an age effect at a given time) and the effect of improved schooling of the affected population. Indeed, we have seen considerable changes in this regard: whereas the share of those with at most primary school was 14 percent among women between 1993 and 1998, the same share is only a little more than 5 percent after 2002. At the same time, the share of higher education graduates have increased from 9 percent to 13.5 percent over the same time period. Breaking down the first row of Table 2.4 on the previous page by education, we can observe substantial differences in both the level and the change in transition rates. According to the differences shown in Table 2.7 on the following page, less educated women are much more likely to exit work than the better educated. In particular, the possibility of their entry to nonpensioner nonemployment is twice, the possibility of entry to disability pension is three times as high in the first period. It is apparent that the overall decrease in transition rates into disability is substantial in the case of the less educated, but it is almost zero for the better educated. Also small in absolute sense, a similar pattern is observable in the case of transitions to old-age retirement too. When judging quantities however, do keep in mind that these are around 25 and 32 percent changes and the estimates are coming from around ten thousand observations and are thus very precise. A much bigger change in absolute terms, transitions from work to nonpensioner nonemployment, such as unemployment has decreased considerable by the second period. Although similar in absolute terms, the 0.7 percentage point drop translates to 60 percent in the case of the more educated, but being only 40 percent in the case of the less educated.

Education is only one of the different attributes affecting transition between states. Looking at different attributes' effect on transition probabilities, one can get a better view of the separate contribution age, schooling, local employment chances and so on. Looking at transitions, estimates are affected by individuals actually moving across states, hence more genuine age effects are picked up than estimating state probabilities in the cross section. Because there are potentially a lot of relevant attributes, we now move on to their multivariate analysis.

Table 2.7: Transition rates from "working" state by schooling level - 40-64 year old women

Present	Next period			
	Working	Not working, has pension?		
		no	old-age	disability
	Less than secondary education			
1993-1995	96.76	2.39	0.40	0.45
2004-2006	97.69	1.67	0.33	0.31
	At least secondary education			
1993-1995	98.3	1.2	0.34	0.16
2004-2006	99.03	0.46	0.36	0.15

Because pensioner inactivity seems to be an absorbing state, we are mostly interested in inflow to pensioner state from work and nonpensioner nonemployment and also the change in outflow from nonpensioner nonemployment. Keeping the same focus as before, we again restrict our sample to the part of the population past the age of 40 and use the st1 state space, separating unemployment and the two types of pensioner status. Estimating the models, we shall stay in the framework suggested by the Markov transition process outlined earlier and use a multinomial logit specification to estimate it. Estimating the discrete choice model should in principle proceed with the least restrictions, offered by the multinomial probit model. Given the large number of observations and four possible outcomes however, multinomial probit estimation and the computation of average marginal effects would require considerable computational resources. Multinomial logit on the other hand poses a more tractable problem. Although it is a more restrictive and a theoretically less appealing model, its main disadvantage, the lack of allowance for cross-alternative correlation between unobserved effects, can be checked relatively easily. To perform such a check, we simply run a set of per-alternative linear probability models as a system. If the resulting correlation of the unobservable effects, approximated by the residuals, is close to zero, one can use the multinomial logit model with greater confidence. Low correlations is the result we obtain here with the actual numbers being around 0.03-0.06 across states for men (not shown here). Calculation of standard errors is corrected for clustering in all cases takes account of the potential serial correlation across spells belonging to the same individual.

When selecting covariates for inclusion on the right-hand side of the model, we can think in the framework of an extended model of dynamic labour supply, where the individual is making a decision in every time period about continuing work, searching for a new job, or entering retirement. Staying on the labour market, individuals' net benefits are determined by available human capital (schooling), conditions on the local labour market (local unemployment rate), other costs, such as the presence of children, partner's status if present (coded as the combinations of working/nonworking nonpensioner/pensioner) and other individual characteristics, such as age. Age plays a double role here, showing the effect of both age and retirement ages. Assuming that age effect have not changed too much over time, the differences between the two time periods' estimates show the change in retirement regulation. Despite these characteristics are selected so that they are in line with a possible economic theory, my ambition here is not to create or estimate a structural model (such as the one presented in the next or in the fourth chapter), the impacts can therefore be understood as mere correlations.

The full estimation results are shown in the Appendix. Estimates for the 1993-1998 and 1999-2006 period, for men and women and for the "working" and the "nonpensioner nonemployed" as a starting state are shown in Table A.8 on page 133 to Table A.14 on page 139. These tables give average marginal effects, rather than parameters or marginal effects at averages of variables. Average marginal effects are calculated by evaluating the regression equation for each individual and every variable except for the one in question. In the case of continuous variables, individual-specific derivatives can be calculated directly from the resulting equation, providing us with the marginal effect sought. In the case of discrete variables, the marginal effect is computed as the difference between the value of the equation when the discrete variable is 0 and the value of the equation when this variable is 1. These calculations provide us with a marginal effect for every variable and every individual - a distribution of marginal effects. Calculating the mean of this distribution yields the average of marginal effects as a concise summary. As opposed to parameters, average marginal effects have a direct interpretation as contributions to differences in transition probabilities. Unlike marginal effects computed at the mean of the variables, which correspond to a nonexistent set of traits, average marginal effects have a neat interpretation of the summary of the population behaviour (this feature is especially attractive when working with discrete variables, where inserting shares into a nonlinear equation is not attractive). We have to note that most of these estimates are precise but due to the small relative number of transitions, the predictive power of the model is very weak. This is not a very appealing feature, but with raw transition rates below 0.01, it is a quite common feature of such models.

Given the sheer number of effects estimated, at first I go through only the case of women exiting work, but looking at the contribution of all covariates. The relevant table 2.8 on page 42 is also brought forward form the Appendix. Firstly, we note that education plays a role in all transitions, but to old-age pension. In other cases, the most significant difference appears between those without primary education and the rest, but the propensity to stay on job is increasing with education in general. Age indicators are significant in the case of staying on job and exiting to pensioner nonemployment. They show a jump after the age of 55, consistently with the prevailing pension age and starting to decrease immediately after that. By the age of 60, the effect is halved. Surprisingly, being employed by a state-only employer versus elsewhere increases the chance to stay on job. One explanation to this firstly is that quite a few former employees were forced to take up entrepreneurship (the reference group), secondly the privatisation was over during the larger part of the period, and the remaining state-only workplaces (hospitals, schools, administration, etc), encouraged a longer working life. Being the parent of a dependent child has a measurable negative effect only on the transition to old-age pension, emphasizing the income requirement coming with a child. Somewhat surprisingly, having a nonworking nonpensioner spouse encourages transition to old-age pensioner nonemployment. Having a nonworking spouse also makes transition to nonworking status more probable, even if we are controlling for the age of the partner, which has an effect similar to the one found with the individual. Finally, regional unemployment rate (in percentages), our proxy for local labour market conditions, show a positive effect on transition to all nonemployment statuses. Its effect is the greatest on old-age pensioner nonemployment, has a somewhat smaller effect on disability pensioner status and no effect on nonpensioner nonemployment. Given that it is measured in percentage points, the effect can be considered as moderate.

There are noteworthy changes in the impacts over time. Firstly, the effect of education is not differentiated among the post-primary educated, merely separates them from those having only primary or less education. The divide is clear, appearing for all, but the old-age pensioner receiving state. It is the strongest in the case of nonpensioner nonemployment, contributing largely to transition chances of the less educated individuals. Age has a very strong effect on the probability of exit from work, now starting to increase after age 56, in line with the increase of retirement ages. It is important to note however, that beyond this shift in the start, also impacts at later ages have increased and thus do not go down as it was the case in the first period. After the age 59, the outflow rate contribution is fairly stable and remains so until 62. Changes in other aspects are not too great and do not point to any specific direction.

Men's results are very similar to women's in general, but there are notable differences. Educational effects behave similarly both in the cross section and over time, except that education loses its impact in the second period in the case of the transition to disability pension. Age effects seem to have a peak at 60 in both periods and probabilities do flatten out or even go down a bit in the second period. Unlike similar women, men employed with state-only employees do not have the employment stability advantage, and this even turns to

Table 2.8: Multinomial logit estimates of the probability of entering st2 states when working in t - 1993-1997 period, 40-64 year old women; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+ lower vocational	0.0156^{***}	-0.0144^{***}	0.000909	-0.00217^{**}
	(0.00270)	(0.00219)	(0.00137)	(0.000902)
Educ: secondary w. maturity	0.0198^{***}	-0.0175^{***}	0.00132	-0.00367^{***}
	(0.00217)	(0.00145)	(0.00159)	(0.000447)
Educ: higher	0.0215^{***}	-0.0174^{***}	-0.00145	-0.00271^{***}
	(0.00162)	(0.000895)	(0.00129)	(0.000449)
Age: 53	-0.0314^{***}	0.0106^{***}	0.0209^{***}	-0.000118
	(0.00721)	(0.00413)	(0.00624)	(0.00109)
Age: 54	-0.0692^{***}	0.0181^{***}	0.0512^{***}	$-8.98e-05$
	(0.00850)	(0.00487)	(0.00743)	(0.00106)
Age: 55	-0.140^{***}	0.0467^{***}	0.0941^{***}	-0.000879
	(0.0141)	(0.00910)	(0.0122)	(0.00112)
Age: 56	-0.0987^{***}	0.0100	0.0920^{***}	-0.00329^{***}
	(0.0159)	(0.00778)	(0.0146)	(0.000235)
Age: 57	-0.0922^{***}	-0.000611	0.0946^{***}	-0.00174
	(0.0170)	(0.00713)	(0.0160)	(0.00108)
Age: 58	-0.0692^{***}	-0.0143^{***}	0.0868^{***}	-0.00327^{***}
	(0.0180)	(0.00374)	(0.0177)	(0.000235)
Age: 59	-0.0755^{***}	-0.00336	0.0821^{***}	-0.00325^{***}
	(0.0202)	(0.00857)	(0.0188)	(0.000235)
Age: 60	-0.0696^{***}	-0.0136^{***}	0.0864^{***}	-0.00327^{***}
	(0.0211)	(0.00442)	(0.0208)	(0.000235)
Age: 61	-0.0457^{***}	-0.0180^{***}	0.0646^{***}	-0.000917
	(0.0165)	(0.000556)	(0.0165)	(0.00164)
Age: 62	-0.0641^{***}	-0.0180^{***}	0.0854^{***}	-0.00328^{***}
	(0.0200)	(0.000556)	(0.0200)	(0.000235)
Age: older than 62	-0.0638^{***}	-0.0139^{***}	0.0811^{***}	-0.00337^{***}
	(0.0188)	(0.00291)	(0.0186)	(0.000237)
Employed: purely state-owned	0.00945^{***}	-0.00663^{***}	-0.00224^{***}	-0.000577
	(0.00124)	(0.000986)	(0.000595)	(0.000488)
Employee	-0.00881^{***}	0.00679^{***}	0.00349^{***}	-0.00148^{***}
	(0.00249)	(0.00215)	(0.00116)	(0.000570)
With dependent child	0.00183	0.000716	-0.00193^{**}	-0.000613
	(0.00123)	(0.000787)	(0.000901)	(0.000380)
Partner: working with pension	-0.0115^{**}	0.00208	0.00133	0.00809^{***}
	(0.00474)	(0.00366)	(0.00138)	(0.00270)
Partner: not working, no pension	-0.0144^{***}	0.00991^{***}	0.00385^{*}	0.000623
	(0.00345)	(0.00263)	(0.00216)	(0.00100)
Partner: not working with pension	-0.00843^{***}	0.00607^{***}	0.00165	0.000707
	(0.00226)	(0.00186)	(0.00106)	(0.000794)
Partner: age	-0.000264^{*}	$-3.55e-05$	0.000208^{***}	$9.18e-05^{*}$
	(0.000154)	(0.000128)	$(7.51e-05)$	$(4.73e-05)$
Unemployment rate in the the small region (%)	-0.00114^{***}	0.000479^{***}	0.000319^{***}	0.000345^{***}
	(0.000186)	(0.000155)	$(8.20e-05)$	$(6.25e-05)$
Observations	57960	57960	57960	57960
Pseudo-R2		0.1		

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

a disadvantage in the second period. Other covariates, such as partner's activity, age and the local unemployment rate shows no substantial differences between the two sexes.

Previously we have noted an interesting, but not well defined pattern of transitions to retirement. If looked at a relatively narrow interval of one quarter, one finds that some individuals transit to a nonpensioner nonemployed state before becoming pensioners. Because of this and because of the worries associated with potential difficulties individuals might be facing after the stricter retirement regulations, it is also worth looking briefly at outflows from nonpensioner nonemployment. The estimation results give indirect answers to these questions. Firstly, a pattern relatively stable across time periods suggest that men and women behave differently in this respect. Transition from nonpensioner nonemployment to a pensioner one really does take a "detour" in case of men, where transition to old-age pension probabilities increase some 3 years before retirement age along with a drop of transition to work rates. The latter drop in transition to work is noticeable in case of women too, but it starts *after* the legal retirement age. Transition to pension rates decrease here, instead of increasing and stability of the nonpensioner nonemployment status increases. As opposed to men's story, this suggests a situation where "missing the boat" of retirement puts the affected individuals in a rather difficult situation. Even though the actual number of affected women is relatively small, this difficulty have to be kept in mind when thinking about older-age security.

Schooling plays a similar role here as it did in the case of transitions from work: important in the first period, making the more educated more successful in escaping, but this difference fades away in the second period. Local unemployment rate has a small positive, but significant effect on transition to disability pension, and an older partner makes transition to old-age pension more probable independently of own age. Also, a nonemployed partner makes transition to work less likely, holding everything else constant.

It is peculiar to the nonemployed state that we have data on job search available. Wanting a job makes transition to work more, while staying nonemployed significantly less probable. Availabilty makes transition to work more, and usage of disability pension less probable, which, supposing that disability has a health condition background, is expected. Finally, job search has the same effect as wanting a job both in terms of significance and size of the effect. In the case of men, it also decreases the chance of transition to old-age pension in both periods.

What can we make of the changes in transition probabilities, after all? We have started with the observation that the per-1998 and post-1998 periods are very different in Hungary, the former being characterised by the end of the privatisation, the latter by introduction of increasing retirement ages. After 1997, employment rate of older people have risen considerably, and at the same time, transition rates out of work to both pensioner and nonpensioner inactivity have decreased. Parametric estimation of transition rates have showed a number of interesting features. Firstly, it appears that transition chances to and out of employment are strongly and monotonically affected positively by education in the first, but not so much in the second period. There the difference appears mostly between the relatively few primary educated and the others. Age, mostly capturing the availability of old-age pension, have a strong effect in both periods, tracing the shift in retirement ages. Family relations and search behaviour have an expected and mostly unchanged effect. Regional unemployment rates show a positive correlation with transition to both type of retirement, lessening in importance in the case of old-age pension, but not in the case of disability. The former observation is in line with old-age pension being relatively easily available during the transition, but stricter afterwards, while the latter reflects the results showed on the county level by Scharle (2008). In the case of men, there is a sign of an indirect retirement path through non-pensioner nonemployment, while in the case of women, we mostly see serious employment difficulties in the case of those unable to retire when most do so.

2.5 Conclusions

The economic transition brought about an inevitable depression of the economy in all eastern-central European countries. Different countries "reacted" differently to this situation – by plan or by chance, we do not know exactly – developing different institutional structures. In Hungary, privatisation was rapid and thorough, resulting in lots of jobs being destroyed, but only a fraction of these being created. The net loss in jobs was absorbed by the pension system, which was tuned accordingly. Old-age pension was available early in most cases and disability pension was available under forgiving conditions. The end result was a mass of older people quiting the labour market between the age of 53-58. This system did not contribute only to creating one of the lowest employment rates in Europe, but also left a heritage of early retirement to Hungary.

After the pension reform of 1997, old-age retirement ages were set to increase gradually. Employment rates have begun to increase both for older people and the whole population as such. Despite of the important role the pension system played in shaping employment conditions both during the transition and after it, there were no sources of stylised facts available. This chapter tried to provide such a collection in four parts. After the description of the Hungarian pension system from a labour market point of view, we looked at microdata to characterise the employment and transfer status of the 25-64 population both before and after the pension reform. Comparison of multiple combinations of the two statuses showed that the reform has changed employment behaviour of both men and women, but especially that of the latter, given that the regulatory change for greater for them. Cohort profiles showed that the overall increases happened in line with the regulatory changes, inducing reaction of the cohorts "it should" on paper. We could not detect either a re-direction of exits towards disability pensions or a generally worsening situation in terms of unemployment.

To understand the pathways to retirement and the source of the changes, we looked at transitions of the 40-64 population between different states. Average transition matrices of the different labour market-transfer status states have revealed that in the post-2000 period, employment became more permanent than before and transitions to pensioner or nonpensioner nonemployment less frequent. The transition of the unemployed to work has became more likely, but also that into nonpensioner nonemployment, suggesting that besides the generally improving employment situation, a number of individuals can not cope with the new, more competitive situation. The number of working pensioners was never too big, but this has increased slightly. Raw differences suggested relatively large differences in these changes in transition rates among groups defined by schooling or age. Given the changes the Hungarian society went through affected education, family life and the work environment too, I used parametric estimation to separate the effect of compositional change from that of the change of transition probabilities. Results show that after the 1997 reform, employment became more stable for most individuals, increasing education and the changing retirement rule both making people attaching more to jobs or if losing them, trying to get a new one with greater vigilance than before. Although the evidence is only descriptive, it seems that the new pension regulation, along of course with the changed environment, has strengthened older people's attachment to the labour market. The cost of this must be paid by those who can not keep up with the change and appear as entering the relative hopeless state of nonpensioner nonemployment after the retirement age has passed.

Chapter 3

Strategic social policy in action? Financial incentives in the Hungarian pension system

Ageing in industrialised societies has made the operation of pension systems one of the main subject of interest for economists in the recent years. Fiscal concerns for the sustainability of pay as you go schemes is perhaps the most widely discussed topic. Given a particular pension system, sustainability is determined to a great extent by the economic dependency ratio in the society, which is in turn heavily dependent on the employment rate. However, the interdependence between pension systems and the labour market is not one-way only. Because the availability and replacement rate of pensions determines the opportunity cost of employment for large parts of the society and for older workers in particular, the pension system itself can have an effect on labour market behaviour. This chapter discusses this effect empirically in Hungary using data from the years after the economic and political transition.

The economic transition in Eastern-central Europe was very peaceful. Almost no substantial industrial action or demonstration took place and there was virtually no opposition to the reform-policies governments put forward. Different countries followed different strategies during the transition, making early and large-scale privatisation only one of these. Still, peace has prevailed even in Hungary, the forerunner of this approach. Considering the number of workers affected by privatisation and inevitable mass-layoffs following them, such a passive behaviour is unprecedented. This is most surprising given the experience of organised workers' actions in countries facing similarly grand economic changes. At the same time, social security and pension expenses in particular are reaching very high levels in CEE countries and, as shown in chapter 2, inactivity connected to pensioner status has reached outstanding levels too. It is not clear if this apparent co-relation is a result of explicit strategic decision making, or that of a string of independent, but mutually supporting decisions. Whether or not this conjecture is correct has other consequences than knowing history better.[1] If the pension systems were actually designed, or let to be designed in a way to easily help out those unsuccessful on the labour market, it is straightforward to explain the unprecedentedly high level of inactivity in some CEE countries and also to pinpoint the features of the pension system that are inevitable to fix.

The recent discussion in Vanhuysse (2006) is built around the hypothesis that social policies after the transition were designed deliberately to pacify otherwise disruptive movements. Although the idea has already been explored elsewhere (see Gere (1997) in Hungarian, for example), this is the first systematic work built on this framework to my knowledge. The two main questions of the problem are a) what could have been the outcome in a specific country, had it not chosen the policy it did and b) why is the Czech Republic different from Hungary and Poland also in structure of employment. From an empirical economist's point of view, it is clear that because of the lack of appropriate data, these questions can not be answered rigorously, ie. by finding a counterfactual and comparing the observed outcome to that. All we can do is to extrapolate our a priori knowledge to the case at hand. Vanhuysse does exactly this in the field of political economy. He develops his argument by considering other large-scale changes and looking at the rationality of observable actions. He first notes that in the transforming CEE countries, everything was together for a political Molotov-cocktail to explode into a series of protests. This initial condition prompted action, which had to take care of dissolving the potentially protesting mass of threatened workers. Vehicles for this were

[1] Augusztinovics (1999) among others argues for the causality is running from the serious drop of employment to the relative loose pension regulations and thus to unprecedented pension expenses. Given the data available, it is not clear which explanation is correct. Because of this, the current chapter and indeed any analysis relying on econometric techniques in general will not be able to overcome this limitation.

the unemployment benefit and the pension system. The former started loosely and became strict over time in almost all countries. The latter generated masses of retirees mostly in the form of old-age pensioners in Poland and in the form of disability pensioners in Hungary. This is the reason why looking at the motivations embedded in the pension system of these countries can be interesting if we want to learn about the plausibility of the hypothesis.

Designing and running pension systems that allow the easy retirement of a large part of the workforce can be suboptimal from a purely economic point of view, but given the political economy background, it might actually be sensible. Although the proof is somewhat loose and there is no real explanation for why the Czech Republic is so different from Hungary and Poland, the core idea of Vanhuysse (2006) is worth keeping in mind. Pension systems, quite like those in the western European countries after the oil shocks, were most probably designed to absorb workers threatened by the transformation:

> "But given the non-random nature of transitional unemployment and the political threat it represented, this policy nevertheless allowed a convenient degree of ≫self-targeting≪according to two micro-level traits: individual-specific uncertainty, and risk aversion." "...moving from labor market status to welfare recipient status inevitably involved immediate material losses. But the relevant calculus for workers to make was to see which decision would allow the highest stream of income as discounted over the foreseeable future."

We shall not be able to decide if the explanation of Vanhuysse (2006) is correct or not. We can, however, attempt to show if the incentives in the pension system are compatible with his hypothesis. Results from reduced form estimates of transitions to pensioner status in chapter 2 have shown that individual characteristics strongly predicting retirement are similar to those correlated with low wages and poor labour market performance in general (low education, residence in regions with low employment). My aim here is to provide estimates to these transitions with more structure and show the effect of these characteristics through expected income in pensioner and non-pensioner status. In order to do so, I use survey data on transitions to retirement and realised personal income over the 1992-2002 period because administrative data, or any data collected with this purpose in mind is absent in Hungary. Nevertheless, the use of such information is a considerable improvement over using LFS data only, which unfortunately contain no income-related information in Hungary. Although these data refer to the period after the times of the greatest outflow to pensioner status, changes in pension regulations were mostly parametric (see Simonovits (2008), for example), introducing changes in the structure of incentives mostly through changes in the legal retirement age.

After this introduction, I sketch a theoretical framework that motivates the model underlying the empirical estimates and helps us separate the income effects through which the individual characteristics operate. The basis for this is the option value model of Stock and Wise (1990). Unfortunately, because of the lack of suitable data, their method can not be applied to the Hungarian case directly and has to be simplified. In the third section, I modify the original model and lay out an estimation strategy that relies on a simple probit equation and a selectivity corrected estimate of expected future income. The fourth section discusses data and definitions. The fifth section presents estimates from the reduced form and structural equation as well. The last, sixth section concludes.

3.1 A theoretical framework

Simple correlations showed in Chapter 2 that working individuals, especially women, are more likely to enter pensioner state if they have below-higher education and if they are living in areas where the local unemployment rate is high. This is true for men as well, even more in the case of disability than in the case of old-age pension. Although we know that these individual characteristics affect labour market prospects, we need at least a simple model to sort out the ways they operate. To study the retirement decision, I shall use the general framework of the option-value model of Stock and Wise (1990), a standard workhorse of retirement-research. In the transition setting, this model can be thought of one of the decisions the individual is facing in the Boeri (2000) model after being laid off from work. The option-value model is one of intertemporal choice: an agent has to choose between two mutually exclusive states. In state W, the individual-specific Y_t income is risky and is coming from employment only, while in state R, income P_s is fixed and it comes from pension benefit. The agent lives until time T and has to make an irrevocable decision about the timing of to move from W to R. This decision can be translated to a series of possible decisions in every time period t to retire or not. Earlier retirement means that the secure, but potentially lower income stream starts earlier, forgoing accrual if available when retiring later. The fact that R is an absorbing state and no work is possible in R is key to the analysis. This assumption does not only make the theoretical model tractable, but is also empirically relevant. Because of this, the option to switch in the r-th period has the value $V_t(r)$ in the t-th period is given by

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} U_W(Y_s) + \sum_{t=r}^{S} \beta^{s-t} U_R(P_s)$$

where β is a discount factor describing time preference and is constant for everyone, i is the interest rate, U_W is the per period utility function applicable during work, U_R is the per period utility function applicable in pensioner status and V is the lifetime utility function. In every period, a decision has to be made whether it is worth retiring in t, or postponing retirement to the later time of r. The expected positive gain to be realised by entering pensioner state for every r can be simply formulated as

$$G(r) = E_t[V_t(r)] - E_t[V_t(t)].$$

The decision is based on whether $G(r)$ is the greatest in the current period among all possible times of retirement. If it really is the greatest, retirement is optimal in t and is thus chosen. The authors have examined the impact of the structure of US occupational pensions on retirement, and their results indicate that both salaries and pensions have a strong, but different effect on the incentives to retirement.

Estimation of the option-value model can proceed along two avenues. The rigorous way is the application of a full-fledged dynamic programming procedure and estimating the parameters of the model through simulation. A theoretically less rigorous approach is estimating a simple probit equation instead. Being attractive because of its considerably lower need of processing power and time, this procedure was shown by Lumsdaine et al. (1990) to be very close to those obtained from a dynamic programming exercise, provided that the motivations – expected incomes and social security wealth – are well-specified.

A main component of the motivations for claiming pension is the expected income streams in the different states. The option-value model has been developed and first used to explain the incentive effects of firm-level pension schemes. It was subsequently applied to other environments, such as social security pension schemes in Europe. In the case of Germany for example, Börsch-Supan et al. (2002) uses the option-value framework to look at the incentive effects of early retirement programmes. Both applications of the option-value model rely on wage forecasts to predict future income paths in the case of no retirement. Looking at retirement from firms in regular ages, many people are very close to retirement and have a reasonably foreseeable wage path (if we do not consider exit from the firm to a nonpensioner state). Nevertheless, in the case of early retirement – a form of retirement often used in the transition countries –, both the time horizon (by definition) and the size of the risk taken (because of the probably selected nature of the group of people considered) is much larger. Despite working with individuals close to normal retirement age, Stock and Wise (1990) exploit the benefit of having individual income histories within the firm and thus can predict future wage evolution well. Börsch-Supan et al. (2002) circumvent this problem by concentrating on civil servants, whose wage and pensions structure is quite rigid. Because of this, although there is no information on complete work histories available, the expected pension and social security wealth is still possible to calculate.

3.2 An operational model

The data required for estimation of the option-value model or any complete model of the retirement decision is unfortunately not available in many countries and Hungary is one of these. Administrative records of course hold the necessary information for computing pension in the case of individuals having actually applied for it, but those are not accessible for research at the moment and can not be linked to contextual information either. As there is no specialised survey running that would specifically look at older people (such as SHARE in the EU or the HRS in the US), one can only resort to general purpose ones. The data set I rely on will be described in the next section, but we have to note in advance that it provides suitable information for one individual in only two consecutive time periods. This is satisfactory as a bare minimum, but is not enough to calculate either social security wealth or expected pension. This means that the option-value model is inapplicable in its original form – our task is therefore to develop a less ambitious, but still informative framework in which the effect of economic incentives can be studied. One can see such a model as a modification (simplification) of the original option-value framework.

In the modified model, agents face the same decision problem as considered in the option-value model – choosing between the mutually exclusive retired (state 1) and non-retired (working, state 2) states. Our interest focuses on the equation describing the decision upon the transition to pensioner status. To make timing a little bit more precise, we can say that the decision relates to the state in $t+1$ and is made during period t when all information from that and subsequent periods is known, but no information is released about period $t+1$ yet. Formulated as a simple binary index model, the decision is driven by the expected utility in the two states, including the expected income levels $\mathrm{E}_{t-1}(y_{0it+1}|\Omega)$ and $\mathrm{E}_{t-1}(y_{1it+1}|\Omega)$, as well as a set of additional observable characteristics of the state that we denote by Z_{0i} and Z_{0i}, respectively as well as two unobservable factors v_{0i} and v_{1i}:

$$I_{it+1} = \begin{cases} 0 \text{ if } V_{0t+1} \geq & V_{1t+1} \\ 1 \text{ if } V_{0t+1} < & V_{1t+1} \end{cases}, \qquad V_{jt+1} = \mathrm{E}_t\left(y_{jit+1}|\Omega\right)\alpha_j + Z_{jit+1}\gamma_j + v_{jit+1} \tag{3.1}$$

where Ω is the set of information the expectation is conditioned on. Focussing on the outcome of transition to pensioner status, rearranging the equation, and re-writing it in terms of probabilities, we get

$$\Pr(I_{it+1}=1) = \Pr\left[\mathrm{E}_t(y_{0it+1}|\Omega)\alpha_0 - \mathrm{E}_t(y_{1it+1}|\Omega)\alpha_1 + Z_{0it}\gamma_0 - Z_{1it}\gamma_1 < v_{1it} - v_{0it}\right] \quad (3.2)$$

$$\Pr(I_{it+1}=1) = \Pr\left[\mathrm{E}_t(y_{0it+1}|\Omega)\alpha_0 - \mathrm{E}_t(y_{1it+1}|\Omega)\alpha_1 + Z_{0it}\gamma_0 - Z_{1it}\gamma_1 < v_{it}\right] \quad (3.3)$$

$$\Pr(I_{it+1}=1) = \psi\left[\mathrm{E}_t(y_{0it+1}|\Omega)\alpha_0 - \mathrm{E}_t(y_{1it+1}|\Omega)\alpha_1 + Z_{0it}\gamma_0 - Z_{1it}\gamma_1\right], \quad (3.4)$$

where $v_t = v_{1it} - v_{0it}$ and ψ is a distribution function. From another point of view, this is a decision is upon which equation will describe the income flow of the individual in the future, besides the other characteristics the chosen state has. Income is given by a set of autoregressive equations conditional on the state when the decision is made:

$$y_{0it+1|I_{it}=0} = X_{0it+1}\beta_0 + y_{0it}\rho_0 + u_{0it+1}, \quad (3.5)$$

$$y_{1it+1|I_{it}=0} = X_{1it+1}\beta_1 + y_{0it}\rho_1 + u_{1it+1}, \quad (3.6)$$

$$y_{1it+1|I_{it}=1} = y_{1it}\delta \quad (3.7)$$

If the individual does not make the transition to pensioner status in time t, his or her income $y_{1it|I_{it}=1}$ is determined by previous period's income y_{1it-1}, other personal and local market characteristics X_{1i} and a stochastic term u_{1i} as stated in equation 3.7. The reason for this choice is pragmatic and is driven by the availability of data for two periods only. Because there is no longer data set available for the study of income processes in Hungary and hence no study to support the validity of this approach, we have to assume that this ARX(1) specification captures income dynamics to a sufficient extent. When the transition to pensioner status is made after a period of work, the level of pension $y_{0it|I_{it}=0}$ is determined by the pension authority on the basis of previous earnings y_{1it-1}. Although the reference period in real life is longer than this, scarcity of data requires us once more to limit the influence of earnings only to one period as stated in equation 3.6. Given that last period's income can be less representative in the case of some individuals than in the case of others, this relationship warrants closer scrutiny during empirical analysis. In order to approximate the missing information on labour market history, also this income equation features a set of individual characteristics X_{0i} and a stochastic term u_{0i}. Finally, if the individual makes the transition to pensioner status, then there is no uncertainty by assumption and the pension is being incremented with a known and certain factor δ, as stated in equation 3.5. This formulation says implicitly that once retirement is chosen, work is precluded and also that the starting pension level determines the value of the pension over the remaining lifetime – provided of course, as we assume for simplicity – that the length of the lifetime is known in advance. This specification is missing the possibility of changes in the pension formula as well as increases and decreases in the value of the pension, that is political risk of the state pension system. Such – dominantly aggregate – shocks will be handled in the empirical specification. The advantage is however that it makes fist period pensioner income a sufficient statistic to assess the complete pension wealth under the current conditions. Because empirical results of Chapter 2 suggest that the pensioner state is effectively an absorbing one and there is therefore no possibility of choice in that case, these three equations describe incomes in the complete state space considered here.

Predicting pensions this way clearly does not correspond to the official formula, but data availability prohibits it exact replication. In the case of working income, our method is comparable to what has been done before in the literature. The wage model is first-order autoregressive with individual characteristics included – similarly to the model of Stock and Wise (1990). The substantial difference compared to their method is that individual trends in wage growth are not observable with our data. In particular, the pension calculation method includes a stage called "valorisation" that adjusts starting pensions relative to wage and price growth. As a result of this adjustment, people retiring in the beginning and middle of the 1990s suffered from low starting pensions, and such changes shock has to be represented in the estimation procedure. Even if the formulation is simple, it has to allow for differences in the method of calculation that relate to this changing environment.

To complete the model, we specify its stochastic structure as well. For the sake of simplicity, we assume that conditional on the observed X_0, X_1, Z_0 and Z_1 variables the disturbances are normally distributed:

$$v, u_0, u_1 \sim \text{ii}N(0, \Sigma), \text{ where } \Sigma = \begin{bmatrix} \sigma_v^2 & & \\ \sigma_{u_0 v} & \sigma_{u_0}^2 & \\ \sigma_{u_1 v} & \cdot & 1 \end{bmatrix}. \tag{3.8}$$

Because of income receipt in the two states are mutually exclusive, their covariance is not defined. Note that the model defined by the set of equations 3.1 on page 53 and 3.5, 3.6 and 3.7 on page 54 is a switching regression model, similar to the union- non-union wage model of Lee (1978) or others following the same structure presented in Maddala (1983). The fact that X_{0i} and X_{1i} are not the same here does not change much and only helps identification.

3.3 Data and estimation method

This study relies on the HHBS Rotating Panel of the Institute of Economics, Hungarian Academy of Sciences, based on the Hungarian Household Budget Survey (HHBS) of the Hungarian Central Statistics Office. The original HHBS has been running since the 1970s, but it is only after 1993 that it is possible to track individuals over time and hence this is the time period we shall be looking at.[2] The primary sampling unit of the survey is the flat, and every person in the flat is surveyed. There is variation over time in the sample size: a cross section consists of 8 to 10 thousand households, which translates to 22-26 thousand individuals. The survey provides detailed information about the demographic and key labour market characteristics of the entire household, and the incomes of the various individuals, including the income/consumption arising from own production. Income data is collected during a diary-keeping period, along with consumption and also in the spring after the reference year, close to the deadline of filing the tax record.

The HHBS is principally a cross-section, but in order to keep the sample "fresh", the HCSO implements a rotating design through 3 years. Although the HCSO usually does not

[2]Strictly speaking, there is a set of files from 1987, 1999 and 1991 that already refer to individuals and might be possible to connect on the basis of observable characteristics. Initial attempts showed that this is not possible in a reliable way, hence using data from this period can not be considered.

assemble the panel elements into a real panel dataset, there is enough information to do so. György Molnár, senior researcher at the Institute of Economics, Hungarian Academy of Sciences has created the HHBS panel, dubbing it the Rotation Panel (Molnár, 2005). The specific rotating structure means that if a household enters the sample in wave 1, it remains there theoretically until wave 3, and leaves it thereafter. In practice, this means that in the periods of 1993–1995, 1996–1998 and 1999–2001 the data of the various households and, unless the composition of the households has changed, also of their members can be connected into three separate but identically structured panel database.

Although Molnár put considerable effort to build the three-year panel data sets, his activities uncovered substantial problems, stemming partly from the fact that the HHBS was originally not intended to be panel survey. Molnár (2006), an unpublished note characterises the over-time changes and regional distribution of response rates, as well as the attrition in the panel he assembled. Results show that besides the high rate of nonresponse already apparent in the cross-section – especially in Budapest, where the response rate can be as low as one third instead of the 60 percent overall rate –, there is heavy attrition observable in the panel over time. As a result, the three-year panels represent only 25-17 percent of the original sample instead of the theoretical one-third. The author also observes that the attrition is not random, as it is the high-income and better qualified individuals and their households that "get tired" from participating in the survey and dropping out of it. Being interested in income mobility and also in the calculation of estimates of levels of key variables, Molnár put a lot of effort into cleaning the three-year panels and implementing a special weighting procedure (iterative scaling) used in the case of household surveys. Unfortunately, because of the three-year panels contain a smaller absolute number of transitions and because I can not use weights in probit estimation, I could not take advantage of the three-year panels and the attached weights, but had to rely on two-year panels instead.

Linking only two years has a considerable advantage: it provides us with considerably more observations, hence transitions too. The two-period panels are built from every possible combinations of adjacent years from 1993 to 2001, except for the 1995-1996 one. However, because the number of transitions is not too large even in the seven 2 wave panels, I have analysed them together ("stacked"), rather than separately. This procedure can be regarded as an extension of the pooled cross-section analysis method. However, as in the case of the pooled cross-sections in general, it is necessary to address the effect of the omission of historical time. I do this by inflating the cash variables to a common point in time (year 2000) and, for regression analyses, by including the various control variables and indicators. There is a cost to the use of two period panels, too. Apart from not being able to take advantage of the cleaned three-period files, the main disadvantage of using two-year panels and using probit estimation is the inability of using weights. The best we can do in this case is to be aware of the direction of potential bias in our results and try to assess its effect on the results.

The resulting stacked database consists of a total of 140,574 spells, that is observations for one individual for one time period that can be linked to another spell either before or after in time. Before using these for estimation, some cleaning had to be done, primarily to get rid of single spells (without future observations), observations with more than 3 spells suggesting false matches. Given that in this Chapter I do not want to deal with problems associated with schooling or those of the elderly, the sample is further restricted to those between 24 and 64 years of age. After this final trimming the data set contains 45,385 spells of individuals within the above age limit, having information also on the next period.

Looking at transitions from working nonpensioner to pensioner status, we have to define these states before we proceed further. Because there is insufficient information available to construct employment status according the ILO-definition, we have to define a "working" state independent of that. Also, a pensioner state has to be defined. Data in income-types are available, therefore it seems straightforward to use that information for both purposes. Because of the structure of the survey, there is a decision to be made in both cases. Although the HHBS collects information on monthly and yearly income, it is not easy to separate the receipt of income components in time. Even though yearly data is more comprehensive and is more precise in principle given its reliance on tax records, the lack of information on the length of the spell to which such data corresponds makes using this data prone to error. A lower level can indicate a truly low level of income throughout the whole year or merely a short spell with high income. Knowing more than one income source does not change this considerably either. Even in the years when total length of the period(s) is known, we do not know the order in which potentially different levels of income was acquired. For example, if we are looking at people who transited to pensioner status mid-year, and see income from both employment and pensions, it is impossible to tell if the individual was at work after making the transition to pensioner state, and if he or she was in fact at work, what was the level of income before the transition and after it. Not knowing the level of income at work seriously decreases the reliability of our prediction of expected pensioner income. Because of this, I use monthly income data, as it is much less likely to bring about such problems. Even though it is probably more contaminated by transitional income shocks, these are most certainly smaller than the distortion brought about by the inability to account for the length of income spells within a year. An initial version of this research used 3 year panels and yearly data to estimate the model, and turned out to be unfit for that purpose because of the low reliability of estimates. Switching to monthly data and two-period panel improved statistical precision considerably.

Knowing what type of income data to use, we can turn to defining the specific states. Firstly, the pensioner state is simply defined as an individual who receives old-age or disability pension benefit in the period considered. Ideally we also would like to differentiate disability and old-age pensioners, as the two retirement routes have potentially different characteristics. This is, however, not possible after 1997, and even if it was, the resulting sample size would be very small in either case (as the available data shows for the pre-1998 period). Because of this, I do not differentiate pensioner types and maintain that the similar pension formulas used in the two groups and the supposedly similar purpose of these schemes (at least for those retiring before the legal age) makes retirement behaviour sufficiently similar. Secondly, we define working state as receiving at least some of their earnings from work. This definition is perhaps the most fit if one tries to match the ILO definition, as one hour of work can yield very little income. Here we have an additional aim however, that is to reliably estimate next period work-related and pension income, therefore we would like to obtain an income value fit for these purposes. In order to do this, we define only those as working, for whom at least 5 percent of total gross income comes from wages or other work-related earnings. The 5 percent cutoff is arbitrary, but reflects on the fact that it is only the extreme right-tail of the work-related earnings distribution where such income constitutes a very small share only of all income. Not considering the trivial cases with a value of zero, this ratio is 43 percent at the first decile of the ratio-distribution with an average of 90 percent.

Using the above concepts, we can define our transition of interest as an individual, who is working and not pensioner in the first period, but is pensioner in the second. In the whole sample, we observe a total of 747 transitions to pensioner status. Estimating the number of employees or pensioners from these data and definitions would probably be a bad idea, as data quality might not be good enough to accurately reproduce levels. Transition rates on the other hand are behavioural variables that might be more stable than levels across population groups, hence less affected by the re-weighting implicit in sample distortions. Focussing on the working 40-64 year olds, a group comparable to results coming from the LFS, we are left with a total of 600 transitions. Unfortunately it turns out that estimates of transition rates is erroneous in this case too. Instead of the year-to year rate of 2.4 percent calculated from the LFS, transitions to pensioner status is estimated at 5.36 percent – more than double of the reference value. Given that the rate of employment was similar in both datasets, this tells us that there are much more of those in the sample who entered retirement than those who stayed at work. The reason for this is most certainly the nonrandom attrition over time connected perhaps to the value of time. Because we do not have information on those exiting the survey, we can merely note this feature and speculate on the influence of variables that drive attrition. Before doing so however, it is best to lay out the estimated model.

In the above, we have used the presence and absence of income-types to define employment and pensioner status, not to infer anything from the actual income levels. When turning to estimating the model, we shall be using a comprehensive income measure comprising of all income and a net rather than a gross one (because of the importance using net incomes in pensions calculations).

As a preliminary step, we shall estimate the reduced form of the decision equation using a probit model. This includes all variables assumed to determine pensioner and nonpensioner income, as well as the probability of making the transition to pensioner state apart from these income variables. The estimation of the actual model proceeds in two steps. Firstly, the income equations 3.5, and 3.6 on page 54, are estimated and expected income values are predicted from them, secondly these predicted values are inserted into the decision equation 3.1 on page 53. Using the predicted income values in the decision equation allows us to estimate the effect of the expected incomes separately from the variables included in Z. As described above, one important difference between already used methods and the one put forward here is that both pension and wage predictions rely on current and *future*, not current and *past* earnings (and only two periods). In other words: although the timing of the model would require us to rely on 3 periods, $t-1$ and t for estimating the income processes and t and $t+1$ to estimate the decision equation, we rely on a sufficient amount of stationarity of the income processes to allow us to shift them forward in time.

If important unobserved characteristics are at work in determining the level of next-period income and sorting people between the two states and they are also correlated with observables, estimating the income equations by OLS gives inconsistent estimates. In the estimation stage, we have to take care of this need for a correction. Having fully specified the conditional distribution of the stochastic components, it is natural to attempt to estimate the system using full-information maximum likelihood, explicitly allowing for a correlation between unobservables. In our case, this strategy has the often encountered numerical stability problems, therefore we revert to a different estimation strategy. Similarly to other switching regression studies, we can exploit the fact that the two states we consider are mutually exclusive and $\sigma_{u_1 u_0}$ is nonexistent. Because of this, the problem reduces to the estimation of two equations with selectivity, sharing the same selection equation. These are following the same logic as the case put forward in the seminal work of Heckman (1979). Note that as the reduced form probits correcting for selectivity are identical, the actual estimates will be numerically identical, except for a negative sign prepending one set of results. As a first step, the equations can be estimated as two-step Heckman models for improved stability. Even though the parameters are formally identified from the nonlinearity of the model, we shall include variables in each equation that are useful in identifying them from independent variation. The variables used in the estimating equations are shown in Table 3.1. Variables used in an equation are marked with X, showing the inclusion and exclusion of variables used to achieve identification of the model. The nonpensioner income equation is identified by a set of commonly used human capital type variables, while identification of the pension equation relies heavily on the interaction of the income variable with the gender and year dummies. The decision equation is identified by an indicator of partners' behaviour and by the time remaining until the legal age of claiming old-age pension.

Table 3.1: Variables used in the estimating equations

Variable	Nonpensioner	Pensioner	Decision
Net income (log)	X	X	
Local employment rate	X		
Education: low	X	X	
Education: high school	X	X	
Education: college	X	X	
Woman	X		
Partner retired			X
Partner retires in t+1			X
On sick leave			X
Potential experience	X	X	
Potential experience sqrd.	X	X	
Net inc.XyearT (all years)		X	
Net inc.Xwoman		X	
Years to legal retirement age			X
Years to legal retirement age sq.			X
Past legal age			X
Indicators for years	X	X	X
Indicators for regions	X		X
Indicators for settlement types	X		

When listing the variables, we have implicitly assumed that these can be used in the estimation without causing any endogeneity problem. This is true for gender and schooling(these are clearly predetermined), and is also true for local labour market characteristics, because of the low migration rate in Hungary and the known weak effect of economic incentives on migration (see Cseres-Gergely (2005a) on this). Nevertheless, this is clearly not true in the case of pensioner status. Fortunately, in the case of maximum-likelihood estimation of simultaneous equation systems, which the one describing partners' retirement decision is, we can rely on the result that merely conditioning on the other outcome variable (here: has the partner made the transition to pensioner status already?) is sufficient and no correction for selection bias is required similarly to the linear regression framework.[3] The only thing we have to keep in mind is the interpretation of the marginal effects. Despite the indicator of partners' behaviour is sufficient as a control, it will capture part of the effect of the individual's own characteristics, namely the part that affects the partner's behaviour through the own pensioner status indicator. Evaluating the marginal effects in the usual was does not take this indirect effect into account.

Because the availability of income data is required for the estimation of the income processes, we treated it natural that it is only working individuals we include in the estimation. Nevertheless, one might be worried that using only this group biases our estimates of the strength of incentives and this worry is well-funded. The technical reason for this decision is clear and can not be overcome. On the other hand, it would seem logical to employ a selectivity correction taking this selection into account. This would be no problem technically: the two Heckman-type selection equations would have to be replaced by double-hurdle ones following the original idea of Cragg (1971). Similarly to the selection model, the double-hurdle model can also identified from purely nonlinearity in the case of insufficient instruments. However, the instruments used for estimating the Heckman equations are not particularly strong and it is very difficult to come up with instrumental variables that could predict being at work in a given time, but are uncorrelated with unobservables affecting transition to pensioner status in the subsequent period, such a correction is not pursued here. Evaluating estimation results, we have to be aware that the individuals we are looking at are most certainly above average in terms of their labour market potential and thus their gain is possibly lower from retirement than it is for the average person. There are two effects to consider here. If transition to pension really does function as a labour market shelter, we observed (both in absolute and relative terms) fewer transitions to pensioner status than we would if we looked at the unemployed too. Secondly, because we see transitions only for "more able" people, our estimates of the strengths of economic incentives might be inconsistent.

[3]Greene (1998) uses this method and explores the reason for being able to do so. The argument is actually quite simple as described in Chapter 19 of Greene (2000): "We can establish this with the (admittedly) trivial argument: The term that enters the log-likelihood is $P(y_1 = 1, y_2 = 1) = P(y_1 = 1|y_2 = 1)P(y_2 = 1)$".

In particular, if unobserved ability is positively correlated with expected wages and pension income and correlated negatively with the decision to retire on its own right, we could attribute less importance to economic incentives than they should be attributed. Because this correlation structure is realistic, we can think of the estimated parameters as being close to the lower bound of the population parameters.

3.4 Estimation results and discussion

First we consider the selection equation, being at the heart of the model. This reduced form equation considers three groups of influences which are entered gradually to show their separate effect. Average marginal effects[4] of these and other regressors are shown in Table 3.2 on page 66. (Also see Table A.15 in the Appendix for cross-sectional estimates for comparison purposes.)

The first four specification of the equation is estimated on a sample restricted between the ages 24 and 64 to exclude those potentially still in higher education and also those older individuals who will not be part of the final estimation. They include indicators for the remaining years until the legal retirement age (for old-age pension), providing a nonparametric control for the baseline hazard of the transition to pensioner status. Model (1) contains only these indicators of the baseline hazard. To save space, marginal effects are not included in the table itself, but plotted on Figure 3.1 on the next page, hence the omission of parameter estimates all together from the table. The figure suggests a baseline hazard increasing with age in a quadratic fashion, starting to increase significantly at around 40 years of age (based on males' legal retirement age at 60). Because of this, we shall be using only a linear and a quadratic measure of the time remaining to the legal retirement age in smaller sample estimates. Although for some it might be more natural to think about this hazard in the form of an age effect, years to go until the legal age provides a more consistent measure of the horizon of working life when mixing the two sexes and data from different legal retirement

[4]As explained in section 2.4, average marginal effects are theoretically more appealing than evaluating the nonlinear probit likelihood function at the mean of variables. Because of this, tables presenting estimation results will contain these statistics, rather than marginal effects at average values of the variables or parameter vectors.

ages, as we do here. This simple specification does explain some of the variation in transitions to pensioner status, but the explanatory power is nothing close to what we see in the cross-section.

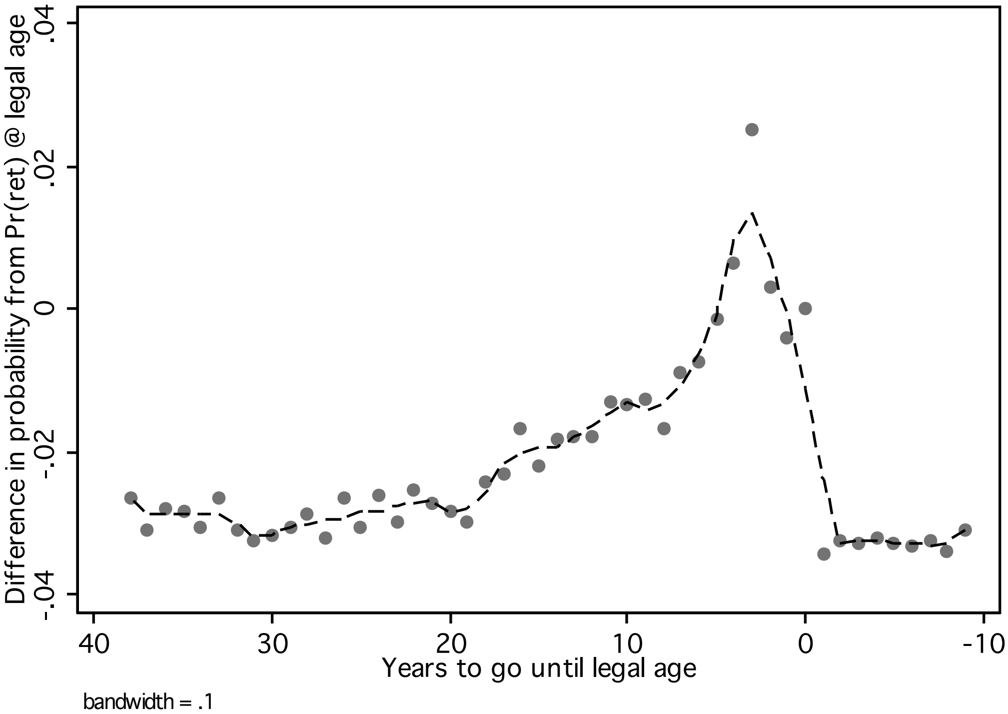

Figure 3.1: The difference in probabilty of making the transition to pensioner state as expressed by the distance from the legal retirement age (the dotted line shows a nonparametricall fit on the estimates).
Parameter estimates from specification (1) in Table 3.2 of page 66 are shown by small disks. The smooth line is generated using the lowess nonparametric estimator with the bandwidth set to 0.1.

Adding local employment rate as a proxy for the state of the local labour market in model (2) does not change results too much in itself, but adding schooling, gender and partner retirement status variables in model (3) does. Those with higher education have a lower risk of transition and so have women, while those with an already pensioner partner have a higher chance of being pensioner themselves in the next period. These estimates are both statistically and substantially significant – we have to keep in mind the very low unconditional transition probabilities when evaluating the magnitude of the marginal effects. Extending the model further in specification (4), we see that correlation between partners' behaviour appears to be especially important – Coile (2003) shows similar evidence for the US in an option value context (we do not pursue to explore the gender asymmetry shown there). In addition, the indicator of having taken sick days – our proxy for health issues – is both

Table 3.2: Reduced-form binary probit estimates of the probability of transition to pensioner status - individuals between 24-64 [(1)-(4)] and between 40-64 years of age [(5)-(6)]; average marginal effects

	(2)	(3)	(4)	(5)	(6)	(7)
Local employment rate	−0.0242	−0.0193	−0.0229	−0.0449*	−0.0651*	−0.0267
	(0.015)	(0.015)	(0.015)	(0.023)	(0.038)	(0.033)
Education: low		−0.00191	−0.00295	−0.00213	0.0516	0.0162
		(0.0035)	(0.0035)	(0.0079)	(0.032)	(0.028)
Education: high school		−0.00740**	−0.00830**	−0.00343	0.0836	0.0196
		(0.0035)	(0.0035)	(0.0079)	(0.068)	(0.049)
Education: college		−0.00941**	−0.0114***	−0.00207	0.170	0.0417
		(0.0037)	(0.0035)	(0.0085)	(0.17)	(0.11)
Woman		−0.00732***	−0.00854***	−0.0235***	0.0748	0.0189
		(0.0017)	(0.0017)	(0.0028)	(0.13)	(0.096)
Partner retired		0.00703***	0.0207***	0.0293***	0.0303***	0.0291***
		(0.0020)	(0.0022)	(0.0034)	(0.0050)	(0.0049)
Partner retires in t+1			0.139***	0.167***	0.118***	0.126***
			(0.010)	(0.015)	(0.017)	(0.018)
On sick leave			0.0374***	0.0312***	0.0411***	0.0403***
			(0.0040)	(0.0039)	(0.0061)	(0.0058)
Working			0.00786***			
			(0.0024)			
Net income				−0.0228***	−0.0317**	−0.0263**
				(0.0031)	(0.014)	(0.012)
Potential experience					−0.00285	−0.00421
					(0.0066)	(0.0065)
Potential experience sq.					0.000164***	0.000104*
					(0.000053)	(0.000059)
Net inc.Xyear1					0.00199	−0.00215
					(0.016)	(0.015)
Net inc.Xyear2					0.00403	0.00101
					(0.016)	(0.015)
Net inc.Xyear5					−0.00675	−0.0104
					(0.019)	(0.017)
Net inc.Xyear6					0.0214	0.00996
					(0.018)	(0.017)
Net inc.Xyear7					0.0170	0.0183
					(0.017)	(0.016)
Net inc.Xyear8					0.0256	0.0174
					(0.018)	(0.016)
Net inc.Xwoman					−0.00568	−0.00334
					(0.0089)	(0.0082)
Years to legal retirement age					−0.0105*	−0.00198
					(0.0054)	(0.0058)
Years to legal retirement age sq.					0.000535***	0.0000289
					(0.000064)	(0.000088)
past legal age					−0.0302**	
					(0.014)	
Nonparametric baseline hazard	yes	yes	yes	yes	no	no
Pseudo R2	0.072	0.076	0.124	0.229	0.199	0.13
Observations	45329	45329	45329	21264	11171	10430

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

significant and influential, increasing the risk of transition to pensioner state.

Concentrating the sample on the working and including net income in model (5), the number of spells with information on the future drops to 21,264. The importance of schooling vanishes in this case, but other variables keep their influence. Income proves to be a strong predictor too, having a negative impact on retirement. This makes sense as those with a larger income are likely to want to harvest the fruit of their working capacity and stay on the labour market as long as possible. Note also that the effect of local employment rate became significant, showing a negative effect on the risk of transition to pension. Thought of as a proxy of overall employment chances, this effect is as expected.

Because ultimately we aim at the population most likely to retire, we further restrict the sample to people between ages 40 to 64, which is the age group we shall be looking at. The result is a data set with 11,171 spell with information on the future. In addition, the nonparametric baseline has been replaced with a quadratic one plus a "past legal age" indicator, and also quadratic experience measure and interaction of income with gender and time-period indicators were added. After these changes, three points can be observed. First, already significant results stay qualitatively unchanged, but sharpen up a bit, one exception being the indicator for women. Secondly, years to go until legal retirement age emerges as the single most important newly included variable, showing a 1 percentage point increase in the propensity to retire by every year. Interestingly, the indicator for an individual working past retirement age has a negative coefficient. Indeed, it is so atypical that somebody works past retirement, that it is very hard to predict the end of this period. Thirdly, the effect of income stays significant and negative. Adding interactions of income with years do not have significant parameters, which suggests that the *overall* impact of wages on retirement was unchanged during the period we are looking at. Restricting our attention to those making the transition to pensioner state at least 3 years before the legal age in model (7) does not change results too much. As the majority retires before the legal age, they naturally dominate the estimtates (note that the number of observations did not change significantly).

In the above estimates, it is model (6) we shall be using as a selection equation for estimating expected nonpensioners and pensioner income. The specification of nonpensioner income, equation 3.7 on page 54 of our model, follows a standard Mincer-type structure, but because lagged income is included in the equation, effects of conditioning variables can be interpreted as governing and endogeneously determined proportion in the growth of wages. Starting with a benchmark OLS estimate as specification (1), Table 3.3 on page 70 shows estimates for nonpensioner income. The persistence in wages is moderate and although potential experience has no significant effect, increasing education exhibits the well known positive and monotonically increasing effect on wages. Ideally the equation should be estimated for men and women separately, as women are known not only to earn lower wages than men, but with different impact of the relevant explanatory variables. Unfortunately, the small number of transitions does not permit this, but the negative parameter on the dummy for women captures the expected effect at least in part. The positive impact of the local activity rate represents the effect of a wage curve: local labour markets with higher activity rate (lower inactivity rates, thus lower market pressure) yield higher wages. Some of the regional and time dummies are significant too, introducing a downward correction for worst performing regions and years immediately after the transition. Fit of the labour income equation is reasonable, producing an 0.51 percent correlation between observed and predicted income for the population that is working through period 2. Note that the selectivity correction introduced in model (2) does not seem to have a perceptible effect on the estimates, despite the non-negligible explanatory power of the selection equation. This result suggests that the expected future income of those retiring and those who do not does not differ significantly in case they decide against making the transition to pensioner state on the basis of the information contained in non-observable characteristics. Estimates were repeated on the subsample of early retirees, constraining the sample a year below the legal retirement age. Results shown under columns (3) and (4) do not differ very much from the overall estimates, exactly as we expect.

In the case of expected income when making the transition to pensioner state, a similar set of equations are estimated as in the case of those not. The pension equation predicts pensioner income as a function of the log of period 1 net income and other variables affecting pension. Because the pension formula includes last period income in both the pre- and post-1997 regime, this variable is highly relevant and stand for earlier wage experience too. Because the changes in how pensions were calculated (mainly changes in the progressivity), there is not only one income term entered, but also a full set of interactions with year dummies. This allows our approximate "pension formula" to depend on the time period being looked at and adjust to changes in a flexible way. Income terms have indeed a statistically and also substantially significant and effect on pensioner income in most cases. They are the largest in 1995, which can be interpreted as being the year when pension depended most on last year's earnings. Differences in past labour market experience of the two sexes is proxied by the interaction of last (period 1) net earnings and a female dummy. The interaction is meant to capture that on average, women accumulate less labour market experience than men and therefore either retire later or – as we have seen in the administrative data – with greater deductions from their pension. In addition to its substantial importance, this interaction is the key for the identification of the pension equation over and above nonlinearity.

Results of estimating the pension equation, equation 3.6 on page 54 of our model, are shown in Table 3.4 on page 71. Surprisingly, *potential* experience shows no significant effect. The interacted variable is significant only in the model controlling for selection. As opposed to nonpensioner income estimates, the selection correction is significant in this case, suggesting that there are significant unobservable differences that affect the transition decision and also the level of pension itself. The selection equation in this case is completely identical to the reduced form probit estimate. Is the significance of selection term being significant in one but not in the other equation contradictory? No. Although parameter estimates need to be the same in the selection equation, the generated selection term might well have very different effects on on type of behaviour, but not on the other. The results here suggest that the selection operate through past labour market experiences. We have to note that selection is significant only if we look at every retiring individual. Concentrating on early retirement only, selection is not significant anymore.

Predicting expected income in both states for the whole population considered, we are able to estimate the structural probit form of the transition to pension equations – equation 3.1 of our model. Estimates are presented in Table 3.5 on page 74 for three specifications.

Table 3.3: Parameter estimates of income in $t+1$ (in logs) if not pensioner, 40-64 year old working individuals [OLS (1) and (2) and selectivity corrected, using two-step Heckman method (3) and (4)]

	(1)	(2)	(3)	(4)
Net income$_{t-1}(log)$	0.702^{***}	0.704^{***}	0.707^{***}	0.708^{***}
	(0.016)	(0.017)	(0.017)	(0.017)
Experience	0.0127	0.0159	0.0108	0.0110
	(0.012)	(0.012)	(0.013)	(0.013)
Experience squared	-0.000219	-0.000288	-0.000201	-0.000205
	(0.00019)	(0.00021)	(0.00022)	(0.00022)
Education: low	0.152^{***}	0.145^{***}	0.147^{***}	0.147^{***}
	(0.052)	(0.053)	(0.055)	(0.055)
Education: high school	0.261^{***}	0.253^{***}	0.255^{***}	0.254^{***}
	(0.054)	(0.055)	(0.057)	(0.057)
Education: college	0.372^{***}	0.362^{***}	0.353^{***}	0.352^{***}
	(0.057)	(0.058)	(0.060)	(0.061)
Woman	-0.0522^{***}	-0.0531^{***}	-0.0544^{***}	-0.0544^{***}
	(0.014)	(0.014)	(0.014)	(0.014)
Local employment rate	0.268^{**}	0.275^{**}	0.261^{**}	0.262^{**}
	(0.13)	(0.13)	(0.13)	(0.13)
Constant	2.674^{***}	2.606^{***}	2.655^{***}	2.649^{***}
	(0.25)	(0.27)	(0.27)	(0.28)
lambda		0.0601		0.00728
		(0.082)		(0.11)
Observations	10,915	10,914	10,191	10,191
corr(y,yhat)	0.51	0.51	0.51	0.51

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.4: Parameter estimates of income in $t + 1$ (in logs) if pensioner, 40-64 year old working individuals [OLS (1) and (2) and selectivity corrected, using two-step Heckman method (3) and (4)]

	(1)	(2)	(3)	(4)
Net income$_{t-1}(log)\times$year1	0.389^{**}	0.415^{***}	0.425^{***}	0.447^{***}
	(0.16)	(0.078)	(0.16)	(0.064)
Net income$_{t-1}(log)\times$year2	0.427^{*}	0.442^{***}	0.345	0.359^{***}
	(0.22)	(0.10)	(0.24)	(0.093)
Net income$_{t-1}(log)\times$year4	0.601^{***}	0.621^{***}	0.432^{*}	0.450^{***}
	(0.22)	(0.10)	(0.22)	(0.088)
Net income$_{t-1}(log)\times$year5	0.461^{*}	0.496^{***}	0.403^{*}	0.426^{***}
	(0.25)	(0.12)	(0.23)	(0.091)
Net income$_{t-1}(log)\times$year6	0.283	0.286^{**}	0.217	0.228^{**}
	(0.27)	(0.13)	(0.25)	(0.095)
Net income$_{t-1}(log)\times$year7	0.377^{*}	0.370^{***}	0.395^{**}	0.388^{***}
	(0.22)	(0.10)	(0.20)	(0.076)
Net income$_{t-1}(log)\times$year8	0.297	0.275^{**}	0.264	0.257^{***}
	(0.26)	(0.13)	(0.25)	(0.096)
Net income$_{t-1}(log)\times$woman	-0.00944	-0.0102^{**}	-0.0172^{*}	-0.0161^{***}
	(0.0089)	(0.0042)	(0.0095)	(0.0038)
Experience	0.0200	0.0321	0.0305	0.0347
	(0.063)	(0.031)	(0.077)	(0.030)
Experience squared	-0.000298	-0.000600	-0.000527	-0.000615
	(0.00094)	(0.00047)	(0.0012)	(0.00048)
Constant		5.802^{***}		5.336^{***}
		(0.94)		(0.80)
lambda		-0.134^{**}		-0.0585
		(0.064)		(0.053)
Observations	11,190	11,171	10,447	10,430
corr(y,yhat)	0.45	0.44	0.4	0.4

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Columns (1) and (2) show results for all individuals, while columns (3) and (4) show the same for those only one year before the legal retirement age. Finally, columns (5) and (6) return to all individuals, but include an interaction between income types and years remaining until the legal age. Effects of current income and schooling variables are all subsumed in the two predicted income variables and thus contribute to the decision only through these financial incentives. In case of variables excluded from income equations, the results are similar to what we have already seen in the reduced form probit across all specifications. Living with a retired spouse increases the probability of retirement and so does the fact that the spouse him or herself retires from in $t + 1$. Years remaining until the legal retirement age still have a significant negative effect on retirement propensity, the quadratic indicating a degree of acceleration. Having been on sick pay while nonpensioner has still a strong effect in all cases.

Parameters estimates concerning the expected period $t + 1$ incomes conform to expectations and are again similar across specifications. A one percentage point increase in expected nonpensioner income reduces the probability of retirement by 0.077 percentage point, which goes down marginally if we control for selectivity. Expected pensioner income has a somewhat larger and similarly stable effect at around 0.1 percentage point. This means that if income in nonpensioner status increases by one percent either through the increase in income from employment or through the increased stability of employment, the probability that a person retires will decrease by 0.077 percentage point, but if pensioner income increases by the same amount, it increases the probability of pensioner status by almost 50% more, by 0.1 percentage point. Considering the non-monetary benefits of the two states, which we can not control for only partially here, this imbalance makes sense. To hold the probability of entering pensioner status constant, a higher compensation is required in the nonpensioner state, which is probably due to the disamenities associated with that state. The interaction with nonpensioner income is not significant, but the one with pensioner income has a negative sign, suggesting that the closer is the retirement opportunity, the more valuable is the income obtained through pension. Including an interaction with remaining years does bring about substantial changes. Parameter estimates do change somewhat if we restrict attention to early retirement, but the change is not substantial and the ratio of the two effects remain unchanged.

Given that there is no comparable calculation available for Hungary, the validity of the estimates can not be checked directly. On the other hand, the results in the already cited studies looking at similar problems do provide a point of reference. The parameters of a fully specified model are buried in the reduced form used here, but the parameter k used by Stock and Wise (1990) has a meaning similar to the ratio of the effect of the two income sources in our discrete choice model. The authors write: “Earnings without work, retirement benefits, are valued at 1.66 times wage earnings while employed, based on the estimated value of k. That is, a person would exchange a dollar with work for 60 cents not accompanied by work.” Our own results are changing depending on the specification of the underlying econometric model, but their ratio is around 1.5 in all cases. Given that we accept the analogy of the two types of indicators, the current estimates are similar to those of Stock and Wise (1990), which is reassuring, provided that we maintain the hypothesis that the two indicators are comparable.

Which estimate should we give credit? Based on the parameter estimates only, it is hard to decide in favour of one or the other model: selectivity corrected estimates do not seem to be very different from the straight OLS ones. Pseudo R^2 values are of no help either, as they are also virtually identical for both models. Based on this evidence, it is indifferent which model we choose and we can conclude that selectivity does not play an important role in this process.

3.5 Conclusions

Activity of the working age population is quite low in Hungary, similarly to other post-communist new EU member states, with the exception of the Czech Republic. In this chapter I built on the hypothesis that the workings of the Hungarian pension system contributed substantially to the rise and persistence of this situation. Raw data showed that the comparatively low legal retirement age itself creates incentives to retire. Estimation of a model of

Table 3.5: Structural binary probit estimates of the probability of the transition to pensioner status, 40-64 year old working individuals; average marginal effects

	(1)	(2)	(3)	(4)	(5)	(6)
E(nonpensioner inc.)	−0.0771***	−0.0740***	−0.0694***	−0.0672***	−0.102***	−0.102***
	(0.013)	(0.014)	(0.012)	(0.012)	(0.020)	(0.022)
E(pensioner inc.)	0.101***	0.0918***	0.0970***	0.0901***	0.162***	0.155***
	(0.024)	(0.026)	(0.021)	(0.023)	(0.037)	(0.040)
Partner retired	0.0290***	0.0286***	0.0269***	0.0264***	0.0289***	0.0285***
	(0.0050)	(0.0050)	(0.0048)	(0.0048)	(0.0050)	(0.0050)
Partner retires	0.121***	0.121***	0.131***	0.131***	0.121***	0.121***
	(0.017)	(0.017)	(0.018)	(0.018)	(0.017)	(0.017)
On sick leave	0.0405***	0.0405***	0.0392***	0.0393***	0.0405***	0.0406***
	(0.0061)	(0.0061)	(0.0057)	(0.0057)	(0.0061)	(0.0061)
Years to legal age (L)	−0.0207***	−0.0208***	−0.00678***	−0.00705***	−0.0185*	0.0154
	(0.0013)	(0.0013)	(0.0020)	(0.0020)	(0.010)	(0.019)
Years to legal age sqr	0.000666***	0.000674***	0.000147*	0.000160**	0.000727***	0.000735***
	(0.000058)	(0.000058)	(0.000081)	(0.000081)	(0.000065)	(0.000066)
Past legal age	−0.0131	−0.0133			−0.0147	−0.0146
	(0.018)	(0.018)			(0.017)	(0.017)
E(nonpensioner inc.)*L					0.00254	0.00270
					(0.0016)	(0.0017)
E(pensioner inc.)*L					−0.00631**	−0.00633**
					(0.0029)	(0.0030)
Observations	11171	11171	10430	10430	11171	11171
Log pseudolikelihood	-1905	-1907	-1724	-1726	-1903	-1906
Pseudo R2	0.18	0.18	0.14	0.14	0.18	0.18
p-value of the test on the equality of coefficients on income types	0.08	0.1	0.01	0.02	0.21	0.22

Standard errors robust to heteroskedasticity and clustering are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

retirement on individual data also helped detecting the effect of direct financial incentives for retirement through early and disability retirement schemes. Results show that these incentives have a significant effect on decisions to make the transition to pensioner state. The incentive effect of income in nonpensioner state is constant over time, while that of pensioner income is increasing as individuals approach the legal retirement age. Even though the effect of financial incentives is significant, the effect of the closeness of the certain legal age remains an important predictor of making the transition. Although theory suggests that individuals in the pensioner and the nonpensioner state can be selected on the basis of potentially endogeneous nonobservable characteristics, appropriate controls in the estimation procedure did not show strong evidence of selectivity.

It is apparent that the workings of the pension system in the post-socialist Hungary is similar to pension schemes engineered to motivate people to retire at a pre-defined manner. The current analysis can not decide if this feature is actually a result of a deliberate design, or just a randomly evolved system. It is certain, however, that there are financial incentives operating in a pension system, which does not necessarily has to have those included by design. What can we make of these results now, as the economic transformation is essentially over? Shocks will hit other economies too and governments will take measures to alleviate them, often in the form of public policy affecting employment. If this is so, and if the similarity is sufficient, the post-socialist experience can serve as an example to these coming occasions. Pension systems' design does not affect only the system itself, but can have a profound effect on the labour market as well.

Chapter 4

Why are extraverted young men less likely to receive higher education? Evidence from Hungary[1]

Whether and how personality traits affect labour market outcomes has become a focus of active research in education and labour economics recently. The role of cognitive skills, often measured by IQ, has been recognized since at least the seminal works Mincer (1958) and Mincer (1974). Economists' interest in other personality traits, often labeled as non-cognitive skills, is more recent. Bowles et al. (2001), Heckman and Rubinstein (2001), Heckman et al. (2006) emphasize the importance of non-cognitive skills in wage formation. While new in economics, personality traits have been the focus of an entire field within psychology for decades. A recent paper by Borghans et al. (2008) has called for more systematic research on non-cognitive traits by a incorporating more results of psychology research.

The broad question in this area is relatively simple: which personality traits are important for which outcome and why. From the economists' point of view, perhaps the most important outcome is labour market success. The role of personality affects this both directly and

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indirectly. In the latter channel, it is mediated through educational attainment in two possible, non-exclusive ways: educational choice (and attainment) may be caused by personality traits, or education may cause those traits to develop (Carneiro and Heckman, 2003). The effects on labour market outcomes and education are therefore of foremost interest. In terms of traits, a wide range of measures have been analyzed, from self-esteem and locus of control (Heckman et al., 2006) to social adjustment (Carneiro et al., 2006). At the same time, psychology research has converged on the importance of the Big Five personality classification. The five dimensions established there are the following: extraversion/introversion; friendliness/hostility; conscientiousness/impulsivity; emotional stability/neuroticism; and openness to experience. It is important to learn more about the role of the Big Five traits as established in psychology in the domains important for economists, by using the appropriate methods used by economists (Borghans et al., 2008).

This chapter focuses on extraversion, which is perhaps the most influential of all the Big Five personality traits. In particular, we shall be looking at the gender differences in the relationship of extraversion in enrollment into higher education. Extraversion is the tendency to enjoy human interactions and to be enthusiastic, talkative, assertive, and gregarious. Gender differences in personality have been analyzed in the psychology literature (see, e.g. Costa et al. (2001)), and gender differences in educational and labour market outcomes have been the focus of a large economics literature (see, e.g. Altonji and Blank (1999)). At the same time, gender differences in the returns to personality traits have been less often analyzed. An exception is (Jacob, 2002) who shows that not only have boys significantly more behavioral problems in high school, but these problems have a more negative effect on boys than on girls in terms of college enrollment. These effect are found to persist even after controlling for a series of family background variables. We know of no study that looked at gender differences in the role of extraversion in educational and labour market outcomes.

In order to answer our question, we make use of the Budapest Longitudinal Survey of Child Development (BLSCD). The BLSCD is a unique longitudinal dataset that collects detailed information on a few hundred respondents from their birth through age 22. Although the number of relevant observations is relatively low at around 320, the richness of the survey enables us to improve upon existing studies in measuring cognitive and non-cognitive skills and to remedy some of the endogeneity problems, based on the longitudinal dimension.

Our main results are coming from a stylized model of higher education attainment, empirically estimated using a multinomial probit specification. We show that besides the strong and gender-neutral effect of cognitive scores, the extroversion measure reduces the probability of higher education attainment of young men in a robust fashion, but the same is not true for women. By using proxies for the cost of higher education in terms of personality traits, we can separate the cost effect of past behavioral problems from the current effect of personality traits. Our results suggest that extraversion lowers the returns on the labour market for men, rather than raising the costs of education.

4.1 Data

The data we use are coming from the Budapest Longitudinal Survey of Child Development (BLSCD hereafter) of the Institute of Psychology, Hungarian Academy of Sciences. The BLSCD is an ongoing panel survey that collects detailed information on respondents from their birth through age 22 (as of now).

The sample of the survey is a subsample of a demographic research project of the Hungarian Statistics Office and is representative for all children born between 1. January 1982 and 30. September 1983 in Budapest, Hungary. The original sample consisted of 482 newborns, a subsample of an large anthropometric survey conducted by the Demographic Institute of the Hungarian Central Statistics Office. The primary sampling unit was one "midwife-area" within Budapest. Within such a chosen area, all babies born between January 1982 and September 1983 are included in the sample. The original sample was followed through six phases of data collection. phase 1 was administered when the baby was 3 months old, phase 2 at the age of 3, phase 3 at around age 6, just before enrollment into primary school, phase 4 at the age of 8, and phase 5 at the age of 12. The project did not get funding for the following ten years until phase 6 was administered at age 22 (in year 2005). Data quality was kept high by working with the same interviewers throughout the 22 years of the survey.

Table 4.1: Representativity of the BLSCD variables compared to the Hungarian LFS (2004) - means of selected indicator variables for 22 year-old youths living in Budapest

	BLSCD	HLFS
Labor market status		
Not working non-student	0.17	0.21
Working non-student	0.28	0.34
enrolled in higher education	0.54	0.45
Former education		
General secondary (or higher)	0.57	0.51
Specialized secondary	0.27	0.25
Vocational	0.07	0.08
Primary or less (0-8grades)	0.09	0.16
Gender		
Female	0.50	0.50
Male	0.50	0.50
Observations	294	334

Source: own calculations from microdata

Out of the 482 families in the original sample, 68 opted out before phase 1. In practice, therefore, BLSCD started with 414 newborns (86 per cent). Of them, 354 (86 per cent) were interviewed in phase 6 at age 22. Attrition is relatively low but it is unlikely to be random. There is unfortunately no detailed study on attrition and nonresponse in the survey. Because of item-nonresponse with a “swiss-cheese” patter, the estimation sample is reduced to 312 observations.

The representativeness of the survey is difficult to account for as most of the data is unique, but we can compare basic demographics to national representative survey data. For such comparison, we use the four quarterly cross-sectional samples of Hungarian Labor Force Survey (HLFS) of 2004, and look at those who were 22 years old and lived in Budapest. Unfortunately, city of birth is not known in the HLFS thus the comparison is necessarily biased by migration into the city. Since quite a few BLSCD individuals migrated out of Budapest, for this comparison we restrict the sample to the 294 individuals who still lived in Budapest in phase 6. In terms of variables, we look at employment and enrollment to higher education, previous schooling and gender.

Table 4.1 on the previous page shows that by and large, BLSCD participants seem to be more likely to be enrolled in higher education and more educated. This means that the sample might be biased towards more able individuals. The extent of the bias is hard to assess because of the imperfect nature of the comparison.

The BLSCD dataset contains detailed interviews with both parents at birth and a battery of psychological tests. Home environment and parenting practices are also measured in detail. Child development tests were administered at age 2 and 6, and cognitive tests are available for age 6, 8, and 22. phase 5 (age 12) is less rich in psychology tests but it includes detailed questionnaires of how schoolteachers and parents see the child subjectively. phase 6 (age 22) again contains cognitive tests and measures of personality.

The dataset is not publicly available, and in a large part stored only on paper. The information available to us is a small subset of the universe recorded in the survey. Labor market participation and history is recorded for every individual. We have a measure of age 22 cognitive capacity (Raven IQ score) as well as age 22 personality measures (Big Five scores for openness, conscientiousness, extraversion agreeableness and neuroticism) available.[2] We also have parents' educational attainment (measured for both parents at the birth of the child), and the child's IQ score measured at age 5 (Binet). School grades from grade 1 through grade 12 are available, and we use grade point averages calculated from them. Finally, parents and schoolteachers assessed the child's behavioral problems at age 12 in an independent way.

The focus of this chapter is higher education, thus the estimation sample was restricted to those who could potentially study in higher education. In Hungary, as in many continental European countries, a maturity examination must be passed in order to apply to college. Such exams are administered at the end of grade 12 in secondary schools. Vocational training schools are of 11 grades, and they do not administer such examinations themselves, but graduates can enroll into short courses and take the examination afterwards. All with at least 11 grades of education (and with non-missing educational attainment data) were retained for

[2]These measures and in the case of the Big Five, its components are calculated from a battery of individual questions using standard procedures. Because of accessibility restrictions, we only have access to the questionnaire and the combined measures, but not to the answers to the individual questions.

Table 4.2: Means of variables by gender

	Female	Male	All
Not employed, non-student	0.12	0.16	0.14
Employed non-student	0.28	0.29	0.28
Enroled in higher education	0.60	0.55	0.58
IQ	−0.01	0.16	0.07
Extraversion*	−0.02	0.01	−0.01
IQ age 5*	0.04	0.05	0.04
Agreebleness*	0.07	−0.07	0.00
Conscientiousness*	0.00	0.00	0.00
Neuroticism*	−0.17	0.19	0.00
Openness*	−0.07	0.08	0.00
GPA (grades 1 through 8)*,	0.11	−0.12	0.00
GPA (grades 9 through 12)*	0.18	−0.19	0.00
Mother's education (years)*	0.04	−0.04	0.00
Behaviour problems (assessed by parent)*	−0.18	0.19	0.00
Behaviour problems (assessed by teacher)*	−0.07	0.07	0.00
Number of observations	162	150	312

Notes: Estimation sample: educational attainment at least 11 grades (vocational school)
*: variable standardised to have an overall mean 0 and unit standard deviation

Table 4.3: Correlation between standardised Big Five components

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
Extraversion	1.00				
Agreeableness	−0.04	1.00			
Conscientiousness	0.29	0.06	1.00		
Neuroticism	0.13	0.26	0.14	1.00	
Openness	0.32	0.18	0.35	0.17	1.00

the analysis. The estimation sample consists of 312 individuals who could be interviewed also in phase 6 of the survey.

Table 4.2 summarizes the variables used in the analysis, separately for females and males. Part of these variables is a binary indicator (such as activity and enrolment variables) Cognitive and noncognitive variables are continuous standardised scores (from IQ to Openness and GPA) as well as variables indicating parents' education and behaviour problems. Standardisation ensures that the overall mean of the variables is 0 and the overall standard deviation is 1. Table 4.3 shows the correlation between the Big Five components (from Agreebleness to Openness). It appears that there is at most a medium-weak correlation among the components

Table 4.4: Student status and labour market activity at age 22 (per cent)

	Female	Male	All
In higher education	60	55	58
Not in higher education	40	45	42
of which			
employed	28	29	28
not employed	12	16	14
All	100	100	100
Observations	162	150	312

Note: Estimation sample: educational attainment at least 11 grades (vocational school)

4.2 Descriptive evidence

Hungary is a relatively small transition country and a member of the soviet-bloc before 1989, which might suggest that the data we use or our results are specific to the particular time and place. If one takes a look at Hungary's recent social and economic development, it becomes clear that this is not the case. Not only was Hungary the first to go forward with thorough privatization, but its society has adapted rapidly to the new circumstances. It is safe to say that the transition was by and large over by 2000 (see Brown (1999) and chapter 2 of this thesis, among others), which, together that our sample is constrained to Budapest, implies that much of the development of the young people we are looking at took place after the transition, in a setting broadly similar to western European countries.

At age 22, individuals in the survey could be enrolled in higher education, working, unemployed or inactive. Although the focus of this chapter is on enrollment into higher education, we shall also be looking at whether those not enrolled work or not. Table 4.4 shows the distribution of the 312 individuals in the sample according to their status at age 22.

The three states are defined as mutually exclusive. Full-time enrollment in higher education is defined as a single category regardless of economic activity (only 25 out of the 180 students have reported some work for pay). A dozen students already completed college and they are counted in this category as well. According to this definition, 58 per cent of the 22 year-old continued their studies in higher education. Gender differences in enrollment are small: 60 per cent of women versus 55 per cent of men continued in higher education. Of the

Table 4.5: IQ and extraversion by student status and labour market activity at age 22.

	IQ			Extraversion		
	Female	Male	All	Female	Male	All
In higher education	0.26	0.42	0.34	0.08	−0.23	−0.07
Not in higher education	−0.43	−0.16	−0.30	−0.17	0.30	0.07
of which						
employed	−0.35	−0.20	−0.28	−0.11	0.32	0.1
not employed	−0.61	−0.10	−0.33	−0.3	0.28	0.02
All	−0.01	0.16	0.07	−0.02	0.01	−0.01

Notes: IQ is measured by standardised Raven IQ, age 22. Extraversion is measured by standardised Big5 scores, age 22. Estimation sample: educational attainment at least 11 grades (vocational school)

non full-time students, two thirds were employed and one third were not employed. There are no gender differences in terms of unconditional employment probabilities (somewhat below 30 per cent). The gender non-employment differential mirrors the higher education differential, with men being slightly more likely to be not employed than women. Table 4.5 shows the test scores for men and women by their status at age 22.

Cognitive capacity is measured by a Raven IQ score, standardized to the entire sample. Since those with very low education are excluded from the estimation sample, the overall mean in Table 4.5 is positive, at 0.07. There is a small gender difference in the scores, with men scoring 0.17 standard deviation higher than women. More importantly, enrollment in higher education is strongly positively related to cognitive capacity: the difference is above 0.6 standard deviations. This is in line with results previously found in the literature, see e.g. Figure 3 in (Borghans et al., 2008). The difference is somewhat larger for women (0.69) than for men (0.58). The gender differential is larger among employed and non-employed non-students. Non-employed women have significantly lower cognitive scores, but the same is not true for men.

Extraversion seems to be weakly negatively related to higher education overall. The difference between students and non-students is -0.14, which is also within the range of what was previously found in the literature, again see (Borghans et al., 2008). Contrary to cognitive capacity, however, the overall relationship between higher education and extraversion is a result of two large but opposing relationships for women and men. According to Table 4.5, women in higher education score 0.25 points *higher* in terms of extraversion than their non-student peers. At the same time, male students score 0.53 points *lower* than non-student males. The gender difference in the relationship of employment and extraversion is smaller. Employed women are 0.2 points more extraverted than non-employed women, while employed men are similar in terms of extraversion than non-employed men (and all more extraverted than non-student women). Overall gender differences in terms of extraversion are negligible.

In order to see whether the relationships documented in Table 4.5 on the previous page are preserved when the two test scores are conditioned on each other[3], we estimated simple probit models for the probability of being in higher education. Cognitive test scores at age 22 are probably endogenous for at least two reasons: measurement error and reverse causality. If classical measurement error is present in the variables, it is likely to understate the effect of intelligence, while reverse causality is likely to overstate it, because higher education in itself may have a positive effect on test scores (students are more "in shape" for such tests, and they are likely to take them more seriously). In order to treat that endogeneity, we re-estimated the probit models instrumenting age 22 cognitive test scores by age 5 cognitive test scores.

Table 4.6 on the next page shows the results, in the forms of average marginal effects whose definition and advantage compared to marginal effects evaluated at averages of variables was already discussed in section 2.4. Analogously to Table 4.5 on the preceding page, first we looked at women and men separately and then the whole sample together. The coefficient estimates and other details are to be found in Table A.16 on page 143 of the Appendix.

The first three columns show the simple probit results. They confirm what we have seen in Table 4.5 on the preceding page. Cognitive scores (C22) are positively related to higher education: one extra standard deviation of IQ increases the probability of higher education by 30 percentage points for women and 20 percentage points for men (25 percentage points combined). Extraversion (E22) is not related to higher education for women and overall, but it is significantly negatively related to higher education for men. One extra standard deviation

[3]This regression is kept simple as it serves descriptive purposes. Because there is moderate correlation between them, results are practically unchanged if we include further Big Five components too – see Table 4.3 on page 81 on this.

Table 4.6: The probability of higher education as a function of cognitive capacity and extraversion. average marginal effects from probit (1-3) and instrumented probit (4-6) models.

	(1) Women	(2) Men	(3) All	(4) Women	(5) Men	(6) All
IQ	0.296^{***}	0.201^{***}	0.248^{***}	1.371^{***}	1.015^{***}	1.191^{***}
	(0.059)	(0.052)	(0.038)	(0.18)	(0.28)	(0.16)
Extraversion	0.0611	-0.148^{***}	-0.0403	0.0720	-0.266^{*}	-0.0750
	(0.045)	(0.047)	(0.031)	(0.11)	(0.15)	(0.076)
Observations	162	150	312	162	150	312
log-likelihood	-92.44	-89.02	-187.7	-277.45	-273.16	-558.87

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: IQ is measured by standardized Raven IQ, age 22. Extraversion is measured by standardized Big5 scores, age 22. Estimation sample: educational attainment at least 11 grades (vocational school).

of extraversion decreases the probability of higher education by 15 percentage points.

The IV results – shown in columns 4, 5 and 7 – for the effect of cognitive scores are much larger than simple probit estimates. This indicates substantial measurement error in cognitive scores. The results on extraversion are virtually unchanged for women and overall, but the one for men has more than doubled in absolute terms. At the same time, the large measurement error in cognitive scores indicate that similar errors may be present in the extraversion tests as well. If that is indeed the case, the true negative effects of extraversion on higher education for men may be even stronger than the estimates shown here.

This differential role of extraversion in higher education for women versus men is the focus of this chapter. There are several possible explanations for the phenomenon. One of these might be that there is a exogeneous barrier (a "glass ceiling") above women building their career that men do not have to fight. If this barrier is easier to fight for a higher education graduate, the returns to college can be higher for women than for men, ceteris paribus. Alternatively, the differentials in returns can develop endogeneously. In the spirit of the Weiss and Gronau (1981) model, one might say that the main difference between the career prospects of men and women is that the latter, on average, can expect an interruption of their career in relation to childbirth. Given the break itself and the lessened capacity to earn on the job credentials, one might expect that women will try to obtain more formalized credentials under such circumstances. In particular, a college diploma is a certificate that has value even with little labour market experience and after a gap, whereas a career based on on the job learning and presence would be severely hindered by such an interruption. Although both idea can motivate the differences we see here, we do not pursue them in detail, but move on to a more structural, yet agnostic model.

4.3 A more structural model

In order to disentangle the possible mechanisms, we jointly analyze the probability of higher education and the probability of employment if not in higher education. The analysis takes the form of a multinomial probit model, with an explicit structure for the returns to personality traits.

Let S denote the vector of personality traits, including intelligence and extraversion. Assume that earnings W are determined on a competitive labour market by a fixed wage rate for units of human capital H. Human capital is a function of personality traits S and education ed. For simplicity and without loss of generality, set this fixed wage rate to unity. Then

$$W = H(S, ed).$$

Let ed=high denote education of college or more, and let ed=low denote less than college education (but at least 11 grades according to our sample restriction). Rewrite the returns to personality traits if education is low and if high by $a(S)$ and $b(S)$, respectively:

$$a(S) = H(S, ed = low) \tag{4.1}$$

$$b(S) = H(S, ed = high) \tag{4.2}$$

Achieving higher education also entails costs, denoted by c, also possibly a function of personality traits S: $c(S)$ Moreover, assume that by not working at age 22, one can achieve a utility level purely from leisure that is equivalent to receiving earnings d.

The value of the three states, not working, working, and studying towards a higher education degree, are then the following:

$$\begin{aligned} V_0 &= V_{notworking} = d \\ V_1 &= V_{working} = a(S) \\ V_2 &= V_{studying} = b(S) - c(S). \end{aligned} \tag{4.3}$$

To be more precise, the last equation denotes an expected value, and thus $b(S)$ should be interpreted as the present value of all future expected returns, while $c(S)$ as expected costs (similarly to the liberal approach of the option value model). If we assume that utility is random and the observed outcomes reveal the optimal choice of the individuals the probability of each state is then given as follows:

$$\begin{aligned} p_0 &= \Pr(notworking) = \Pr(V_0 > V_2, V_0 \geq V_1) \\ p_1 &= \Pr(working) = \Pr(V_1 > V_0, V_1 \geq V_2) \\ p_2 &= \Pr(studying) = \Pr(V_2 > V_1, V_2 \geq V_0) \end{aligned}$$

Substituting in the specifications for the expected utilities, we can rewrite the system as

$$\begin{aligned} p_0 &= \Pr(notworking) = \Pr\left\{d > [b(S) - c(S)], d \geq a(S)\right\} \\ p_1 &= \Pr(working) = \Pr\left\{a(S) > d, a(S) \geq [b(S) - c(S)]\right\} \\ p_2 &= \Pr(studying) = \Pr\left\{[b(S) - c(S)] > a(S), [b(S) - c(S)] \geq d\right\} \end{aligned}$$

In order to obtain to an estimable model, we specify the functions a, b, and c as linear functions and we also allow for random variation in each as well as in d. For easier notation, let lowercase s denote the vector of personality traits contained in uppercase S, augmented by a first element of one in order to allow for a constant. Thus we obtain $a(S) = \alpha_a s + \varepsilon_a$, $b(S) = \beta s + \varepsilon_b$, $c(S) = \gamma s + \varepsilon_c$, $d = \delta + \varepsilon_d$. Using this notation and rearranging terms we get

$$
\begin{aligned}
p_0 &= \Pr(notworking) = \Pr\left[-(\beta-\gamma)s+\delta > \varepsilon_b-\varepsilon_c-\varepsilon_d, \alpha a-\delta \leq -\varepsilon_a+\varepsilon_d\right] \\
p_1 &= \Pr(working) = \Pr\left[\alpha s-\delta > -\varepsilon_a+\varepsilon_d, (\beta-\gamma-\alpha)s \leq -\varepsilon_b+\varepsilon_c+\varepsilon_a\right] \\
p_2 &= \Pr(studying) = \Pr\left[(\beta-\gamma-\alpha)s > -\varepsilon_b+\varepsilon_c+\varepsilon_a, -(\beta-\gamma)s+\delta \leq \varepsilon_b-\varepsilon_c-\varepsilon_d\right].
\end{aligned}
$$

Let e_1 be the identity vector with one in the first element and zeros elsewhere. Then we can simplify notation by introducing the following π vectors of reduced form parameters:

$$
\begin{aligned}
\pi_{02} &= -(\beta-\gamma)+\delta e_1 \\
\pi_{10} &= \alpha-\delta e_1 \\
\pi_{21} &= (\beta-\gamma)-\alpha,
\end{aligned} \tag{4.4}
$$

where the subscripts refer to the subscript of the utility values between which the comparison is made. Note that the coefficients attached to the cost and benefit of education are separable and grouped together with parentheses merely for expositional purposes. Similarly to the coefficients, we can collect the random variation into single variables too:

$$
\begin{aligned}
u_{02} &= \varepsilon_b-\varepsilon_c-\varepsilon_d \\
u_{10} &= -\varepsilon_a+\varepsilon_d \\
u_{21} &= -\varepsilon_b+\varepsilon_c+\varepsilon_a.
\end{aligned} \tag{4.5}
$$

Using the newly defined variables, we can rewrite the probabilities in a more compact way:

$$
\begin{aligned}
p_0 &= \Pr(notworking) = \Pr\left(\pi_{02}'s > u_{02}, \pi_{10}'s \leq u_{10}\right) \\
p_1 &= \Pr(working) = \Pr\left(\pi_{10}'s > u_{10}, \pi_{21}'s \leq u_{21}\right) \\
p_2 &= \Pr(studying) = \Pr\left(\pi_{21}'s > u_{21}, \pi_{02}'s \leq u_{02}\right).
\end{aligned} \tag{4.6}
$$

Supposing additionally that the unobserved random variables follow a joint normal distribution with variance-covariance matrix Σ

$$(u_{02}, u_{10}, u_{21}) \sim \text{ii N}(0, \Sigma), \text{ where } \Sigma = \begin{bmatrix} \sigma_{02}^2 & & \\ \sigma_{02,10} & \sigma_{10}^2 & \\ \sigma_{02,21} & \sigma_{10,21} & \sigma_{21}^2 \end{bmatrix},$$

the equation system 4.6 on the previous page defines a multinomial (also known as a conditional) probit model developed by Hausman and Wise (1978). The parameters of the model are the coefficients π_{10}, π_{20} and π_{21}, and the covariance matrix of the unobservables u_{10}, u_{20} and u_{21}. The multinomial probit allows for arbitrary correlation across the reduced form, therefore also among the structural unobservables ε - in contrast to, for example to the multinomial logit. Allowing for such a correlation is important here as unobserved heterogeneity in productivity in low-education jobs (captured by e_α) are likely to be correlated with unobserved heterogeneity in productivity in high-education jobs (captured by e_β). Potential examples include health, motivation, self-esteem, and the ability to cope with difficult situations. Another advantage of multinomial probability models is that they can yield consistent estimates for average effects if the measured effects themselves are heterogeneous within the population we are looking at (as it is the case in the original Hausman and Wise (1978) application).

All probability models impose natural restrictions on the coefficients. Since the probabilities need to add up to one, anything that increases one probability should lead to an equally large decrease in the other probabilities combined. As a consequence, the reduced form π coefficients sum up to zero. This is satisfied in our case as well: $\pi_{10} + \pi_{20} + \pi_{21} = 0$.

The multinomial probit model allows for the estimation of normalised versions of the all parameters. Normalisation is required because the variance of the unobservable components are not all identified. The standard restriction is to set one of the variances to unity and identify all parameters (including the π coefficients of interest) relative to the "true" value of the restricted variance. Since a single positive number is used for normalisation, it affects neither the sign nor the relative magnitude of the coefficients.

From estimated reduced-form π parameters, one needs to identify the structural parameters α, β, γ and δ through equations 4.5 on page 88. Given that there are four structural and three reduced parameters, not all of the former are identified. Less importantly, because of the lack of individual-specific variation, the constants in the linear approximations to the a, b and c functions are not identified separately from d. This means that returns to and costs of education at fixed personality traits are not identified from simple cross-sectional comparisons – this is a standard problem in identifying labour demand. More importantly, the slope coefficients on s are identified for a (returns to personality traits in low-education jobs) but not for b and c separately – the parentheses in the system 4.5 on page 88 are included to highlight this. If the latter two were in fact be identified, they would separate the returns to personality traits in high-education jobs from the effect of such traits on the costs of getting higher education. In data at hand, however, only net returns are identified, that is returns to traits minus their effects on the costs, but not the components separately.

The identification problem is partly due to the fact that we practically do not observe higher education graduates on the labour market. But even in such a case one would need enough college graduates to be unemployed for reasons that are exogenous to personality traits. It is an analogous argument for lower education workers that allows us to identify returns to personality traits for them (α): there we assumed that the value of outside options d does not depend on personality traits S. An analogous assumption is unlikely to hold for the costs of education, therefore $c = c(S)$, the dependence is explicit. As a result of this, in reduced-form cross-sectional settings similar to this one, labour market returns to personality traits for higher educated employees can in general be estimated only relative to their effects on the costs of higher education.

4.4 Estimation results

We estimated the multinomial probit model specified in equation system 4.6 on page 88 in four ways. All four models contain the standardised IQ and extraversion scores, both measured at age 22, both fully interacted with gender. This gives the model the flexibility to capture the gender-related differences observed in simple probits also in the more complex specification.

Model (1), the baseline specification, enters no other covariates. Model (2) includes other components of the Big Five personality battery, also interacted with gender. The four additional personality traits are the following: agreeableness, conscientiousness, neuroticism and openness. With the number of observations at hand, it is impossible to estimate the effect of each personality trait precisely. Our aim is simply to see whether the estimated effect of extraversion is modified by entering the other traits, and whether estimates on those other traits are broadly in line with those found in the literature.

Model (3) and (4) try to overcome the identification problem discussed in the previous section by including a proxy for the cost component (γ) in the net expected returns to higher education ($\beta - \gamma$) and thus separate it from the returns. If the net effect of personality traits operates through the costs of education, we should see the net effect decreasing in magnitude. Model (3) contains grade point average (GPA) in grades 1 through 8 and grades 9 through 12, as well as mother's education. Past GPA can capture the results of the effect of personality traits on costs of schooling in the past. Those results can therefore proxy for personality-related costs of higher education under the assumption that such costs are related across different levels of education. Parental education is a more direct proxy for such costs (fathers' education is very insignificant on top of mothers' education and is therefore omitted from the model). Model (4) enters some direct measures of psychic costs of past education: the occurrence of behavioral problems at age 12. phase 5 of the survey contains a 33-item questionnaire on the prevalence of behavioral problems that parents and schoolteachers answered independently. The questions include items such as lying, aggression, provocative behavior or being the clown of the class and are scored on a scale running from 1 to 5. We use two separate indices created from these individual indicators reflecting both parents' and teachers' assessments.

Note that the proxies in Models (3) and (4) are imprecise and thus may both "underdo" and "overdo" their job. On the one hand, they are unlikely to capture the entire effect of personality on the costs of education (γ). On the other hand, they may capture some of the expected labour market returns of personality traits (β) as well. Nevertheless, as long as the main measures of personality (IQ and extraversion scores) are measured with error, these proxies can serve as alternative measures of the same traits and thus their coefficient may in part reflect the true effects. Although the net effect is impossible to tell, we can expect the two sets of proxies to have some effects on the coefficients on IQ and extraversion. Lack of finding such effects is indicative of the net returns operating mainly through expected labour market returns as opposed to costs of education.

Parameter estimates on all right-hand side variables as well as other statistics are in the Appendix in Table A.17 on page 144 and Table A.18 on page 145 for the "inactivity" and "student" outcome, respectively. Before discussing the main results, we have to note briefly that the auxiliary parameter estimates are quite intuitive. Openness to new experience (Model 2) seems to increase the propensity to higher education almost as much as IQ does, exactly what is found by Borghans et al. (2008) on its effects on education. Agreeableness, conscientiousness and neuroticism have no significant effects, an effect again broadly in line with the literature that shows at most modest effects on education. GPA and parental education is strongly associated with higher education (Model 3), and behavior problems at age 12 are negatively associated with higher education, especially if marked by the schoolteacher.

The most important results are summarised in tables 4.7 on the next page and 4.8 on page 95. Table 4.7 shows the average marginal effects of IQ and extraversion on the three probabilities, while Table 4.8 shows the implied structural parameters α and $\beta - \gamma$.

Cognitive scores have strong positive effects of getting a higher education. According the results from Models (1) and (2), one standard deviation increase in cognitive scores is associated with 30 percentage points increase in the probability of enrollment for women, and 20 percentage points for men. The corresponding negative effect on not getting a higher education is similar in magnitude whether working instead or not working for women. For men, the corresponding negative effect is mostly seen in the probability of working. Model (3) shows somewhat different results. By controlling for past grades and parental education, the effect of IQ is cut by a half for women, and even more for men. As a result, some of previously significant effects become insignificant, but the qualitative pattern remains the same. Model (4) shows the same results as Models (1) and (2).

Table 4.7: Estimated average marginal effects from the multinomial probit models

		(1)	(2)	(3)	(4)
Employed	IQ*Female	−0.123***	−0.124***	−0.0626*	−0.108***
		(0.034)	(0.035)	(0.034)	(0.035)
	IQ*Male	−0.0554*	−0.0499	0.00341	−0.0446
		(0.031)	(0.031)	(0.029)	(0.031)
	Extraversion*Female	−0.0479	−0.0253	−0.0653**	−0.0488
		(0.033)	(0.036)	(0.031)	(0.033)
	Extraversion*Male	0.0469	0.0447	0.0378	0.0414
		(0.030)	(0.035)	(0.027)	(0.030)
	Male	0.0658	0.0685	0.00437	0.0524
		(0.042)	(0.045)	(0.039)	(0.042)
Working	IQ*Female	−0.175***	−0.173***	−0.0766	−0.161***
		(0.049)	(0.050)	(0.058)	(0.050)
	IQ*Male	−0.142***	−0.141***	−0.0410	−0.133***
		(0.044)	(0.047)	(0.047)	(0.045)
	Extraversion*Female	−0.0181	−0.0138	−0.0646	−0.0163
		(0.041)	(0.047)	(0.047)	(0.041)
	Extraversion*Male	0.0994**	0.152***	0.0912**	0.0937*
		(0.042)	(0.049)	(0.043)	(0.042)
	male	0.0224	0.000881	−0.0588	0.00279
		(0.054)	(0.058)	(0.060)	(0.056)
Student	IQ*Female	0.298***	0.297***	0.139**	0.269***
		(0.059)	(0.061)	(0.070)	(0.060)
	IQ*Male	0.197***	0.190***	0.0376	0.177***
		(0.051)	(0.054)	(0.055)	(0.052)
	Extraversion*Female	0.0660	0.0390	0.130**	0.065
		(0.046)	(0.053)	(0.054)	(0.046)
	Extraversion*Male	−0.146***	−0.196***	−0.129***	−0.135**
		(0.047)	(0.054)	(0.050)	(0.048)
	male	−0.0882	−0.0693	0.0544	−0.0552
		(0.060)	(0.064)	(0.069)	(0.062)
	Observations	312	312	312	312
	Log-likelihood	-264.38	-251.48	-208.45	-258.51

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: IQ is measured by standardised Raven IQ, age 22. Extraversion is measured by standardized Big5 scores, age 22. Estimation sample: educational attainment at least 11 grades (vocational school).

The effect of extraversion on the probabilities for women are insignificant in all specifications except for Model (3). There, by controlling for past GPA and parental education, extraversion has a moderate positive effect on the probability of higher education and roughly equal negative effects on the probability of being a working or a non-working non-student. Formally testing the equality of the effect of extraversion across men and women in this specification, we can not reject the null hypothesis. For men, the effect of extraversion is significant and negative on higher education across all specifications. The male extraversion estimates are fairly similar across specifications, being virtually the same for Models (1), (3) and (4). They are somewhat larger for Model (2) when measures for other personality traits are controlled for, but the qualitative patterns remain the same there as well. In the baseline model, one standard deviation increase in extraversion scores is associated with 14 percentage points decrease in the probability of enrollment. The magnitude of the effect is about two-thirds of the estimated effect of IQ for men. The corresponding positive effects for being a non-student are significantly stronger for being employed. One standard deviation increase in extraversion scores is associated with 10 percentage points increase in the probability of employment. Again, the magnitude of the effect is about two-thirds of the estimated (negative) effect of IQ. Comparable specifications of the multinomial probit model give estimates that are similar to those obtained from the simple probit model both in their sign and magnitude. Given the weak correlation only between the Big Five dimensions, this is in line with expectations.

Average marginal effects on the probabilities are very useful in seeing the magnitudes, but they in themselves cannot answer where the effects come from. In order to answer the more structural questions we need to look at the more structural parameters. These parameters can be calculated using equations 4.5 on page 88 from the point estimates of Models (1) through (4). Note that because we used inactivity as the base category, we obtained estimates for the second and the third equation, of which the former directly identifies $alpha$, and the difference between the two identifies $\beta - \gamma$. Results of these calculations are shown in Table 4.8 on the following page.

According to the point estimates, returns to IQ without higher education (α) are similar

Table 4.8: Point estimates of the structural parameters of interest

	α			
	(1)	(2)	(3)	(4)
$IQXfemale$	0.15	0.18	0.19	0.13
$IQXmale$	−0.10	−0.12	−0.13	−0.12
$ExtraversionXfemale$	0.19	0.10	0.24	0.21
$ExtraversionXmale$	0.03	0.18	0.01	0.03
	$\beta-\gamma$			
	(1)	(2)	(3)	(4)
$IQXfemale$	0.80	0.77	0.24	0.73
$IQXmale$	0.80	0.81	0.31	0.76
$ExtraversionXfemale$	−0.04	0	0.14	−0.06
$ExtraversionXmale$	−0.53	−0.91	−0.46	−0.50

in all specifications. The estimated effects are positive for women and slightly negative for men. In sharp contrast to these results, net returns to IQ are strong and positive for higher education, with no gender difference to speak of. Recall that in Models (1) and (2), only net returns to personal traits are identified for higher education. These are the effects of personality traits on expected earnings minus the effects on costs of getting the higher education degree ($\beta - \gamma$).

As we have argued, Models (3) and (4) may help telling whether net returns to personality traits in higher education are large because they increase expected earnings in high-educated jobs (β) or because they decrease the costs of education (γ). Net returns to IQ stay unchanged in Model (4) where we control for behavioral problems in primary school. In Model (3), however, where past GPA and parental education are controlled for, net returns to IQ decrease by two-thirds both for men and women. As we discussed earlier, this may indicate a larger role played by IQ in reducing costs of higher education, ie. providing better capacity to study. An alternative explanation, also discussed earlier is that past GPA is another measure of cognitive capacity besides the Raven IQ scores measured at age 22. That would change the estimated coefficient of IQ even if it has nothing to do with costs of higher education. Note, however, that in this latter case, the coefficient on IQ would change roughly the same way in α and in $\beta - \gamma$. The results in Table 4.8 show that no such change is observable in α. This suggests that IQ increases the probability of higher education enrollment in large part by decreasing the costs of education.

Returns to extraversion in low-educated jobs are very similar to returns to cognitive capacity in such jobs for women, but not for men. Returns are very small but positive for women and practically zero for men (the latter except for Model 2 but small even there). Net returns to extraversion for higher educated women ($\beta - \gamma$) are zero, but they are strong and negative for men. The magnitude of the negative net effect of extraversion with higher education is about two thirds of the positive effect of cognitive capacity (it is even larger in Model 2). The estimated structural effects of male extraversion are virtually the same in Models (1), (3) and (4), indicating that whatever the proxies capture in the last two models, they do not interact with the net effect of extraversion on higher education.

The results suggests that, for men, the negative effect of extraversion on the probability of higher education operates through lowering the expected returns on the labour market as opposed through costs of education. The results are more mixed for women where models with cost proxies show more positive effects of extraversion. But that is true both for α and $\beta - \gamma$, suggesting that a possibly negative role for extraversion in the costs of education is not the only explanation for the phenomenon we observe. All in all, the results do not provide much evidence for extraversion to play a large part in the costs of education. Instead, the measured effects are likely to operate through expected returns on the labour market.

4.5 Conclusions

Using a unique dataset from Budapest, Hungary, we analyzed the role of extraversion on enrollment into higher education. Doing so, we have joined a growing body of literature looking at the effect of cognitive and non-cognitive skills on labour market outcomes. We have focused on the indirect effect of such skills, operating through the enrollment into higher education.

Our main contribution is twofold. Firstly, instead of a random measure of noncognitive traits, we made use of a standard set of indices called the Big Five, in particular its dominant measure of extraversion. Secondly, we separated the effects on participation according to gender to uncover substantial differences. Similarly to other approaches in the literature, we have found that non-cognitive skills have a significant negative effect on the higher education attainment of young men, while such effect is missing for women. Using proxies for earlier behavioral problems, we obtained results suggesting that non-cognitive traits work mostly through increasing the returns of early entry to the labour market, rather than decreasing the cost of higher education.

Our empirical model was agnostic about the sources of the gender differences and the size of our data was enough only to show the existence of such differences. Although our result fits well into the related literature, it will be interesting to see why these differences emerge and what longer term effects do they have. To carry out such an analysis, we have yet to see data that is both long and rich enough not only to follow individuals, but to follow a large number of them and do so for a long time so that several outcomes are observable over time.

Chapter 5

Have the old edged out the young in the new millennium? – or: what can we say about the effect of increased employment of the older on the young without wage data

Employment rates vary a lot across Europe and largely because of the differences in pension policies (discussed in the case of CEE countries in Chapter 3) countries having the lowest rates among the 55-64 age group usually have the lowest overall rates as well. In the absence of behavioural changes, we can expect a further 4-5 percent decrease in older people's employment rates during the coming 25 years. Both ageing and the fiscal pressure on pension systems suggest attacking the problems through active ageing policies, where pension reforms are key "sticks" along with "carrots" of unemployment assistance and perhaps legislative support. For such policies to be effective, they have to raise exit age, and ultimately, employment of older workers. Burniaux et al. (2004) reports an estimated expected increase in older workers' participation around 8 percentage points within the EU. Nevertheless, activation of the older might have also unintended side effects, such as affecting the labour market position of the young adversely. Clearly, if such effects exists, there are labour market as well as fiscal consequences and the expected net benefits have to be re-evaluated.

The importance of the employment of older workers is also recognised as an important goal of the common European Employment Strategy (EES). The 2003 communication of the EES by the EC suggests that the relevant concept to describe the connection between older and younger workers is direct substitution and the condition for a negative impact is the difference in growth rates in old and young employment rate. An opposing change in employment share in certain industries is considered too. The data used in the analysis spans the 1998-2002 period - both claims seem to be well supported by graphs of raw data (not reproduced here). Figure 5.1 on the following page re-creates one of the figures in the EC communication for a longer time span, including the recent years up to 2006. It shows employment rates of three age groups, that of the younger (15-24), the prime age (25-54) and the older (55-64) workers from the beginning of the 1990s on. Using prime age employment as an indicator of overall labour demand (strongly correlated with output), it is easy to spot four distinct periods over the years: 1) the end of the economic downturn until 1994, 2) the recovery and steady growth until around 2000, 3) short stagnation through 2001-2003 and 4) a recovery thereafter. Young and older employment seem to behave very differently. While employment of the older follows the dynamics of overall employment figures quite closely (but with much greater changes in magnitude), youth employment reacts with some lag and gets “off-track” at around 2000-2001, not being able to recover from the post-2000 crisis.[1] In the case of the younger, increasing unemployment shows that the decrease in employment was not completely absorbed by alternative channels – such as higher education – and therefore the loss we see is real. Position of he younger is thus weaker after 2000 than that of the old in every respect: in terms of employment, unemployment and in turn, most certainly also in terms of wages (there is unfortunately no cross-country data available on the latter). Moreover, this weakening seems to have gone hand in hand with the position of the older getting stronger.

[1]This effect is even more dramatic if we include the new member states. However, because these countries are very different in terms of their young labour market and in their development of higher education, they are omitted from the present analysis.

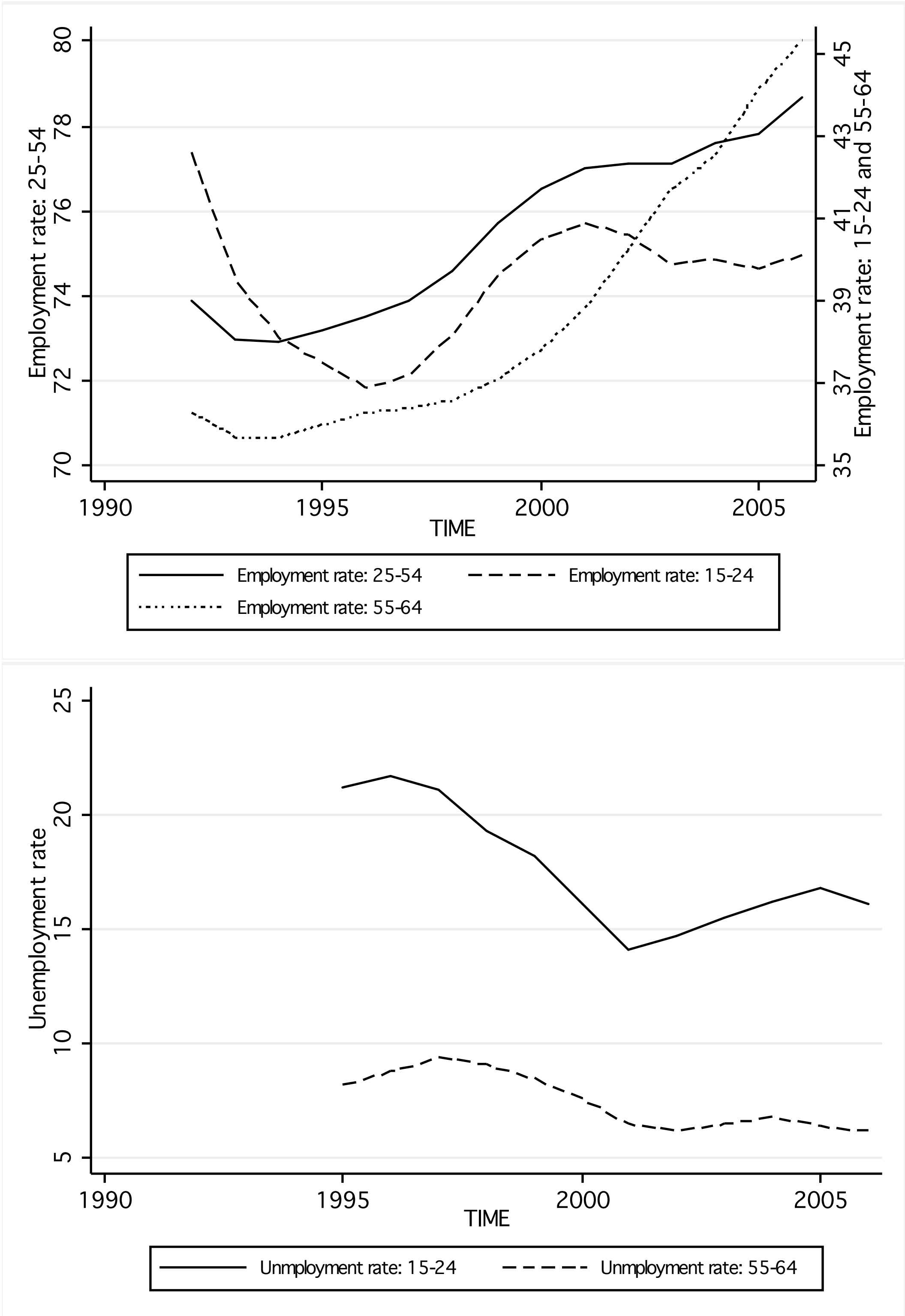

Figure 5.1: Employment and unemployment rates of the young (15-24), prime age (25-54) and older (55-64) workers within the EU15

Given the institutional background of governments working very hard towards and retention of older workers in the labour market, the question emerges: is the apparent (relative) decrease of the employment rate of the young caused by the increase in the employment rate of the old? Although we shall see that this question is impossible to answer at the level of the EU, it is still interesting to look at the conditions, theoretical and data requirements of answering it. In what follows, I will be looking at these. Firstly, I gather information on the potential mechanics of the relation between the old and the young and clarify the framework in which it is meaningful to talk about a relationship between them at all. Secondly, I discuss the requirements for the identification of these theoretical effects. Thirdly, I use aggregate data on employment from the EU-15 countries to estimate the relationship between changes of the two age group's employment rates based on the theoretical considerations of the first part.

5.1 An overview of the related literature

The problem of crowding between younger and older workers – called "cross-age crowding" henceforth – is more likely to come up in policy- rather than in theory-related discussions these days. This was however not always the case. Also, during the early 1980s, the problem appeared in a reversed direction: at those times, European governments were busy setting up early retirement schemes in which the hope that this will help combating youth unemployment played a major part. A correlation between old and young employment was interesting then to see if this effort was worth the cost. Subsequently, optimism was shown to be invalid theoretically by Layard et al. (1991), for example, and illustrated by some empirical evidence. Although the argument was never thoroughly underpinned by empirical investigation, it is instructive to briefly discuss the argument of Layard et al. (1991) explaining why exogenous decrease in the size of part of the workforce will not cause other parts to have better chances on the labour market. The authors put forward their argument against the effectiveness of early retirement in chapter 10 of their book. A natural starting point of the authors' is to analyse the case when output does not change *as a result* of the change – if it does, it can quickly accommodate the decrease in the workforce. If it does not change, however, unemployment shrinks as there are less older workers, which in turn causes inflation to rise or accelerate (wages adjust slowly). The authors argue that because there is no reason for the government to choose a different unemployment-inflation mix than it did before, it might well be tempted to let unemployment go back to its previous level to fight inflation. But this of course will result in a situation with reduced output.

The idea of Layard et al. (1991) can in principle be adopted to retirement and youth employment. In that case, the change is the opposite of the original argument: the influx of extra workforce will increase unemployment, which in turn will decrease wages and the inflationary pressure. Here the government has an incentive to go back to a previous inflation-unemployment mix by inflating real wages, thus lowering production costs of firms and also unemployment through that. Unfortunately this argument is not only roughly sketched, but assumes a lot about behaviour that we are at least uncertain about. The action of the government is not known and so is not the relative constancy of output. It is not clear how long the process of adjustment lasts and what costs individuals incur who are involved in it. Boeri (2005), for example, raises the point that the recently increased employment of women within the EU can delay labour-market integration of the young, which can in turn have permanent effect on their future labour-market performance. Most importantly: there is very little empirical evidence on the employment interaction between the age groups.

There is only a handful of studies looking directly on cross-age crowding. One of these is Herbertsson (2001), who takes only a cursory look at the problem and whos investigation is mainly motivated by the “original” form of the problem, ie. the effect of young unemployment on older employment. Herbertsson presents a fixed-effect panel regression based on data of OECD countries between 1979 and 1998 (Table 7 in the paper), using the employment rate of 55-64 year old people as the outcome and the unemployment rate of 16-24 year olds as the only right-hand side variable. Estimating a significant and negative parameter on the latter, he concludes that there is no crowding-out to speak of, an observation quite in line with theoretical predictions and the observation we can draw from the pre-1999 part of Figure 5.1.

Even though the regression of Herbertsson (2001) serves well as a quick check of cross-age crowding, there are important issues not addressed there. One such issue is that an increase in employment of the old might have very different effect than its decrease. Decreasing work requirements and availability of financial support at the same time (as it is the case of early retirements) should increase wages in the affected market to which there is no theoretical limit if productivity is growing, while an increased supply can hit the wage floor set by minimum wage legislation or collective bargaining and union activity. Secondly, using unemployment of the young as the labour market indicator is a nontrivial choice, as pressure on the youth labour market is easily channelled into participation in education. This does not mean that unemployment is a wrong choice – it merely means that the analysis does not tell everything it could. Finally there are possibly influential factors omitted from the analysis and because there is no theoretical funding to the equation estimated, there is no real way to judge if this is the case.

Still problematic theoretically, the recent assessment of Jousten et al. (2008) is much more convincing from a methodological point of view. Using yearly time series data between 1983 and 2002, the authors look at trends in older employment and young unemployment in Belgium. Using additional information on employment protection and calculating an elaborate and theoretically sound measure of the inducement to retirement, the authors test Granger-causality between employment rates of the older on the one hand, unemployment and employment of the young and of the prime age on the other hand. Their results show that there is no or weak effect of employment of the older on either young or prime age individuals employment chances. Being technically much more refined, this study still has the shortcoming of missing theoretical foundation for the estimated model.

Theoretical shortcomings are avoided by another strand of the literature, stemming in the analysis of labour demand. In his article on labour demand, Hamermesh (1987) describes firms' demand for heterogeneous factors, one example being workers of different age. Surveying different articles that estimate factor-substitution elasticities, the author points out a remarkably stable result. "One intriguing result occurs in all four studies (Borjas (1983a), Grant and Hamermesh (1981), Berger (1983) and Freeman (1979)) that examine the issue.

Adult women are q-substitutes for young workers. Borjas (1983a) also disaggregates the black male work force by age and finds that most of the q-substitutability is between women and young black men." The youth and women are thus found to be close competitors as the increase of the supply of one induces a decrease of the wage of the other – this is the meaning of q-substitutability (Hicks, 1970), while p-substitutability requires that wages of one type of labour decreases if the amount of the other increases. The reason for this is that they both are in relative shortage of experience and often of education too. The situation is similar but not identical to what is unfolding nowadays with regard to employment of older workers in general. Grant and Hamermesh (1981) argues that "competition from adult women has very likely had a negative impact on the labor market for youth." Moreover, this is not the only evidence that points towards a possible cross-age crowding. Hamermesh (1985) reviews elasticity of substitution estimates and presents the signs, but not the numerical results in a tabular format (table 4 page 74-75). Looking at results regarding both p- and q-substitution, the author shows that most results agree in the substitutability of young and older (including but often not separating prime-age) labour. He concludes that

> "The evidence seems quite suggestive, though by no means conclusive, that adult women and youths are substitutes in the sense that an increased supply of one puts downward pressure on the relative wage of the other. That is, a relative influx of adult women into the labour force creates pressure for a fall in the relative wage of young workers; or, if the relative wage cannot fall, for a rise in the unemployment rate of young workers."

As opposed to the previous estimates, this approach relies on theoretical results to look at cross-age crowding, which is a great step further. It is clear, however, that this advantage comes at a price: the data requirements are much higher than that of other ways of analysing the same problem. In particular, wages for all types of labour (in our case: at least for all age groups concerned) are required and so is the price and stock of capital. As we shall see later, this requirement is especially difficult to meet in a cross-country context, in which changes in older employment are unfolding in Europe.

Older employment is of course not the only factor that can affect the employment chances of young people. As opposed to cross-age crowding, generational crowding refers to the effect the large size of a cohort has on its members' labour market chances. Here we can not discuss the complete body of the related literature, but refer to comprehensive studies such as the one by Korenman and Neumark (1997). The effect the generational crowding literature is looking at is a cohort-specific shock implying stronger competition among people being born (actually: entering the labour market) in a specific year. The argument is a standard one, building on stronger competition as the number of participants is increasing. The simple version of the model is tested and developed further by a number of authors. As discussed in Fertig and Schmidt (2003) among others, the importance of rigidities and institutions within the literature is central. A good example of the approach is the paper of Jimeno and Palenzuela (2003), who look at the effect of generation size and institutions together on youth unemployment. Similarly to cross-age crowding, the demographic crowding idea faces empirical challenges. Indeed, the evidence is mixed whether the effect of a larger cohort size depresses or enhances youth labour market possibilities. Refining measurement seems to be a major concern for the literature – a good example is the study of Skans (2005). The author uses data on the level of local labour markets and includes fine measure of population structure in the form of population shares of 5-year age groups. He employs an instrumental variable estimation procedure, using cohort sizes lagged by one and a half decade, in order to circumvent the possibility of reverse causality through selective migration. His results are among the ones opposing standard wisdom regarding demographic crowding and cross-age crowding, indicating that members of large cohorts enjoy better than average labour market conditions and there is a negative correlation between labour market chances of the old and the young.

Looking at both q-substitution and generational crowding, most papers discussed above have relied at least partially on the idea of substitution within the production process. Although substitution plays an important role in the cross-age crowding story, it does not tell anything about its internal mechanics. Even though it might not be possible to fully formalise details in an actual estimation procedure, it might be worth discussing it in more detail what form substitution can take and what might make firms' reaction to demand shocks differentiated by the type of labour employed. It is not hard to see that without some asymmetry between different types of workers, cross-age crowding has limited effect. One way such asymmetry can arise is through differences in the ability of wages to adjust. Reasons why wages of the youth can not adjust downward include the presence of unions, minimum wage policies or other elements of the legislative framework that introduce a formal or effective wage floor. Nevertheless, asymmetries can arise independently of wage floors, as a result of firm behaviour and also due to an apriory neutral policy intervention. Pagés and Montenegro (2007) discusses as a result of employment protection policies in the spirit of Hopenhayn and Rogerson (1993). The authors build on costs and barriers to entry and firing costs that are ex post asymmetric between workers with different tenures. Based on a theoretical model, the conclusion is drawn that higher severance payments put the younger at more risk in bad times than the old. An increase in protection is also shown to lead to a so-called Last In First Out personnel policy for the young. Under such a regime, it is the young who are fired first and hired last.[2] Time series estimates from Chile support the theoretical findings: a synthetic index of job security is indeed positively correlated with youth unemployment. Because the extent of job protection is high in Europe, we might think that such a mechanism is at work in this area as well.

The mechanism described by Pagés and Montenegro (2007) can exert its effect if the only shock is coming from older workers' increased employment. As a reponse to the supply shock, firms would like to adjust all factors' demand, but can adjust only that of the young workers', because of the restrictions imposed by employment protection. There are, however, other mechanisms, whose economic foundations are not so well developed, but nevertheless are often referred to by governmental officials and ordinary people in general. One such mechanism can be characterised by the analogy of a "pipeline". The idea is that the workforce at an employer covers all age groups and naturally ages. Through ageing, old employers "drop out" at the end of the "pipe" and given the exit rate, young people are recruited. Although this is an overly simplistic description of hiring an firing practices, it has powerful implications. Most importantly, if the dropping out of the old is slowed down and

[2]Under heavy fluctuations of the business cycle, such a policy would be enough to increase youth unemployment and decrease employment. This is, however, not the case in the period we are looking at empirically.

the environment is stationery, entry possibilities of the young are worsened. If the proportion of employers with such policy is high enough, employment rate of the young is affected. Despite the discussion of such mechanisms is not easily found in the economics literature, sociologists do recognise its relevance. Calling it "vacancy chains", the topic is explored, for example, by Stewman (1988).

5.2 Theoretical considerations

"Much of the recent discussion of crowding-out has been confusing simply because the term has not been carefully defined." As we shall see, there has not been much discussion recently about what I refer to as cross-age crowding. Although this quote refers to the classic case of public-private investment crowding-out (Carlson and Spencer, 1975), the point is quite applicable to the case of generational-crowding too. Having discussed the related literature, it appeared that besides the varying sophistication of the actual estimation strategy, none of the analyses were related to an economic model which makes interpreting the results more difficult than necessary. There might be many indicators of crowding-out that we could start our investigation with. Out of these, I shall select those based on employment, rather than those concentrating on unemployment. The reason for this is that modeling the mechanisms that shift individuals between unemployment and inactivity (out of the labour force) is well beyond the scope of this discussion. In particular, answering the question whether and when education can be thought of as an escape-route from the labour market is very difficult even though it plays an important role in the case at hand. Once these choices are made, it appears that we are interested in some variant of the following indicator:

$$\left.\frac{\Delta J}{\Delta O}\right|_{\Omega},$$

where J and O are the number of junior and old workers employed, respectively and Ω is a set of quantities that we want to keep constant when we are looking at the change. This indicator in itself gives a change in the exact number of Juniors employed in reaction to a change in the exact number of Older workers, but this might not always be the case. Some indicators might characterise the strength of the reaction with respect to a reference value, some might characterise a sign only. As we shall see, our choice will often be seriously limited by the available information.

In its purest form, the problem is essentially that of substitution of older and young workers, and thus it is best cast in a production function framework. Moreover, as the increase in the employment rate of the old as a result of changed pension regulations can be thought of – and is indeed almost always meant – as a labour market programme, we can use the framework proposed by Johnson (1980) to look at its employment effects in the case of rigid wages. Let us suppose now that there is a linearly homogeneous production function that characterises the whole economy written as

$$Y = F(t, X) = F(A, J, P, O, K), \text{ s.t. } \partial Y/\partial X_i > 0, \ \forall i \neq j$$

where Y is output, A is a measure of technology, X is a generic vector of inputs, specified in our case as follows: K is capital and the amount of junior, prime-age, old workers are denoted by J, P and O, respectively. Because we shall not consider a change in capital, it will be treated as a parameter of production hereafter and assume that demands of other factors will give its amount as given. Similarly, the assumption about Older labour implies that the amount of old people employed is not part of the firms' optimisation problem, older employment being fixed on the short run.

Because the focus of this study is to reflect on practicalities of inference about the interaction of the old and the young, I shall not close the model by either putting it into a general equilibrium framework or by introducing dynamics. Based on the theoretical discussions, these dimensions are important. As we shall consider different ways of adjustments, it becomes apparent that the flexibility of overall demand can make a difference in what adjustment firms will choose. This flexibility will in turn depend on whether the country is small or large, has an open or a closed economy. Similar considerations apply if we want to restrict attention on one sector or another. Omitting the modeling of dynamics will lead to several peculiarities, one of which is jumping between the firm level and the level of the complete economy. Considering firms as price takers but building on the fact that marginal products and thus prices change as a response to firms' factor use decisions is a result of hiding dynamics.

Let us now suppose that firms hold technology and capital fixed, thus using the $F(J, P, O|K, A)$ production function. After an employment shock is received in O, firms will re-optimise after some time. Re-optimisation will in general change output, costs and profits and might take time to complete. One might argue that because increasing demand might not adjust immediately to supply changes, firms might want to keep their output constant despite the change in Older employment. Also, one might also think that firms might find keeping costs constant important. In either cases, no re-optimisation takes place, hence the reaction is entirely influenced by characteristics of the technology and the prevailing prices of the factors, respectively. To see this, note that by fixing costs, the total cost function implicitly defines a trade-off between the factors. Totally differentiating the total cost function C, keeping other factors constant and rearranging gives:

$$\left.\frac{\Delta J}{\Delta O}\right|_{C,P} = -\frac{p_O}{p_J}.$$

Holding output constant, it is the production function that defines a similar trade-off implicitly. Totally differentiating F, we can obtain the trade-off as the Marginal Rate of Technical Substitution (MRTS):

$$\left.\frac{\Delta J}{\Delta O}\right|_{Y,P} = -\frac{F_O}{F_J}.$$

We have to note a couple of feature of these changes. Firstly, the effects are equal in equilibrium and are determined by the first derivatives of the production function. Both ratios are always negative and therefore always imply a decrease in the employment of the Juniors if that of the Old increased. This is so even if the old and the young had an effect on each other's marginal product. No matter what assumptions we make about the costs of adjustment, this is a highly improbable behaviour for firms, as the two effects might go the other way around. Secondly, observe that besides Y and C, we have also held P constant, because using only the production or the total cost function, there is no information that would tell us the amount of change each factor absorbs from the change in Older employment. Choosing either J or O bring information to the model from the outside, such as a variant of the the result of Pagés and Montenegro (2007), stating that in case job protection legislation is in place, shocks are always absorbed by the employment of the younger employees. As soon as we allow for optimising behaviour, this ambiguity can be resolved and we can allow for both J and P to change.

Because of the assumptions about employment of the old and capital, firms maximise profit by choosing Junior and Prime age employment only:

$$\max_{J,P} \Pi(J, P|O, K, A) = F(J, P|O, K, A) - (Jp_J + Pp_P + Op_O + Kp_K)\,,$$

yielding the first-order conditions

$$\begin{aligned} p_J &= F_J(J, P|O, K) \\ p_P &= F_P(J, P|O, K), \end{aligned}$$

where F_i is the derivative of the production function with respect to factor X_i.

Following closely Grant and Hamermesh (1981) and ultimately the approach of Johnson (1980), we observe that this system of equations implicitly define the relationship between the amount of factors used on the one hand and, output used or, if prices can adjust, the change in prices on the other hand. We shall look at changes only as a response to increased older employment. To be able to calculate the changes, we totally differentiate the equations, assuming up front that capital does not change and concentrating on J and P:

$$dp_J = F_{JJ}dJ + F_{JP}dP + F_{JO}dO \tag{5.1}$$

$$dp_P = F_{PJ}dJ + F_{PP}dP + F_{PO}dO, \tag{5.2}$$

where F_{ij} is the cross-derivative of the production function with respect to factor X_i and X_j.

There are four cases to consider here, depending on which of the two prices can change. Note that the ability of prices to change ultimately is determined by market structure and the resulting equilibrium there, so in principle it would be possible to discuss possibilities halfway between complete flexibility and inflexibility as well. Still, because data on labour supply is not available to complement my data, I shall not look at this effect, but only at the polar cases. In these cases changes in the factors used and their prices are mutually exclusive at the end of the adjustment. Because of this, if the price of both J and P are rigid, the left hand side of equations 5.1 on the previous page and 5.2 on the preceding page is zero and the change of O will affect the amount of J and P labour used. The changes are given by each of he equations setting $dp_i = 0$ and not considering and exogeneous change in either J or P:

$$\frac{dJ}{dO} = -\frac{F_{JO}}{F_{JJ}}, \quad \frac{dp_J}{dO} = 0, \tag{5.3}$$

$$\frac{dP}{dO} = -\frac{F_{PO}}{F_{PP}}, \quad \frac{dp_P}{dO} = 0. \tag{5.4}$$

The change in Junior employment is thus proportional to the change in Older employment and the proportionality is determined by the ratio of changes in marginal products when Junior employment and Older employment changes, respectively. If the production function is concave in Junior labour, the sign of this change is determined by the effect of Old labour on the marginal product of the Juniors. If it increases it that is the two are complements, the cross-derivative is positive, and the change will be positive as well: more of the Old would lead to more demand for Juniors. If more old decrease the marginal product of Juniors, that is the two are substitutes, the cross-derivative is negative and the change itself will be negative. Note that the same is true for the Prime age and the prime age itself can have an effect on Junior employment on the long run. Such effects are, however, not considered here.

If the price of both the Prime age and Juniors can adjust, dJ and dP are set to zero, and the price changes are given as

$$\frac{dJ}{dO} = 0, \quad \frac{dp_J}{dO} = F_{JO}, \tag{5.5}$$

$$\frac{dP}{dO} = 0, \quad \frac{dp_P}{dO} = F_{PO}. \tag{5.6}$$

The price change is thus equal to the change in marginal product as a result of the change of O. If the price for Junior labour can adjust, but not that of the Prime age, we have a combination of the two previous cases: J does not change, and dP is given as before. Using the latter to obtain dp_J/dO, we get

$$\frac{dJ}{dO} = 0, \qquad \frac{dp_J}{dO} = -F_{JP}\frac{F_{PO}}{F_{PP}} + F_{JO}, \tag{5.7}$$

$$\frac{dP}{dO} = -\frac{F_{PO}}{F_{PP}}, \qquad \frac{dp_P}{dO} = 0. \tag{5.8}$$

The price change of the Juniors has an additional term in this case showing the changed amount of Prime age labour on the marginal product of the Juniors. If the situation is reversed, that is wages of the Juniors are fixed and wages of the Prime age can adjust, the calculation is completely analogous. Concluding this discussion on potential price and quantity responses, we highlight here that in case of no price response our choice of indicator for the effect of O on J is

$$\left.\frac{\Delta J}{\Delta O}\right|_{p_J,P} = \frac{dJ}{dO} = -\frac{F_{JO}}{F_{JJ}}.$$

Having seen the effect of a changing O on J, one might wonder about their relationship. We have already seen that the MRTS can only be negative, thus if Juniors and the Old are complements, it must be smaller than the reaction in the case of optimisation. Nevertheless, if the two factors are complements, both measures are negative and thus there seems to be room for ranking them. Unfortunately, this is not possible and because of this neither the sign, nor the magnitude of one effect is informative about the other.

If we are willing to parameterise the production function, we can obtain exact formuli for the above measures and characterise their expected size closer. Let us now consider the popular Translog production function for the generic inputs X_k in the log form[3]:

$$\begin{aligned}
\ln\left[F(A,J,P,O,K)\right] &= \ln y = \ln\alpha_0 + \tau A + \alpha_J \ln J + \alpha_P \ln P + \alpha_O \ln O + \alpha_K \ln K \\
&+ \frac{1}{2}\big(\gamma_{JJ}\ln^2 J + \gamma_{JP}\ln J \ln P + \gamma_{JO}\ln J \ln O + \gamma_{JK}\ln J \ln K \\
&+ \gamma_{PJ}\ln P \ln J + \gamma_{PP}\ln^2 P + \gamma_{PO}\ln P \ln O + \gamma_{PK}\ln P \ln K \\
&+ \gamma_{OJ}\ln O \ln J + \gamma_{OP}\ln O \ln P + \gamma_{OO}\ln^2 O + \gamma_{OK}\ln O \ln K \\
&+ \gamma_{KJ}\ln K \ln J + \gamma_{KP}\ln K \ln P + \gamma_{KO}\ln K \ln O + \gamma_{KK}\ln^2 K\big).
\end{aligned}$$

Note that in this production function, I have explicitly introduced Hicks-neutral, separable technological change and capital too. Also note that if the γ coefficients are zero, the function reduces to the Cobb-Douglas production function.

In this case the MRTS between the generic input X_i and the Old is easily written through an elasticity form:

$$\begin{aligned}
MRTS_{JO} &= -\left.\frac{\partial\ln F/\partial\ln O}{\partial\ln F/\partial\ln J}\right|_{Y,X_j}\frac{J}{O} = & (5.9)\\
&= -\frac{\alpha_O + \gamma_{OJ}\ln J + \gamma_{OP}\ln P + \gamma_{OO}\ln O + \gamma_{OK}\ln K}{\alpha_J + \gamma_{JJ}\ln J + \gamma_{JP}\ln P + \gamma_{JO}\ln J + \gamma_{JK}\ln K}\frac{J}{O}. & (5.10)
\end{aligned}$$

This is a fairly complicated form of dependence and because of the lack of separability between factor of production, it requires the knowledge of the level of all inputs. If all γ_{ij}s are zero and we are in the Cobb-Douglas case, the expression is much less complicated and requires the knowledge of the technology parameters and only J and O in addition:

$$MRTS_{JO} = \left.\frac{d\ln J}{d\ln O}\right|_{Y} = -\frac{\alpha_O}{\alpha_J}\frac{J}{O}.$$

Using a production function written in logs, the second measure of change, dJ/dO after optimisation and without the flexibility of p_J is easiest to state using the parameters of the

[3]Note that most often it is not the translog production, but the cost function that is used as a starting point, as the aim is to calculate Hicks-Allen elasticities of substitution. Although this is not the case here, the calculations and the estimation procedure is fairly similar.

log production functions as those directly identify the second derivatives:

$$\frac{d\ln J}{d\ln O}=\frac{d\ln J}{d\ln O}\frac{O}{J}=-\frac{F_{JO}}{F_{JJ}}\frac{O}{J}.$$

At this point, we have to introduce new concepts. Let us denote the output share of factor i by $S_i = p_i X_i/Q$ and introduce C_{JO} and C_{JJ} are the Hicks elasticities of complementarity of J with respect to O and to itself, defined as $C_{ij} = FF_{ij}/F_iF_j$.[4] This elasticity (written in terms of levels) is similar but not identical to the quantity we were looking at in the above discussion: it measures the effect of a change in relative quantities on relative factor prices (see Stern (2004) on how it fits among other elasticities). Assuming competitive markets and thus replacing first derivatives with prices, we re-write the elasticity as $C_{ij} = FF_{ij}/(p_ip_j)$ and express F_{ij} from here. Plugging the resulting expression into the above formula and using the definition of the output shares, we obtain

$$\frac{d\ln J}{d\ln O}=-\frac{F_{JO}}{F_{JJ}}\frac{O}{J}=-\frac{C_{JO}\frac{p_Jp_O}{F}}{C_{JJ}\frac{p_Jp_J}{F}}\frac{O}{J}=-\frac{C_{JO}\frac{p_OO}{F}}{C_{JJ}\frac{p_JJ}{F}},$$

therefore

$$\left.\frac{d\ln J}{d\ln O}\right|_{p_J,P}=-\frac{C_{JO}}{C_{JJ}}\frac{S_O}{S_J}.$$

In order to connect this expression to estimable coefficients, we use the result of Sato and Koizumi (1973), who showed that

$$C_{JO}=\frac{\gamma_{JO}}{S_JS_O}+1.$$

Defining the elasticities this way, the quantity response we are looking for is calculable from the coefficients of cross-terms in the translog production functions as well as from the output shares. If this elasticity is negative, the factors we are looking at are so-called q-substitutes, and if it is positive, they are q-complements. Conclusion about the sign of the elasticity depends on the estimates of the γ parameter and on the knowledge of the S_i and S_j shares

[4]Kim (2000) shows that this elasticity holds marginal cost of production constant. If this intuition was possible to carry forward to the quantitiy response itself, it would provide a good intuition for keeping optimality in production after a quantity change. This direct use of the result is unfortunately not possible.

too, so an exact estimate can be obtained only if we know all of these. Nevertheless, it can be shown that under reasonable assumptions of factor uses the sign of this elasticity is the same as that of the cross-derivative.

5.3 Identification

The theoretical results imply that in order to estimate the effects we are after, we have to obtain parameter estimates of the production function and cost shares too. Although this could be straightforward in many cases when one has access to microdata, we shall se later that this is not the case here. Oftentimes all we have at hand are data on employment, population figures by groups and GDP. Because of this difficulty, first we have to discuss the identifiability of our key parameters.

If we wish to estimate the MRTS or the log-MRTS, all we have to estimate is the first derivatives of the production function. One way to proceed is to estimate the production function directly, that is to regress log output on the log of inputs and their cross products as in equation 5.9 on page 113. Despite its many problems, this procedure has he advantage of not assuming anything about market structure or optimising behaviour of the firms (or the lack of it). The estimating equation in this case is identical to equation 5.9 on page 113 with a stochastic disturbance appended. The resulting equation has $k * k + 2$ – in our case: 26 – coefficients and imposes no restrictions on the estimation, except for the existence and meaningfulness of the equation as such. Specifically, it does not assume a particular form of competition, optimisation, including the resulting homogeneity or symmetry of factor use (the latter can be imposed by omitting the potentially identical coefficients of the cross-terms). Identification of the equation hinges upon the availability of data, sufficient variation in both linear and cross-terms and their exogeneity. Note that the second, extra coefficient is that of Hicks-neutral technological change. If all conditions of estimation are met, direct estimation of the production function is a good way of signing the elasticity of complementarity.

Employment and output data are often available, but data on capital stock is hard to find. What happens to identifiability if $\ln K$ is ommitted from the equation? The effect depends on the variability of capital and its correlation with other inputs. If capital stock is relatively stable, it will be absorbed in the estimate of α_0 or if using panel data, in the fixed effects. If such stability can not be expected, the omission of K will lead to an upward-bias in the estimate of other parameters, the extent of which is determined by the curvature of the isoquants. Nevertheless, this discussion characterises the omission of the level of K only. Because of the cross terms, the omission of K introduces bias to the estimate of coefficients even if it is fixed, but other factors vary. In that case, the estimate of α_J the coefficient of $\ln J$ will be $(\alpha_J + \gamma_{JK} K)$, the second term being the bias in the estimate. In the case of complements, this bias is positive (driving the coefficient towards zero and then to being positive), while in the case of substitutes, the bias is negative (making the coefficient larger in absolute value). Even if we include individual fixed-effects, this bias does not go away. Moreover, the bias is different for all included variables, as it includes the non-identified coefficient of the cross-terms. One might want to use a proxy instead of omitting the variable altogether – it is the difference between the proxy and the actual value that has to be considered the same way. If the flexibility provided by the translog function is not required, that is if the production function is acually Cobb-Douglas, coefficients on the cross-terms is zero, hence this bias does not distort the estimates. If we are interested only in first derivatives and the MRTS, this might actually be a good approach.

This direct estimation method is rarely used in the literature and for good reason. Less importantly, the proliferation of cross-terms is so strong in case of many inputs, that multi-collinearity can make estimation with aggregate data difficult if not impossible, even if the equation is identified formally. More importantly even if this problem is overcome through the use of more data, factor use is hardly exogeneous in any sense of the word. The main reason for suspecting endogeneity is the potential presence of an unobserved technology shock. If factor usage is a result of optimisation and the technology shocks are not observable, the factors used will be correlated with the technology shocks and the estimated parameters are biased.

There are a number of solutions to the endogeneity problem, enumerated neatly in the recent overview of Behar (2008). The two most important of these is exploiting the dynamic nature of the problem to find suitable instruments and tackling the endogeneity with the control function approach, relying on further analysis of the production process. The first method is pioneered by Blundell and Bond (2000). The authors show that persistence in factor use is high enough that by choosing an appropriately long lag length, the endogeneity can be successfully overcome. Unfortunately, because they consider a large N, fixed T problem, this method is not possible to use here, as the number of countries is small and the number of time periods is large in our case. The other method is to introduce a control function into the regression that would tackle the endogeneity by acting as a proxy for the omitted variable. The original idea is due to Olley and Pakes (1996), who use investment to create a control function. This is the idea developed further by Levinsohn and Petrin (2003), who use intermediate goods for the same purpose. Because such data is as difficult to obtain in our case as reliable data on capital stock, we have to find another way of estimating coefficients of the production function.

Because of the technical difficulties and also the ease of imposition of theoretical restrictions, the most often estimated equation in the translog case is a system of share equations. In our case this is

$$\begin{aligned} S_J &= \alpha_J + \gamma_{JJ} \ln J + \gamma_{JP} \ln P + \gamma_{JO} \ln O + \gamma_{JK} \ln K + \epsilon_J && (5.11) \\ S_P &= \alpha_P + \gamma_{PJ} \ln J + \gamma_{PP} \ln P + \gamma_{PO} \ln O + \gamma_{PK} \ln K + \epsilon_P && (5.12) \\ S_O &= \alpha_O + \gamma_{OJ} \ln J + \gamma_{OP} \ln P + \gamma_{OO} \ln O + \gamma_{OK} \ln K + \epsilon_O && (5.13) \\ S_K &= \alpha_K + \gamma_{KJ} \ln J + \gamma_{KP} \ln P + \gamma_{KO} \ln O + \gamma_{KK} \ln K + \epsilon_K. && (5.14) \end{aligned}$$

This system has the same number of coefficients to start with as the production function, but the number can be reduced to 20 simply by noting that the adding-up restriction on makes 5 of these a linear combination of the others. If we are interested in the full system, we can impose symmetry on it and reduce the number of free coefficients to 12. If we are not interested in the full system and do not want to impose the symmetry restriction, we can simply estimate one of the equations. If we want to estimate the elasticity of complementarity, we have to estimate one equation of these that identifies the second derivative of the production function (in our case: γ_{OJ}) and we also have to be able to calculate the cost share of both inputs involved (estimation of both equations improves efficiency, but not required for identification). Efficiency can be increased if the equation attached to both inputs involved in the elasticity is estimated. This approach is required if we are interested in higher derivatives and in the elasticity of complementarity.

Once again, it is instructive to see what happens if we have limited information but still want to extract information from this model. It is readily apparent that compared to estimating the production function, we got rid of the cross-terms in the equations in this case, which makes it less difficult to deal with the bias associated with the potential omission of the capital stock on the one hand. On the other hand, we need additional information for estimation: the prices of inputs. We require only one price in order to estimate the coefficients connected to one input, but need two if we are interested in the elasticity of complementarity. Even though prices appear on the left hand side of the equation, missing them has an effect similar to missing quantities. To see this, let us now divide the equations through by the price, which in the case of juniors yields

$$J/Q = \frac{\alpha_J}{p_J} + \frac{\gamma_{JJ}}{p_J} \ln J + \frac{\gamma_{JP}}{p_J} \ln P + \frac{\gamma_{JO}}{p_J} \ln O + \frac{\gamma_{JK}}{p_J} \ln K + \frac{\epsilon_J}{p_J}.$$

If prices are identical for every observation, the coefficients are identified up to a positive scale – given our earlier result on signing the elasticity of complementarity, this is an important result. The shares themselves are, however, not identified. Unless the prices of the two inputs under consideration are not only constant but also identical, the elasticity of complementarity itself can not be identified. If they are not identical, but we can assume that the difference between them is small, the elasticity is still not identified, but the error made is likely to be small. Note that this approach consistent with possibly not knowing K but only approximating it using a individual-specific fixed-effect.

Prices, especially over a longer period of time and especially all of them are not likely to be completely fixed. If prices are known to be fixed across time periods, but not across individuals or across individuals but not across time periods, we can estimate coefficients specific to the dimension where price is not changing, making it constant. This method will be able to sign the elasticity of complementarity, but only for the smaller aggregates in which the constancy of price is a realistic assumption. Obtaining an overall sign requires extra information and calculation. This method also requires more data then we used before as it can not rely on both dimensions of a panel. Because of the same reason, K must be known as the fixed-effect strategy can not work here.

Finally, it might be the case that prices are different in both the i and the t dimension. In that case the problem appears both in the cross-section and in the time-series dimension, so neither of these can be used for estimation in itself. Coefficients in this model can be thought of as dependent on an unknown variable, p_J that is potentially correlated with all of them because of nonzero cross-price responses. Putting it in another way, we have a case of nonseparable heterogeneity. This model is very general and hence its estimation must rely on a flexible method. Chesher (2003) shows that identification and hence estimation of nonseparable models is possible if we rely on quantile functions and regression respectively. The conditions for the application is that the dependence of the coefficient on the underlying factor must be monotonic - this is satisfied in our case. Unfortunately, this method does not allow for fixed-effects estimation, hence as a bare minimum the knowledge of capital stock would be required for its application.

If we can not estimate either the production function or the system of equations directly, but have only employment data, we can transform the production function to get closer to an estimable equation. Because of the unavoidable bias due to the omission of data on capital stock, we have to assume that the production function is of the Cobb-Douglas form and control for the omission too. Starting from the restricted version of equation 5.9 on page 113, we subtract the log of output $\ln Y$ and also the log of the juniors employed $\ln J$ from both sides of the equation. To obtain log-employment rates, we add $\alpha_J \log W_J$ to both sides of the equation, and add and subtract $\alpha_O \log W_O$ and $\alpha_P \log W_P$ to the right-hand side of the equation – the latter are the number of individuals of the given age in the population. Finally we divide the equation by $-\alpha_J$, making the log of the juniors employed the dependent variable. As a result, the equation we shall use as a basis to the estimates is the following:

$$
\begin{aligned}
\ln J - \ln W_J &= -\frac{\ln \alpha}{\alpha_J} - \frac{\alpha_O}{\alpha_J} \ln \left(\frac{O}{W_O} \right) - \frac{\alpha_P}{\alpha_J} \ln \left(\frac{P}{W_P} \right) - \frac{\alpha_K}{\alpha_J} \ln K - \\
&- \ln W_J - \frac{\alpha_O}{\alpha_J} \ln W_O - \frac{\alpha_P}{\alpha_J} \ln W_P + \frac{1}{\alpha_J} \ln Y + u. \qquad (5.15)
\end{aligned}
$$

This equation can be estimated in itself to yield the elasticity version of the Technical Rate of Substitution directly. Because of the coefficient on output is just the reciprocal of the coefficient on Junior employment, technology parameters are also identified in theory. Note that because all of the technology parameters are positive, estimated coefficients of the employment rate and population size variables are expected to be negative. The only variable is the log log output, for which we expect a positive coefficient.

5.4 Data and feasible estimating equations

The introductory empirical analysis was based on aggregate employment data available from the Eurostat website for most European countries. Because the main point of this paper is to show the amount of information we can extract from this data, I shall use them for estimation too and work with the 2000-2006 period. Collection of employment data started in most countires from the beginning of the 1990s. Most of these surveys are set up adhering to the standards of the International Labour Organisation, therefore they are comparable to each other to a great extent when it comes to employment practices.

Many of the labour force surveys contain income figures too, which would be very useful for our analysis. Unfortunately, these figures seem to be judged untrustworthy by the Eurostat, as they are not released either as micro- or as aggregate data. Looking for auxiliary wage data did not yield any success either. Candidates include the European Social Survey (ESS), micro-level wage data from individual countries' wage surveys or the Luxemburg Income Study. The wage data in the ESS spans only two years and the micro-level data are very hard to access. Because of these difficulties, wages have to be excluded from the analysis, even as input to a benchmark model. The same is true for capital stock. There exist estimates of capital stock for some countries and up until some time, but not for our set of countries and the post-2000 period. Because of this, we have to take this missing information during estimation.

In order to maximise the number of time periods, quarterly data are used during estimation. Because of the structural differences between new and old member states, most importantly in the existing system and speed of expansion of higher education, only the EU15 countries are included.[5] Unfortunately, because of the missing GDP data, we are completely missing Portugal from the final estimates and because of relatively late availability of quarterly GDP data, Germany, France and Luxemburg can contribute only part of the panel (from 2005, 2003 and 2003 respectively). The latter loss is especially problematic, given both the population share of these countries within the EU and the fact that their contribution to only the second half of the panel.

The working data consists of the following variables: employment rate and share (of the total working age population) for the Juniors, the Prime age and the Old along with the log of gdp. The variables used in estimation and their basic descriptive statistics are the following:

Table 5.1: Summary statistics of variables used in the empirical analysis

Variable		**Mean**	**Std. Dev.**	**N**
Employment rate, age 15-24 (log)	lnEmprJ	−1.028	0.348	976
Employment rate, age 55-64 (log)	lnEmprO	−1.082	0.424	976
Employment rate, age 25-54 (log)	lnEmprP	0.933	0.18	976
Employment, age 15-24 (log)	lnEmpJ	5.927	1.457	976
Employment, age 55-64 (log)	lnEmpO	5.873	1.492	976
Employment, age 25-54 (log)	lnEmpP	7.887	1.473	976
Population size, age 15-24 (log)	lnPopJ	6.955	1.467	976
Population size, age 25-54 (log)	lnPopO	6.773	1.5	976
Population size, age 55-64 (log)	lnPopP	8.138	1.487	976
GDP (log)	lnGDP	10.211	1.755	932

Figure 5.1 on page 100 showed the over-time evolution in employment rates for the three age group we concentrate on, but the details captured by Figure A.1 on page 147 in the Appendix make it clear that there is considerable heterogeneity within the EU not only in the level of employment rates, but also in the way these change over time. While there are a

[5]These are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom.

number of countries, where junior employment went strongly down between 2000 and 2006 – these include Portugal, the Netherlands and Sweden, for example – there are a number of countries where the increase in employment of the old was not followed by a strong decrease in the employment of the juniors – such as in Greece or Belgium.

During estimation, we shall use the following linear model:

$$\begin{aligned} lnemprJ_{it} &= \alpha + \beta_O lnemprO_{it} + \beta_P lnemprP_{it} + \gamma_{gdp} lngdp_{it} + \gamma_{empT} lnempT_{it} + \\ &+ \delta lntime + f_i + u_{it}, \end{aligned} \tag{5.16}$$

where $lnempsrJ$ is the log of the share of junior-, $lnempsrO$ is the share of the log of old employment, while $lnpop$ is the log of the working age population. $lngdp$ is the log of GDP, $lntime$ is a time trend for Hicks-neutral technological change while f is a country-specific fixed effect standing for capital stock and other time-invariant effects. As a starting point, this equation is estimated using ordinary least squares (or more explicitly: the fixed effects) estimator, with standard errors adjusted for potential clustering in the error term.

We assumed that the employment of the older is given exogeneously and it is thus not part of the optimisation process of the firm. Not up to complete rigidity, but the level of prime-age employment is assumed to be difficult to change too. Given the institutional background, this assumption is plausible hence the endogeneity of older employment is not too worrying. Given the unobservable time-invariant effects, it is natural to estimate this equation using the fixed-effects estimator. In this case, the estimated equation can be the following (S_s are seasonal indicators):

$$\begin{aligned} lnemprJ_{it} &= \alpha + \beta_O lnemprO_{it} + \beta_P lnemprP_{it} + \\ &+ \gamma_{popJ} lnpopJ_{it} + \gamma_{popO} lnpopO_{it} + \gamma_{popP} lnpopP_{it} + \\ &+ \gamma_{gdp} lngdp_{it} + \delta lntime + \delta_{S1} S_1 + \delta_{S3} S_3 + \delta_{S4} S_4 + f_i + u_{it}, \end{aligned} \tag{5.17}$$

Nevertheless, if we suppose that output and perhaps population is nonstationary too, we have to estimate the equation by differencing the data. In that case, the estimated equation is

$$\begin{aligned} \Delta lnempr J_{it} &= \delta + \beta_O \Delta lnempr O_{it} + \beta_P \Delta lnempr P_{it} + \\ &+ \gamma_{popJ} \Delta lnpop J_{it} + \gamma_{popO} \Delta lnpop O_{it} + \gamma_{popP} \Delta lnpop P_{it} + \\ &+ \gamma_{gdp} \Delta lngdp_{it} + \delta_{S1} S_1 + \delta_{S3} S_3 + \delta_{S4} S_4 + u_{it}, \end{aligned} \tag{5.18}$$

Note that the latter equation can *not* be obtained as a difference of the first, because of the time trend was included in logarithms and the seasonal indicators in “levels” in the first equation. Nevertheless, the latter formulation is easier to work with and is almost identical to one obtained through direct differencing. Identification of the coefficients in these cases is based on deviations from country-specific means and on over-time changes in the variables respectively. Because of this, differences between countries reflecting long-term equilibrium relationships do not dominate the estimates, which in line with the theoretical framework stressing short-term effects.

Because we are working with aggregate data, there is at least one known source of heteroskedasticity we have to take into account during estimation. Employment rates can be thought of as employment indicators averaged over all individuals in a population, whose variance is inversely proportional to the population size. Accordingly, observations in the regression will be weighted with the reciprocal of the square root of the population size in each unit of observation. Because we are not modelling dynamics here, in addition to heteroskedasticity, we are likely to encounter serial correlation. Given that it is of unknown form, but implies correlation within observations, but not across them, we also correct standard errors for clustering.

Despite of the exogeneity assumption is being a plausible one, one might want to make sure empirically that this is indeed the case by employing some alternative technique, such as instrumental variables estimation. Given the common European policy for increasing employment rates of older people through more stringent regulation of early and also regular retirement, an indicator for pension incentives as used in Jousten et al. (2008) or studies based on the option value, such as Stock and Wise (1990) or Börsch-Supan et al. (2002)

might seem to be useful for this purpose. Unfortunately, calculating such indices is a great challenge already for one country and thus it is practically impossible for all countries we are looking at. Motivated by the same policy action, but an admittedly weaker solution is to build on the assumption that the initiative for more of the older working is common to all European countries, but the idiosyncratic shocks that would connect Older and Junior employment is specific to all countries. If this is the case an instrument that captures the EU-wide expansion of older labour, but excludes the effects within the country in question can be satisfactory. One such variable is the mean of employment shares of all countries except for the one to which the particular data point is attached: $\overline{O_{t,JK}} = \sum_{j \neq i} O_{i,t}$. In statistics, such a mean is called a "jackknife" mean and thus I shall refer to this variable as such. If the increased employment rates of the older can be attributed to policy changes and if these are sufficiently common to EU member states, the relatively low inter-country mobility in the EU ensures that this is a valid instrument: it will be correlated with the local employment rate of the old through the common policy component, but will not be correlated to shocks hitting local employment of the juniors.

5.5 Estimation results and discussion

We start discussing the empirical results by looking at the routinely estimated ad-hoc regression, where employment rates are on both the left- and the right-hand side. As we expect, estimating the ad-hoc equation using the fixed-effects estimator yields no significant results in any specification (see Table A.19 on page 146 in the Appendix), so we consider only results for the first-difference of logs specifications, shown in Table 5.2 on the next page. According to these estimates, one percentage increase in the employment rate of older people decreases the employment rate of the juniors by 18 to almost 20 percent. The estimates are statistically different from zero at 1 percent level of significance, but we have to note that the confidence intervals are nevertheless quite large.

Instead of estimating the ad-hoc equation, we can include the population variables to get closer to a theoretically better-funded estimates. The fixed-effect method yield no sig-

Table 5.2: The ad-hoc regression as a reference - first difference estimates based on quarterly data

	(1)	(2)	(3)	(4)
D.lnEmprO	-0.183^{***}	-0.186^{***}	-0.197^{***}	-0.405
	(0.059)	(0.058)	(0.062)	(1.79)
D.lnEmprP		0.103	0.180	0.254
		(0.44)	(0.48)	(0.94)
D.lngGDP				-0.147
				(0.18)
Constant	0.0301	0.0293	0.0373	0.0420
	(0.023)	(0.020)	(0.025)	(0.053)
Observations	432	432	399	399
R-squared	0.23	0.23	0.24	0.23

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
All specifications include indicators for quarters 1, 3 and 4.

nificant coefficient estimates (Table A.20 on page 148 in the Appendix), but those from first-differences do. Even though all population and output controls are included, only the one for prime-age population is significant (with a negative coefficient, as expected). This suggests that for the given period, using or not using the theoretical implications has little effect on the results. Again, as previously, the instrumented equation yields no significant estimate. Looking at the first-stage results, it is clear that the reason for this is the weakness of the first-stage regression. Even though the partial correlation between the employment rate of the old and its jackknife mean is high in a fixed effects model, this is almost completely gone in first differences, meaning that the instrument is not valid in this context.

The results obtained are weighted by the population share of the countries included in the panel, giving larger weight to those with larger populations. Unfortunately, two of these countries contribute to the panel only with data after 2003, when the greatest increase in older employment and the decrease in junior employment has already passed. To see the effect of this, column (3) of Table 5.3 on the next page show estimates on data excluding Germany, France and Luxemburg.

Given that all estimates show a negative effect of 20 percent in terms of log-percentage points, it is worth checking these results against actual figures. Employment rate of the juniors was 39.4 percent in 2000 and went down to 37.6 by 2006, that is, it has decreased by

Table 5.3: The regression based on a transformed production function - first difference estimates on quarterly data

	(1)		(2)		(3)	
	OLS	IV	OLS	IV	OLS	IV
D.lnEmprO	−0.201*	−0.351	−0.305**	0.267	−0.279	−0.116
	(0.094)	(38.6)	(0.14)	(1.23)	(0.16)	(1.89)
D.lnEmprP	1.551	1.606	2.414	1.982	2.593	2.439
	(1.39)	(14.8)	(1.50)	(2.00)	(1.62)	(2.88)
D.lnPopJ	1.462	1.285	2.686	2.712	3.260	3.171
	(1.37)	(45.4)	(2.06)	(2.20)	(2.41)	(2.81)
D.lnPopO	−0.135	0.107	0.207	−0.399	−0.146	−0.375
	(0.38)	(62.6)	(0.30)	(1.34)	(0.33)	(2.80)
D.lnPopP	−2.615*	−2.722	−2.424**	−2.559**	−2.571*	−2.464
	(1.39)	(28.4)	(0.93)	(0.98)	(1.20)	(2.01)
D.lnGDP	−0.198	−0.205	−0.352	−0.331	−0.367	−0.359
	(0.21)	(1.82)	(0.21)	(0.21)	(0.23)	(0.25)
Constant	0.00174	0.00226	0.00266	−0.000772	0.00491	0.00397
	(0.0033)	(0.13)	(0.0046)	(0.0073)	(0.0043)	(0.0088)
Observations	399	399	350	350	318	318
R-squared	0.27	0.26	0.35	0.32	0.36	0.36

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

around 2 percentage points or 4.5 percent. At the same time, employment rate of older people has increased from 31 to 42 percent. Using the estimated 20 percent negative effect, this change in Older employment implies a 7 percent change in Junior employment rate, which translates to a 3 percentage-point decrease. Given that the actual decrease over this period was 2 percentage point, this prediction is realistic. Still, we have to remember that actual figures are a composite of immediate and longer-term reactions. Our theoretical discussion makes it clear that the latter type is not identifiable from the data used here.

5.6 Conclusions and potential extensions

This paper considered crowding-out younger workers by the older, that is a decrease in the labour market chances of the younger as the older work more. The mechanisms behind such an effect can be many-fold, but it seems that despite the potential diversity, it is worth going back to the model of labour demand as an underlying framework. Taking a closer look at this model and its implications on data requirements, we can draw the conclusion that in the absence of data on wages and capital, we can hope to estimate only a very short term effect of increased older employment which is bound to be negative. Having laid out the theoretical relationship between the potential effects, I have set out to estimate this short term effect on employment data only. Results show that on the short run, increasing Older employment by 20 percent can result in an approximately 20 percent immediate reduction in younger employment needs. Nevertheless, this adjustment is not necessarily realised, as long-term adjustment is determined also by the so-called q-substitutability of Older and Junior workers. Because readily available cross-country data are not informative on complementarity, policymakers have to be aware that without the analysis of wage data, forecasts even a couple of years ahead are impossible to make. As such data are not available on the European level, investigation has to focus separately on each member state and consider end results together. Further research can aim at establishing more exact response figures along the lines of the theoretical results, but also deepen our understanding of the crowding process itself. One strength of the factor-demand framework is that it does not require the specification of the actual mechanisms that result in the crowding-out. This does result in a reasonable estimate of the average effect, but does not help policy very much as it does not show a potential point of intervention. Given the availability of suitable microdata on the country-level, employers with different human resource management and promotion schemes are possible to separate and can be looked at separately. Governmental bodies in particular, usually operating a promotion scheme strongly dependent on seniority, can be separated out from others to allow the observation of the presence of a crowding-out effect. As a seniority-based scheme is theoretically predicted to increase the likelihood of crowding-out, failing to find crowding-out effect in this case empirically in such cases can make it necessary to re-think the interaction between age-groups.

Appendix A

Appendix

Table A.1: Retirement ages for women

Women	év																							Length of required work history				
birth year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	<1997	1997-től			
1930	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	>=10	>=10			34
1931	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	>=10	>=10			34
1932	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	>=10	>=10			34
1933	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	>=10	>=10			34
1934	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	>=10	>=10			34
1935	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	>=10	>=10			34
1936	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73			>10&<20		34
1937	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72			>10&<20		34
1938	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71			>10&<20		34
1939	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70				15	34
1940	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69				15	34
1941	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68				15	34
1942	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67				15	34
1943	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66				15	35
1944	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65				15	36
1945	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64				15	37
1946	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63				15	38
1947	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62				15	38
1948	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61					38
1949	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60					38
1950	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59					38
1951	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58					38
1952	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57					38
last age at work																													
- official	54	54	54	54	54	54	54	54	54	55	55	56	56	56	57	57	58	58	59	59	60	60	61	61					
- early												54	54	54	54	54	54	54	54	54	55	55	56						
Length of minimum required work history																													
	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20					
legal pensionable age																													
- official	55	55	55	55	55	55	55	55	55	56	56	57	57	57	58	58	59	59	60	60	61	61	62	62					
- early												55	55	55	55	55	55	55	55	55	56	56	57						

Table A.2: Retirement ages for men

MEN	év																								Length of required work history				
birth year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	<1997	1997-től			
1926	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	>=10				
1927	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	>=10	>=10			
1928	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	>=10	>=10			
1929	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	>=10	>=10			
1930	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	>=10	>=10			37
1931	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78			>10&<20		37
1932	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77			>10&<20		37
1933	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76			>10&<20		37
1934	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75				>=15	37
1935	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74				>=15	37
1936	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73				>=15	37
1937	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72				>=15	37
1938	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71				>=15	37
1939	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70				>=15	38
1940	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69				>=15	38
1941	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68				>=15	38
1942	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67				>=15	38
1943	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66				>=15	38
1944	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65				>=15	38
1945	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64				>=15	38
1946	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63				>=15	38
1947	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62					38
1948	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61					
last age at work																													
- official	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**60**	**60**	**61**	**61**	**61**	**61**	**61**	**61**	**61**	**61**	**61**						
- early													**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**						
Length of minimum required work history																													
	20	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**						
legal pensionable age																													
- official	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**61**	**61**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**62**						
- early													**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**						

Table A.3: Transition rates using st1 states in 1993-1995 and difference between 2004-2006 and 1993-1995 values - 40-64 year old men (percentage)

1993-1995	work state	work nostate	unemployed	inact pension	inact no pension
work state	95.0	2.2	0.74	0.76	1.0
work nostate	0.5	97.0	1.1	0.67	0.98
unemployed	3.1	7.7	82.0	2.0	5.2
inact pension	0.23	0.56	0.093	99.0	0.035
inact no pension	2.1	4.4	4.7	5.1	84.0
difference	work state	work nostate	unemployed	inact pension	inact no pension
work state	1.2	−1.2	−0.066	0.038	0.015
work nostate	−0.32	1.3	−0.51	−0.055	−0.45
unemployed	−0.14	3.1	−6.0	0.65	2.5
inact pension	−0.15	−0.11	0.015	0.15	0.094
inact no pension	0.48	1.3	−1.1	−1.3	0.64

Table A.4: Transition rates using st2 states in 1993-1995 and difference between 2004-2006 and 1993-1995 values - 40-64 year old men (percentage)

1993-1995	work	nowork nopens	nowork oldage	nowork disability
work	97.0	1.9	0.39	0.34
nowork nopens	9.0	88.0	1.3	1.5
nowork oldage	0.78	0.053	99.0	0.14
nowork disability	0.85	0.05	0.22	99.0
difference	work	nowork nopens	nowork oldage	nowork disability
work	0.77	−0.72	0.025	−0.076
nowork nopens	1.5	−1.2	−0.24	−0.061
nowork oldage	−0.3	0.096	−0.63	0.84
nowork disability	−0.14	0.12	0.72	−0.7

Table A.5: Transition rates using st3 states in 1993-1995 and difference between 2004-2006 and 1993-1995 values - 40-64 year old men (percentage)

1993-1995	work nopens	work pens	nowork nopens	nowork pens
work nopens	98.0	0.047	2.0	0.34
work pens	0.19	91.0	0.079	8.7
nowork nopens	9.0	0.034	88.0	2.8
nowork pens	0.098	0.72	0.052	99.0
difference	work nopens	work pens	nowork nopens	nowork pens
work nopens	0.45	0.19	−0.74	0.1
work pens	1.9	2.1	−0.032	−4.0
nowork nopens	1.6	0.016	−1.5	−0.16
nowork pens	−0.051	−0.14	0.11	0.076

Table A.6: Size of flows between states relative to the size of the 15-64 year old population - 1993-1997 period

Present period	Next period				
	Working	Not working, has pension?			Total
		no	old-age	disability	
Work	49.3	0.9	0.3	0.2	50.6
No work, no pension	0.7	10.8	0.1	0.1	11.8
No work, old-age pens	0.1	0.0	24.1	0.0	24.3
No work, disab. pens.	0.1	0.0	0.0	13.2	13.3
Total	50.2	11.8	24.6	13.5	100.0

Table A.7: Size of flows between states relative to the size of the 15-64 year old population - 1998-2006 period

Present period	Next period				
	Working	Not working, has pension?			Total
		no	old-age	disability	
Work	55.5	0.6	0.2	0.1	56.4
No work, no pension	0.6	8.8	0.1	0.1	9.7
No work, old-age pens	0.1	0.0	18.1	0.1	18.4
No work, disab. pens.	0.1	0.0	0.1	15.3	15.6
Total	56.2	9.5	18.6	15.7	100.0

Table A.8: Multinomial logit estimates of the probability of entering st2 states when working in t - 1993-1997 period, 40-64 year old men; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+ lower vocational	0.0129^{***}	-0.0110^{***}	-0.000155	-0.00172^{**}
	(0.00242)	(0.00209)	(0.000811)	(0.000809)
Educ: secondary w. maturity	0.0156^{***}	-0.0129^{***}	-0.000198	-0.00256^{***}
	(0.00181)	(0.00144)	(0.000906)	(0.000503)
Educ: higher	0.0222^{***}	-0.0167^{***}	-0.00201^{***}	-0.00344^{***}
	(0.00121)	(0.000945)	(0.000663)	(0.000292)
Age: 53	-0.0103^{*}	-0.000907	0.0105^{**}	0.000719
	(0.00559)	(0.00262)	(0.00504)	(0.00112)
Age: 54	-0.0175^{***}	0.00406	0.0130^{**}	0.000471
	(0.00624)	(0.00324)	(0.00556)	(0.00113)
Age: 55	-0.0344^{***}	0.00563^{*}	0.0286^{***}	0.000205
	(0.00756)	(0.00332)	(0.00710)	(0.00108)
Age: 56	-0.0474^{***}	0.0212^{***}	0.0265^{***}	-0.000339
	(0.00835)	(0.00486)	(0.00739)	(0.00103)
Age: 57	-0.0566^{***}	0.0160^{***}	0.0391^{***}	0.00137
	(0.0102)	(0.00523)	(0.00940)	(0.00146)
Age: 58	-0.0490^{***}	0.00218	0.0472^{***}	-0.000332
	(0.0109)	(0.00442)	(0.0105)	(0.00119)
Age: 59	-0.118^{***}	0.0376^{***}	0.0824^{***}	-0.00204^{**}
	(0.0154)	(0.00820)	(0.0149)	(0.000792)
Age: 60	-0.167^{***}	0.0312^{***}	0.138^{***}	-0.00224^{**}
	(0.0226)	(0.0108)	(0.0220)	(0.000983)
Age: 61	-0.118^{***}	0.000511	0.121^{***}	-0.00357^{***}
	(0.0219)	(0.00760)	(0.0213)	(0.000217)
Age: 62	-0.118^{***}	-0.0161^{***}	0.137^{***}	-0.00276^{***}
	(0.0233)	(0.00307)	(0.0232)	(0.000809)
Age: greater than 62	-0.104^{***}	-0.0139^{***}	0.121^{***}	-0.00293^{***}
	(0.0210)	(0.00311)	(0.0210)	(0.000519)
Employed at a purely state-owned workplace	0.000664	-0.00107	0.000624	-0.000214
	(0.00136)	(0.00113)	(0.000622)	(0.000486)
Employee	-0.0133^{***}	0.0103^{***}	0.00233^{***}	0.000666
	(0.00201)	(0.00178)	(0.000796)	(0.000612)
With dependent child	0.00182^{**}	-0.000782	-0.00104^{*}	$-4.55e-06$
	(0.000909)	(0.000663)	(0.000578)	(0.000324)
Partner: working with pension	-0.0105^{*}	-0.00480	0.00189	0.0134^{***}
	(0.00570)	(0.00407)	(0.00125)	(0.00400)
Partner: not working, no pension	-0.00689^{***}	0.00768^{***}	-0.000569	-0.000223
	(0.00195)	(0.00170)	(0.000811)	(0.000617)
Partner: not working with pension	-0.0106^{***}	0.00768^{***}	0.00139^{*}	0.00158^{*}
	(0.00223)	(0.00195)	(0.000741)	(0.000839)
Partner: age	$-3.80e-05$	-0.000200	$7.96e-05$	0.000158^{***}
	(0.000146)	(0.000126)	$(5.95e-05)$	$(5.18e-05)$
Unemployment rate in the the small region (%)	-0.00182^{***}	0.00118^{***}	0.000298^{***}	0.000344^{***}
	(0.000158)	(0.000132)	$(6.78e-05)$	$(5.93e-05)$
Observations	75,077	75,077	75,077	75,077
Pseudo-R2		0.09		

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Table A.9: Multinomial logit estimates of the probability of entering st2 states when working in t - 1998-2006 period, 40-64 year old women; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+	0.0340^{***}	-0.0306^{***}	-0.000982	-0.00243^{***}
lower vocational	(0.00186)	(0.00136)	(0.000840)	(0.000797)
Educ: secondary	0.0352^{***}	-0.0306^{***}	-0.00112	-0.00352^{***}
w. maturity	(0.00143)	(0.00108)	(0.000796)	(0.000420)
Educ: higher	0.0257^{***}	-0.0212^{***}	-0.00153^{**}	-0.00299^{***}
	(0.00121)	(0.000961)	(0.000692)	(0.000231)
Age: 53	-0.00539	0.00119	0.00295	0.00125
	(0.00361)	(0.00162)	(0.00318)	(0.000824)
Age: 54	-0.0305^{***}	0.00418^{**}	0.0249^{***}	0.00151^{*}
	(0.00642)	(0.00194)	(0.00619)	(0.000862)
Age: 55	-0.0393^{***}	-0.000433	0.0386^{***}	0.00116
	(0.00759)	(0.00177)	(0.00744)	(0.000951)
Age: 56	-0.0765^{***}	-0.000457	0.0773^{***}	-0.000351
	(0.00971)	(0.00207)	(0.00963)	(0.000746)
Age: 57	-0.0907^{***}	-0.000770	0.0909^{***}	0.000537
	(0.0116)	(0.00253)	(0.0115)	(0.00110)
Age: 58	-0.0992^{***}	-0.00115	0.0994^{***}	0.000927
	(0.0133)	(0.00315)	(0.0131)	(0.00141)
Age: 59	-0.102^{***}	-0.00658^{**}	0.108^{***}	0.000381
	(0.0143)	(0.00260)	(0.0142)	(0.00142)
Age: 60	-0.109^{***}	0.000103	0.109^{***}	$9.82e-05$
	(0.0160)	(0.00494)	(0.0154)	(0.00161)
Age: 61	-0.108^{***}	-0.00426	0.113^{***}	-0.00134
	(0.0174)	(0.00448)	(0.0169)	(0.00123)
Age: 62	-0.118^{***}	-0.00846^{**}	0.128^{***}	-0.00117
	(0.0191)	(0.00335)	(0.0189)	(0.00141)
Age: greater than 62	-0.0921^{***}	-0.00648^{*}	0.101^{***}	-0.00256^{***}
	(0.0183)	(0.00371)	(0.0182)	(0.000137)
Employed at a purely	0.00575^{***}	-0.00386^{***}	-0.000461	-0.00143^{***}
state-owned workplace	(0.000664)	(0.000548)	(0.000310)	(0.000211)
Employee	-0.00701^{***}	0.00521^{***}	0.00201^{***}	-0.000200
	(0.00149)	(0.00131)	(0.000585)	(0.000412)
With dependent child	$3.89e-05$	0.00167^{***}	-0.000794^{**}	-0.000916^{***}
	(0.000600)	(0.000390)	(0.000398)	(0.000239)
Partner: working	-0.00902^{***}	0.00142	0.00138^{*}	0.00622^{***}
with pension	(0.00268)	(0.00204)	(0.000795)	(0.00158)
Partner: not working,	-0.0134^{***}	0.0107^{***}	0.000494	0.00223^{**}
no pension	(0.00227)	(0.00174)	(0.00118)	(0.000908)
Partner: not working	-0.00650^{***}	0.00333^{***}	0.00168^{***}	0.00149^{***}
with pension	(0.00120)	(0.000951)	(0.000538)	(0.000511)
Partner: age	0.000180^{**}	-0.000193^{***}	$4.07e-05$	$-2.69e-05$
	$(8.71e-05)$	$(7.05e-05)$	$(4.29e-05)$	$(2.95e-05)$
Unemployment rate	-0.00126^{***}	0.000948^{***}	$8.14e-05^{**}$	0.000230^{***}
in the small region (%)	$(8.33e-05)$	$(6.64e-05)$	$(3.80e-05)$	$(3.17e-05)$
Observations	138,165	138,165	138,165	138,165
Pseudo-R2		0.1		

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Table A.10: Multinomial logit estimates of the probability of entering st2 states when working in t - 1998-2006 period, 40-64 year old men; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+	0.0257^{***}	-0.0253^{***}	-0.000389	$5.26e-05$
lower vocational	(0.00207)	(0.00119)	(0.00118)	(0.00117)
Educ: secondary	0.0194^{***}	-0.0185^{***}	-0.000290	-0.000572
w. maturity	(0.00167)	(0.000595)	(0.00119)	(0.000999)
Educ: higher	0.0228^{***}	-0.0184^{***}	-0.00243^{***}	-0.00196^{***}
	(0.00124)	(0.000917)	(0.000697)	(0.000459)
Age: 53	-0.00302	0.000388	0.00221	0.000419
	(0.00235)	(0.00133)	(0.00186)	(0.000652)
Age: 54	-0.00423	-0.000523	0.00403^{*}	0.000724
	(0.00261)	(0.00137)	(0.00215)	(0.000690)
Age: 55	-0.00266	-0.00119	0.00396^{*}	-0.000113
	(0.00261)	(0.00136)	(0.00218)	(0.000588)
Age: 56	-0.0111^{***}	-0.00208	0.0128^{***}	0.000379
	(0.00349)	(0.00136)	(0.00319)	(0.000690)
Age: 57	-0.0148^{***}	-0.000331	0.0143^{***}	0.000839
	(0.00399)	(0.00164)	(0.00359)	(0.000800)
Age: 58	-0.0171^{***}	-0.000833	0.0178^{***}	$9.78e-05$
	(0.00457)	(0.00179)	(0.00419)	(0.000720)
Age: 59	-0.0759^{***}	0.00117	0.0739^{***}	0.000821
	(0.00858)	(0.00213)	(0.00847)	(0.000862)
Age: 60	-0.0958^{***}	0.000884	0.0952^{***}	-0.000285
	(0.0118)	(0.00297)	(0.0116)	(0.000870)
Age: 61	-0.0764^{***}	-0.00476^{*}	0.0828^{***}	-0.00164^{***}
	(0.0118)	(0.00256)	(0.0117)	(0.000592)
Age: 62	-0.0633^{***}	-0.0116^{***}	0.0776^{***}	-0.00264^{***}
	(0.0120)	(0.000270)	(0.0120)	(0.000125)
Age: greater than 62	-0.0672^{***}	-0.0105^{***}	0.0804^{***}	-0.00265^{***}
	(0.0123)	(0.00111)	(0.0123)	(0.000125)
Employed at a purely	-0.00688^{***}	0.00586^{***}	0.00113^{***}	-0.000110
state-owned workplace	(0.000996)	(0.000845)	(0.000416)	(0.000327)
Employee	-0.0102^{***}	0.00811^{***}	0.00221^{***}	$-7.92e-05$
	(0.00127)	(0.00114)	(0.000489)	(0.000328)
With dependent child	0.000525	0.000148	-0.000813^{***}	0.000139
	(0.000448)	(0.000303)	(0.000293)	(0.000162)
Partner: working	-0.0116^{***}	0.00139	0.000761	0.00948^{***}
with pension	(0.00317)	(0.00232)	(0.000724)	(0.00209)
Partner: not working,	-0.00939^{***}	0.00794^{***}	0.000870	0.000579
no pension	(0.00126)	(0.00100)	(0.000636)	(0.000444)
Partner: not working	-0.00931^{***}	0.00588^{***}	0.00149^{***}	0.00194^{***}
with pension	(0.00131)	(0.00111)	(0.000455)	(0.000557)
Partner: age	$-5.43e-05$	$-6.39e-05$	$-7.27e-06$	0.000125^{***}
	$(7.31e-05)$	$(5.69e-05)$	$(3.34e-05)$	$(3.22e-05)$
Unemployment rate	-0.00134^{***}	0.00102^{***}	$8.81e-05^{**}$	0.000238^{***}
in the small region (%)	$(7.55e-05)$	$(6.04e-05)$	$(3.53e-05)$	$(2.63e-05)$
Observations	168,486	168,486	168,486	168,486
Pseudo-R2		0.11		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.11: Multinomial logit estimates of the probability of entering st2 states when not working and not receiving pension in t - 1993-1997 period, 40-64 year old women; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+	0.0234***	−0.0338***	0.00963**	0.000783
lower vocational	(0.00844)	(0.00935)	(0.00378)	(0.00241)
Educ: secondary	0.0313***	−0.0672***	0.0333***	0.00265
w. maturity	(0.0120)	(0.0163)	(0.0115)	(0.00365)
Educ: higher	0.0947***	−0.132***	0.0370*	0.000591
	(0.0276)	(0.0336)	(0.0210)	(0.00613)
Age: 53	−0.0268***	0.00312	0.0252***	−0.00147
	(0.00455)	(0.0101)	(0.00873)	(0.00263)
Age: 54	−0.0110	−0.00646	0.0244***	−0.00687***
	(0.00829)	(0.0123)	(0.00910)	(0.00154)
Age: 55	−0.0361***	0.00354	0.0403***	−0.00780***
	(0.00281)	(0.0132)	(0.0129)	(0.00123)
Age: 56	−0.0390***	0.0274***	0.0162*	−0.00467*
	(0.00142)	(0.00955)	(0.00921)	(0.00255)
Age: 57	−0.0265***	0.0252**	0.00943	−0.00814***
	(0.00844)	(0.0125)	(0.00912)	(0.00130)
Age: 58	−0.0388***	0.0481***	0.000283	−0.00957***
	(0.00142)	(0.00671)	(0.00653)	(0.000702)
Age: 59	−0.0317***	0.0349***	0.00350	−0.00672***
	(0.00688)	(0.0103)	(0.00743)	(0.00197)
Age: 60	−0.0387***	0.0436***	0.00473	−0.00956***
	(0.00142)	(0.00827)	(0.00812)	(0.000702)
Age: 61	−0.0308***	0.0333***	0.00437	−0.00683***
	(0.00774)	(0.0111)	(0.00782)	(0.00183)
Age: 62	−0.0388***	0.0488***	−0.00172	−0.00833***
	(0.00142)	(0.00574)	(0.00545)	(0.00114)
Age: greater than 62	−0.0278***	0.0362***	0.00172	−0.0101***
	(0.00639)	(0.00847)	(0.00556)	(0.000704)
With dependent child	−0.00119	0.0140***	−0.00962***	−0.00320***
	(0.00130)	(0.00299)	(0.00262)	(0.000893)
Wants a job	0.0377***	−0.0345***	−0.00673***	0.00348
	(0.00732)	(0.00790)	(0.00181)	(0.00242)
Available for work	−0.00851**	0.0230***	−0.00501	−0.00952***
	(0.00418)	(0.00571)	(0.00366)	(0.00120)
Searches for a job	0.0545***	−0.0519***	−0.00348	0.000842
	(0.0111)	(0.0127)	(0.00464)	(0.00455)
Registered as unemployed	0.0110***	−0.0284***	0.0162***	0.00126
	(0.00407)	(0.00656)	(0.00494)	(0.00198)
Partner: working	0.0291*	−0.0335*	−0.000891	0.00532
with pension	(0.0166)	(0.0184)	(0.00501)	(0.00671)
Partner: not working,	0.00296	−0.00979*	0.00713**	−0.000298
no pension	(0.00408)	(0.00585)	(0.00362)	(0.00215)
Partner: not working	0.00286	−0.00267	−0.000633	0.000449
with pension	(0.00443)	(0.00537)	(0.00247)	(0.00201)
Partner: age	−0.00114***	0.000456	0.000619***	$6.34e-05$
	(0.000269)	(0.000347)	(0.000181)	(0.000123)
Unemployment rate	−0.000770*	0.000221	$5.57e-05$	0.000493**
in the small region (%)	(0.000404)	(0.000499)	(0.000225)	(0.000201)
Observations	18,438	18,438	18,438	18,438
Pseudo-R2		0.1		

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Table A.12: Multinomial logit estimates of the probability of entering st2 states when not working and not receiving pension in t - 1993-1997 period, 40-64 year old men; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+	0.0250^{*}	-0.0261^{*}	0.00406	-0.00304
lower vocational	(0.0143)	(0.0150)	(0.00385)	(0.00378)
Educ: secondary	0.0440^{**}	-0.0485^{**}	0.0106^{*}	-0.00603
w. maturity	(0.0196)	(0.0204)	(0.00613)	(0.00384)
Educ: higher	0.0663^{**}	-0.0681^{**}	0.00802	-0.00624
	(0.0272)	(0.0285)	(0.00821)	(0.00508)
Age: 53	-0.0213^{*}	-0.00457	0.0242	0.00169
	(0.0122)	(0.0231)	(0.0199)	(0.00627)
Age: 54	-0.0176	-0.0367	0.0518^{**}	0.00246
	(0.0129)	(0.0243)	(0.0211)	(0.00584)
Age: 55	-0.0330^{***}	-0.0316	0.0516^{**}	0.0130^{*}
	(0.0126)	(0.0263)	(0.0235)	(0.00769)
Age: 56	-0.0550^{***}	-0.0385	0.102^{***}	-0.00899^{**}
	(0.0107)	(0.0246)	(0.0226)	(0.00395)
Age: 57	-0.0541^{***}	-0.0857^{***}	0.146^{***}	-0.00589
	(0.0112)	(0.0292)	(0.0287)	(0.00431)
Age: 58	-0.0596^{***}	-0.0695^{**}	0.138^{***}	-0.00902^{**}
	(0.0153)	(0.0338)	(0.0315)	(0.00451)
Age: 59	-0.0124	-0.207^{***}	0.221^{***}	-0.00241
	(0.0250)	(0.0451)	(0.0419)	(0.00678)
Age: 60	-0.0867^{***}	-0.0788^{*}	0.181^{***}	-0.0155^{***}
	(0.0123)	(0.0445)	(0.0436)	(0.00288)
Age: 61	-0.0993^{***}	-0.00889	0.126^{***}	-0.0182^{***}
	(0.00279)	(0.0472)	(0.0471)	(0.00121)
Age: 62	-0.0992^{***}	-0.101^{*}	0.211^{***}	-0.0110
	(0.00279)	(0.0597)	(0.0594)	(0.00745)
Age: greater than 62	-0.0779^{***}	-0.0840^{*}	0.180^{***}	-0.0183^{***}
	(0.0201)	(0.0497)	(0.0491)	(0.00121)
With dependent child	-0.00210	0.00478	-0.00146	-0.00122
	(0.00289)	(0.00355)	(0.00174)	(0.00141)
Wants a job	0.0424^{***}	-0.0401^{***}	$9.32e-05$	-0.00234
	(0.0141)	(0.0149)	(0.00417)	(0.00296)
Available for work	-0.00369	0.0503^{***}	-0.00857^{**}	-0.0381^{***}
	(0.0101)	(0.0112)	(0.00357)	(0.00319)
Searches for a job	0.0560^{***}	-0.0571^{***}	-0.00734^{*}	0.00847
	(0.0158)	(0.0174)	(0.00438)	(0.00673)
Registered as unemployed	-0.0168^{***}	0.0176^{**}	0.00366	-0.00455^{**}
	(0.00645)	(0.00737)	(0.00290)	(0.00224)
Partner: working	0.174^{***}	-0.202^{***}	0.00655	0.0216
with pension	(0.0550)	(0.0564)	(0.00906)	(0.0201)
Partner: not working,	-0.0123^{**}	0.0188^{***}	-0.00304	-0.00344
no pension	(0.00614)	(0.00723)	(0.00298)	(0.00277)
Partner: not working	-0.0184^{**}	0.0133	-0.000839	0.00594
with pension	(0.00774)	(0.00914)	(0.00297)	(0.00420)
Partner: age	-0.00145^{***}	0.00129^{**}	0.000208	$-4.85e-05$
	(0.000556)	(0.000651)	(0.000281)	(0.000229)
Unemployment rate	0.000944	-0.00211^{**}	0.000292	0.000870^{**}
in the small region (%)	(0.000763)	(0.000889)	(0.000361)	(0.000344)
Observations	11,727	11727	11727	11727
Pseudo-R2		0.09		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.13: Multinomial logit estimates of the probability of entering st2 states when not working and not receiving pension in t - 1998-2006 period, 40-64 year old women; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+	0.0179***	−0.0310***	0.00604**	0.00709**
lower vocational	(0.00666)	(0.00781)	(0.00265)	(0.00355)
Educ: secondary	0.0244***	−0.0563***	0.0198***	0.0121**
w. maturity	(0.00863)	(0.0119)	(0.00669)	(0.00597)
Educ: higher	0.0476***	−0.0904***	0.0306**	0.0122
	(0.0147)	(0.0201)	(0.0120)	(0.00922)
Age: 53	−0.00974*	−0.000963	0.00672	0.00398
	(0.00548)	(0.00891)	(0.00644)	(0.00319)
Age: 54	−0.0113*	−0.0257**	0.0374***	−0.000417
	(0.00584)	(0.0124)	(0.0104)	(0.00275)
Age: 55	−0.0249***	−0.0274*	0.0526***	−0.000322
	(0.00525)	(0.0140)	(0.0129)	(0.00290)
Age: 56	−0.0142*	−0.0354**	0.0499***	−0.000299
	(0.00739)	(0.0146)	(0.0126)	(0.00293)
Age: 57	−0.0251***	−0.0479**	0.0759***	−0.00286
	(0.00818)	(0.0191)	(0.0172)	(0.00290)
Age: 58	−0.0302***	−0.0407**	0.0753***	−0.00441
	(0.00777)	(0.0196)	(0.0180)	(0.00269)
Age: 59	−0.0229**	−0.0345*	0.0648***	−0.00742***
	(0.0116)	(0.0209)	(0.0178)	(0.00187)
Age: 60	−0.0282***	−0.0248	0.0630***	−0.0101***
	(0.0107)	(0.0214)	(0.0187)	(0.000557)
Age: 61	−0.0437***	−0.000926	0.0531***	−0.00847***
	(0.00116)	(0.0173)	(0.0172)	(0.00153)
Age: 62	−0.0333***	0.00667	0.0367**	−0.0100***
	(0.0102)	(0.0187)	(0.0156)	(0.000557)
Age: greater than 62	−0.0380***	0.00250	0.0446***	−0.00915***
	(0.00567)	(0.0158)	(0.0148)	(0.000918)
With dependent child	−0.000634	0.00858***	−0.00266**	−0.00529***
	(0.00106)	(0.00173)	(0.00111)	(0.000861)
Wants a job	0.0196***	−0.0173***	−0.00292	0.000579
	(0.00577)	(0.00633)	(0.00186)	(0.00173)
Available for work	0.0218***	−0.00937	−0.00169	−0.0107***
	(0.00515)	(0.00578)	(0.00242)	(0.000858)
Searches for a job	0.0396***	−0.0389***	−0.00222	0.00146
	(0.00834)	(0.00925)	(0.00261)	(0.00304)
Registered as unemployed	0.0290***	−0.0368***	0.00703***	0.000800
	(0.00398)	(0.00507)	(0.00271)	(0.00171)
Partner: working	0.0105	−0.0351***	0.00246	0.0221***
with pension	(0.0101)	(0.0129)	(0.00331)	(0.00774)
Partner: not working,	−0.00554*	−0.00872*	0.0101***	0.00416*
no pension	(0.00300)	(0.00489)	(0.00318)	(0.00230)
Partner: not working	−0.00763***	0.00666*	−0.000495	0.00147
with pension	(0.00288)	(0.00362)	(0.00144)	(0.00174)
Partner: age	−0.000697***	0.000436	0.000398***	−0.000136
	(0.000233)	(0.000283)	(0.000118)	(0.000115)
Unemployment rate	−0.000328	0.000229	−0.000318**	0.000417***
in the small region (%)	(0.000283)	(0.000335)	(0.000132)	(0.000122)
Observations	31,388	31,388	31,388	31,388
Pseudo-R2	0.12			

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.14: Multinomial logit estimates of the probability of entering st2 states when not working and not receiving pension in t - 1998-2006 period, 40-64 year old men; average marginal effects

	Employed	Nonemployed nopensioner	Old-age pensioner	Disability pensioner
Educ: primary+	0.0397^{***}	-0.0561^{***}	0.0101^{*}	0.00633
lower vocational	(0.0124)	(0.0141)	(0.00523)	(0.00528)
Educ: secondary	0.0431^{**}	-0.0676^{***}	0.0175^{*}	0.00701
w. maturity	(0.0173)	(0.0200)	(0.00945)	(0.00730)
Educ: higher	0.0211	-0.0629^{**}	0.0309^{**}	0.0108
	(0.0222)	(0.0268)	(0.0145)	(0.0103)
Age: 53	-0.00814	-0.00626	0.00773	0.00666
	(0.0117)	(0.0154)	(0.00918)	(0.00610)
Age: 54	-0.0118	-0.0123	0.0172^{*}	0.00694
	(0.0118)	(0.0159)	(0.00955)	(0.00607)
Age: 55	-0.00914	-0.00746	0.00858	0.00802
	(0.0123)	(0.0156)	(0.00835)	(0.00618)
Age: 56	-0.0305^{***}	-0.000333	0.0158^{*}	0.0150^{**}
	(0.0112)	(0.0155)	(0.00942)	(0.00692)
Age: 57	-0.0344^{***}	-0.0175	0.0392^{***}	0.0127^{*}
	(0.0120)	(0.0168)	(0.0111)	(0.00663)
Age: 58	-0.0566^{***}	0.0217	0.0408^{***}	-0.00593
	(0.0103)	(0.0158)	(0.0116)	(0.00441)
Age: 59	-0.0691^{***}	-0.0133	0.0891^{***}	-0.00672
	(0.0104)	(0.0210)	(0.0190)	(0.00421)
Age: 60	-0.107^{***}	-0.0588^{*}	0.161^{***}	0.00505
	(0.00244)	(0.0326)	(0.0325)	(0.00867)
Age: 61	-0.0483	-0.0567	0.118^{***}	-0.0128^{**}
	(0.0408)	(0.0502)	(0.0324)	(0.00559)
Age: 62	-0.0594	-0.0838	0.155^{***}	-0.0122^{**}
	(0.0458)	(0.0583)	(0.0380)	(0.00613)
Age: greater than 62	-0.107^{***}	0.0214	0.104^{***}	-0.0185^{***}
	(0.00244)	(0.0295)	(0.0294)	(0.00100)
With dependent child	-0.00118	0.00362	-0.000241	-0.00221^{*}
	(0.00215)	(0.00266)	(0.00116)	(0.00123)
Wants a job	0.0154	-0.0116	-0.00509^{**}	0.00131
	(0.0133)	(0.0137)	(0.00227)	(0.00287)
Available for work	0.0295^{**}	0.0104	-0.00276	-0.0371^{***}
	(0.0116)	(0.0121)	(0.00286)	(0.00257)
Searches for a job	0.0170	-0.0121	-0.00911^{***}	0.00420
	(0.0144)	(0.0151)	(0.00166)	(0.00457)
Registered	0.0452^{***}	-0.0357^{***}	0.00158	-0.0111^{***}
as unemployed	(0.00652)	(0.00690)	(0.00183)	(0.00149)
Partner: working	0.0325	-0.0427^{*}	0.00331	0.00686
with pension	(0.0211)	(0.0222)	(0.00477)	(0.00675)
Partner: not working,	-0.0184^{***}	0.0188^{***}	0.000192	-0.000585
no pension	(0.00527)	(0.00615)	(0.00230)	(0.00239)
Partner: not working	-0.0134^{**}	0.0146^{*}	0.000199	-0.00143
with pension	(0.00673)	(0.00749)	(0.00201)	(0.00262)
Partner: age	-0.00134^{***}	0.000456	0.000387^{**}	0.000495^{**}
	(0.000446)	(0.000509)	(0.000169)	(0.000193)
Unemployment rate	-0.000339	-0.000480	$5.04e-05$	0.000769^{***}
in the small region (%)	(0.000582)	(0.000651)	(0.000175)	(0.000230)
Observations	17522	17522	17522	17522
Pseudo-R2	0.09			

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Table A.15: Binary probit estimates of the probability of retired status - 24-64 year old population; average marginal effects [the series of distfromret variables indicate the distance from statutory old-age retirement age such that the omitted distfromret39 indicates the retirement age and distfromretD1 indicates that there is 38 years to go]

	(1)	(2)	(3)	(4)
distfromretD1	−0.284***	−0.285***	−0.287***	−0.280***
	(0.00332)	(0.00320)	(0.00268)	(0.00439)
distfromretD2	−0.288***	−0.290***	−0.292***	−0.287***
	(0.00307)	(0.00269)	(0.00234)	(0.00330)
distfromretD3	−0.293***	−0.294***	−0.294***	−0.289***
	(0.00225)	(0.00214)	(0.00198)	(0.00267)
distfromretD4	−0.290***	−0.291***	−0.291***	−0.280***
	(0.00238)	(0.00230)	(0.00225)	(0.00359)
distfromretD5	−0.294***	−0.294***	−0.292***	−0.282***
	(0.00209)	(0.00203)	(0.00215)	(0.00332)
distfromretD6	−0.299***	−0.300***	−0.296***	−0.287***
	(0.00187)	(0.00180)	(0.00200)	(0.00270)
distfromretD7	−0.302***	−0.302***	−0.298***	−0.289***
	(0.00173)	(0.00166)	(0.00188)	(0.00249)
distfromretD8	−0.304***	−0.305***	−0.298***	−0.289***
	(0.00170)	(0.00165)	(0.00193)	(0.00243)
distfromretD9	−0.303***	−0.303***	−0.296***	−0.283***
	(0.00177)	(0.00172)	(0.00208)	(0.00300)
distfromretD10	−0.302***	−0.302***	−0.295***	−0.283***
	(0.00177)	(0.00173)	(0.00213)	(0.00289)
distfromretD11	−0.300***	−0.300***	−0.292***	−0.279***
	(0.00197)	(0.00192)	(0.00231)	(0.00314)
distfromretD12	−0.300***	−0.300***	−0.291***	−0.277***
	(0.00197)	(0.00190)	(0.00235)	(0.00328)
distfromretD13	−0.299***	−0.300***	−0.290***	−0.275***
	(0.00195)	(0.00190)	(0.00235)	(0.00333)
distfromretD14	−0.297***	−0.297***	−0.286***	−0.267***
	(0.00208)	(0.00203)	(0.00254)	(0.00381)
distfromretD15	−0.295***	−0.296***	−0.284***	−0.261***
	(0.00211)	(0.00207)	(0.00257)	(0.00393)
distfromretD16	−0.289***	−0.291***	−0.278***	−0.251***
	(0.00236)	(0.00228)	(0.00279)	(0.00420)
distfromretD17	−0.289***	−0.290***	−0.278***	−0.250***
	(0.00243)	(0.00236)	(0.00287)	(0.00430)
distfromretD18	−0.286***	−0.287***	−0.274***	−0.246***
	(0.00251)	(0.00244)	(0.00291)	(0.00418)
distfromretD19	−0.284***	−0.285***	−0.271***	−0.238***
	(0.00262)	(0.00257)	(0.00306)	(0.00445)
distfromretD20	−0.281***	−0.282***	−0.267***	−0.230***
	(0.00272)	(0.00265)	(0.00315)	(0.00461)
distfromretD21	−0.277***	−0.278***	−0.262***	−0.220***
	(0.00283)	(0.00276)	(0.00326)	(0.00479)
distfromretD22	−0.277***	−0.278***	−0.262***	−0.219***
	(0.00286)	(0.00279)	(0.00327)	(0.00473)
distfromretD23	−0.274***	−0.275***	−0.258***	−0.213***
	(0.00292)	(0.00286)	(0.00332)	(0.00471)
distfromretD24	−0.270***	−0.271***	−0.254***	−0.205***
	(0.00295)	(0.00291)	(0.00335)	(0.00484)
distfromretD25	−0.264***	−0.265***	−0.247***	−0.200***
	(0.00318)	(0.00313)	(0.00353)	(0.00483)

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Table A.15: Binary probit estimates of the probability of retired status - 24-64 year old population; average marginal effects [the series of distfromret variables indicate the distance from statutory old-age retirement age such that the omitted distfromret39 indicates the retirement age and distfromretD1 indicates that there is 38 years to go]

	(1)	(2)	(3)	(4)
distfromretD26	−0.261***	−0.262***	−0.244***	−0.194***
	(0.00322)	(0.00316)	(0.00359)	(0.00490)
distfromretD27	−0.253***	−0.253***	−0.234***	−0.177***
	(0.00339)	(0.00334)	(0.00376)	(0.00500)
distfromretD28	−0.247***	−0.248***	−0.229***	−0.175***
	(0.00350)	(0.00345)	(0.00383)	(0.00505)
distfromretD29	−0.240***	−0.240***	−0.221***	−0.163***
	(0.00362)	(0.00359)	(0.00395)	(0.00505)
distfromretD30	−0.231***	−0.232***	−0.212***	−0.154***
	(0.00376)	(0.00372)	(0.00403)	(0.00503)
distfromretD31	−0.224***	−0.224***	−0.206***	−0.148***
	(0.00387)	(0.00382)	(0.00411)	(0.00506)
distfromretD32	−0.213***	−0.214***	−0.197***	−0.140***
	(0.00403)	(0.00399)	(0.00425)	(0.00506)
distfromretD33	−0.201***	−0.202***	−0.187***	−0.134***
	(0.00416)	(0.00413)	(0.00431)	(0.00503)
distfromretD34	−0.192***	−0.192***	−0.178***	−0.124***
	(0.00427)	(0.00424)	(0.00439)	(0.00502)
distfromretD35	−0.170***	−0.170***	−0.159***	−0.110***
	(0.00450)	(0.00447)	(0.00459)	(0.00507)
distfromretD36	−0.138***	−0.138***	−0.128***	−0.0924***
	(0.00479)	(0.00476)	(0.00483)	(0.00505)
distfromretD37	−0.0899***	−0.0910***	−0.0842***	−0.0557***
	(0.00535)	(0.00532)	(0.00538)	(0.00524)
distfromretD38	−0.0437***	−0.0435***	−0.0391***	−0.0200***
	(0.00585)	(0.00582)	(0.00575)	(0.00528)
distfromretD40	0.118***	0.116***	0.109***	0.0577***
	(0.0117)	(0.0116)	(0.0112)	(0.00800)
distfromretD41	0.128***	0.124***	0.114***	0.0540***
	(0.0131)	(0.0130)	(0.0125)	(0.00876)
distfromretD42	0.133***	0.131***	0.120***	0.0538***
	(0.0144)	(0.0144)	(0.0138)	(0.00965)
distfromretD43	0.122***	0.120***	0.108***	0.0459***
	(0.0140)	(0.0141)	(0.0134)	(0.00934)
distfromretD44	0.0827***	0.0800***	0.0772***	0.0194 ∗∗
	(0.0137)	(0.0137)	(0.0132)	(0.00895)
distfromretD45	0.0980***	0.0939***	0.0909***	0.0292***
	(0.0148)	(0.0148)	(0.0143)	(0.00963)
distfromretD46	0.0927***	0.0888***	0.0827***	0.0271***
	(0.0155)	(0.0155)	(0.0148)	(0.0101)
distfromretD47	0.0712***	0.0863***	0.0769***	0.0207∗
	(0.0174)	(0.0180)	(0.0170)	(0.0112)
distfromretD48	0.0555***	0.0672***	0.0596***	0.00957
	(0.0169)	(0.0175)	(0.0166)	(0.0110)
Educ: primary+			0.00216	0.0283***
lower vocational			(0.00580)	(0.00433)
Educ: secondary			−0.0333***	0.0237***
w. maturity			(0.00574)	(0.00475)
Educ: higher			−0.0844***	0.00152
			(0.00545)	(0.00540)
Female			−0.0512***	−0.0390***

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Table A.15: Binary probit estimates of the probability of retired status - 24-64 year old population; average marginal effects [the series of distfromret variables indicate the distance from statutory old-age retirement age such that the omitted distfromret39 indicates the retirement age and distfromretD1 indicates that there is 38 years to go]

	(1)	(2)	(3)	(4)
			(0.00232)	(0.00201)
Partner:			0.0893***	0.0691***
retired			(0.00320)	(0.00259)
Partner:				−0.311***
working				(0.00220)
Employment rate in the		−1.043***	−0.846***	−0.342**
small region		(0.173)	(0.172)	(0.147)
Employment rate in the		0.761***	0.612***	0.238*
small region - squared		(0.160)	(0.159)	(0.137)
Region: Central		−0.0108**	−0.0114**	−0.00503
		(0.00533)	(0.00515)	(0.00445)
Region: Central-		−0.0428***	−0.0427***	−0.0256***
transdanubian		(0.00543)	(0.00534)	(0.00507)
Region: Western-		0.00738	0.00349	0.00319
transdanubian		(0.00576)	(0.00555)	(0.00460)
Region: Northern		0.00228	0.00171	0.000835
Hungary		(0.00574)	(0.00557)	(0.00471)
Region: Northern		0.00579	0.00228	−0.00424
Great Plain		(0.00568)	(0.00549)	(0.00454)
Region: Southern		−0.00865*	−0.0142***	−0.0250***
Great Plain		(0.00513)	(0.00494)	(0.00406)
Settlement:		0.0131**	0.0119*	0.0222***
county town		(0.00641)	(0.00620)	(0.00524)
Settlement:		0.0127**	−0.000973	0.00158
town		(0.00559)	(0.00531)	(0.00445)
Settlement:		0.0270***	0.00626	0.000298
village		(0.00569)	(0.00539)	(0.00442)
year: 1994		−0.000598	−0.00119	0.00452*
		(0.00301)	(0.00295)	(0.00259)
year: 1995		−0.000342	−0.000880	0.00133
		(0.00304)	(0.00296)	(0.00258)
year: 1996		0.00171	0.00264	0.00332
		(0.00371)	(0.00362)	(0.00310)
year: 1997		0.0337***	0.0297***	0.0219***
		(0.00385)	(0.00374)	(0.00313)
year: 1998		0.0413***	0.0371***	0.0274***
		(0.00356)	(0.00344)	(0.00285)
year: 1999		0.0441***	0.0400***	0.0300***
		(0.00350)	(0.00336)	(0.00285)
year: 2000		0.0475***	0.0426***	0.0294***
		(0.00317)	(0.00305)	(0.00263)
Observations	113348	112854	112854	112854

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.16: Binary probit (1-3) and instrumented probit (4-6) estimates of the probability of higher education as a function of cognitive capacity and extraversion - regression parameters

	Probit			Instrumented Probit		
	Women	Men	All	Women	Men	All
Equation: HE student						
IQ	0.770***	0.508***	0.635***	1.371***	1.015***	1.191***
	(0.15)	(0.13)	(0.097)	(0.18)	(0.28)	(0.16)
Extraversion	0.159	−0.376***	−0.103	0.0720	−0.266*	−0.0750
	(0.12)	(0.12)	(0.080)	(0.11)	(0.15)	(0.076)
Male			−0.235			−0.320**
			(0.15)			(0.14)
Constant	0.288***	0.0700	0.273***	0.244**	−0.0336	0.242**
	(0.11)	(0.11)	(0.10)	(0.11)	(0.12)	(0.10)
Equation: IQ						
Extraversion				0.0640	−0.0913	−0.0136
				(0.066)	(0.071)	(0.049)
IQ at age 5				0.259***	0.225***	0.242***
				(0.072)	(0.069)	(0.050)
Male						0.174*
						(0.091)
Constant				−0.0238	0.151**	−0.0248
				(0.060)	(0.068)	(0.063)
Observations	162	150	312	162	150	312
pseudo R-squared	0.15	0.14	0.12	.	.	.

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: IQ is measured by standardized Raven IQ, age 22. Extraversion is measured by standardized Big5 scores, age 22. Estimation sample: educational attainment at least 11 grades (vocational school).

Table A.17: Multinomial probit parameter estimates - equation: work

	(1)	(2)	(3)	(4)
IQ*Female	-0.154	-0.180	-0.188	-0.133
	(0.22)	(0.23)	(0.25)	(0.23)
IQ*Male	0.101	0.124	0.136	0.124
	(0.20)	(0.22)	(0.23)	(0.21)
Extaversion*Female	-0.194	-0.0951	-0.238	-0.211
	(0.22)	(0.25)	(0.25)	(0.23)
Extaversion*Male	-0.0293	-0.181	-0.0123	-0.0359
	(0.21)	(0.25)	(0.22)	(0.21)
Agreeableness*Female		-0.00267		
		(0.23)		
Agreeableness*Male		-0.0609		
		(0.20)		
Conscientiousness*Female		-0.174		
		(0.24)		
Conscientiousness*Male		-0.376^{*}		
		(0.22)		
Neuroticism*Female		-0.0587		
		(0.19)		
Neuroticism*Male		0.0265		
		(0.21)		
Openness*Female		-0.136		
		(0.21)		
Openness*Male		0.587^{**}		
		(0.26)		
Behavioural problems (parent)				0.0309
				(0.14)
Behavioural problems (teacher)				0.0700
				(0.14)
GPA 1-8			-0.0942	
			(0.19)	
GPA 9-12			-0.212	
			(0.19)	
Mother's education			0.250	
			(0.18)	
Male	0.271	0.354	0.193	0.264
	(0.29)	(0.32)	(0.32)	(0.30)
Constant	-0.688^{***}	-0.775^{***}	-0.806^{***}	-0.704^{***}
	(0.21)	(0.23)	(0.24)	(0.22)
Observations	312	312	312	312
Log-likelihood	-264.38	-251.48	-208.45	-258.51

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: IQ is measured by standardized Raven IQ, age 22. Extraversion is measured by standardized Big5 scores, age 22. Estimation sample: educational attainment at least 11 grades (vocational school).

Table A.18: Multinomial probit parameter estimates - equation: student

	(1)	(2)	(3)	(4)
IQ*Female	0.950***	0.947***	0.430*	0.863***
	(0.22)	(0.22)	(0.26)	(0.22)
IQ*Male	0.699***	0.689***	0.173	0.641***
	(0.19)	(0.20)	(0.21)	(0.20)
Extaversion*Female	0.155	0.0999	0.382*	0.148
	(0.17)	(0.20)	(0.21)	(0.17)
Extaversion*Male	−0.502***	−0.728***	−0.455**	−0.468***
	(0.18)	(0.21)	(0.19)	(0.18)
Agreeableness*Female		0.274		
		(0.18)		
Agreeableness*Male		0.278		
		(0.17)		
Conscientiousness*Female		0.0473		
		(0.19)		
Conscientiousness*Male		−0.187		
		(0.18)		
Neuroticism*Female		−0.0524		
		(0.16)		
Neuroticism*Male		−0.0792		
		(0.20)		
Openness*Female		0.130		
		(0.18)		
Openness*Male		0.698***		
		(0.23)		
Behavioural problems (parent)				−0.178
				(0.12)
Behavioural problems (teacher)				−0.240**
				(0.12)
GPA 1-8			0.931***	
			(0.18)	
GPA 9-12			0.584***	
			(0.17)	
Mother's education			0.456***	
			(0.15)	
Male	−0.202	−0.113	0.249	−0.0960
	(0.23)	(0.24)	(0.26)	(0.24)
Constant	0.667***	0.635***	0.432**	0.610***
	(0.16)	(0.16)	(0.18)	(0.16)
Observations	312	312	312	312
Log-likelihood	−264.38	−251.48	−208.45	−258.51

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: IQ is measured by standardized Raven IQ, age 22. Extraversion is measured by standardized Big5 scores, age 22. Estimation sample: educational attainment at least 11 grades (vocational school).

Table A.19: The ad-hoc regression as a reference - fixed-effects (FE) estimates on quarterly data

	(1)	(2)	(3)	(4)
EmprO	−0.0974	−0.0868	0.0276	0.0881
	(0.083)	(0.082)	(0.088)	(0.16)
EmprP		−0.00914	0.0245	0.0200
		(0.027)	(0.031)	(0.028)
lnGDP			−0.0960	−0.0534
			(0.080)	(0.044)
lntime				−0.126
				(0.19)
Constant	0.431***	0.453***	1.312	1.512
	(0.030)	(0.075)	(0.75)	(1.01)
Observations	447	447	415	415
Number of countries	15	15	14	14
R-squared	0.16	0.17	0.20	0.21

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
All specifications include indicators for quarters 1, 3 and 4

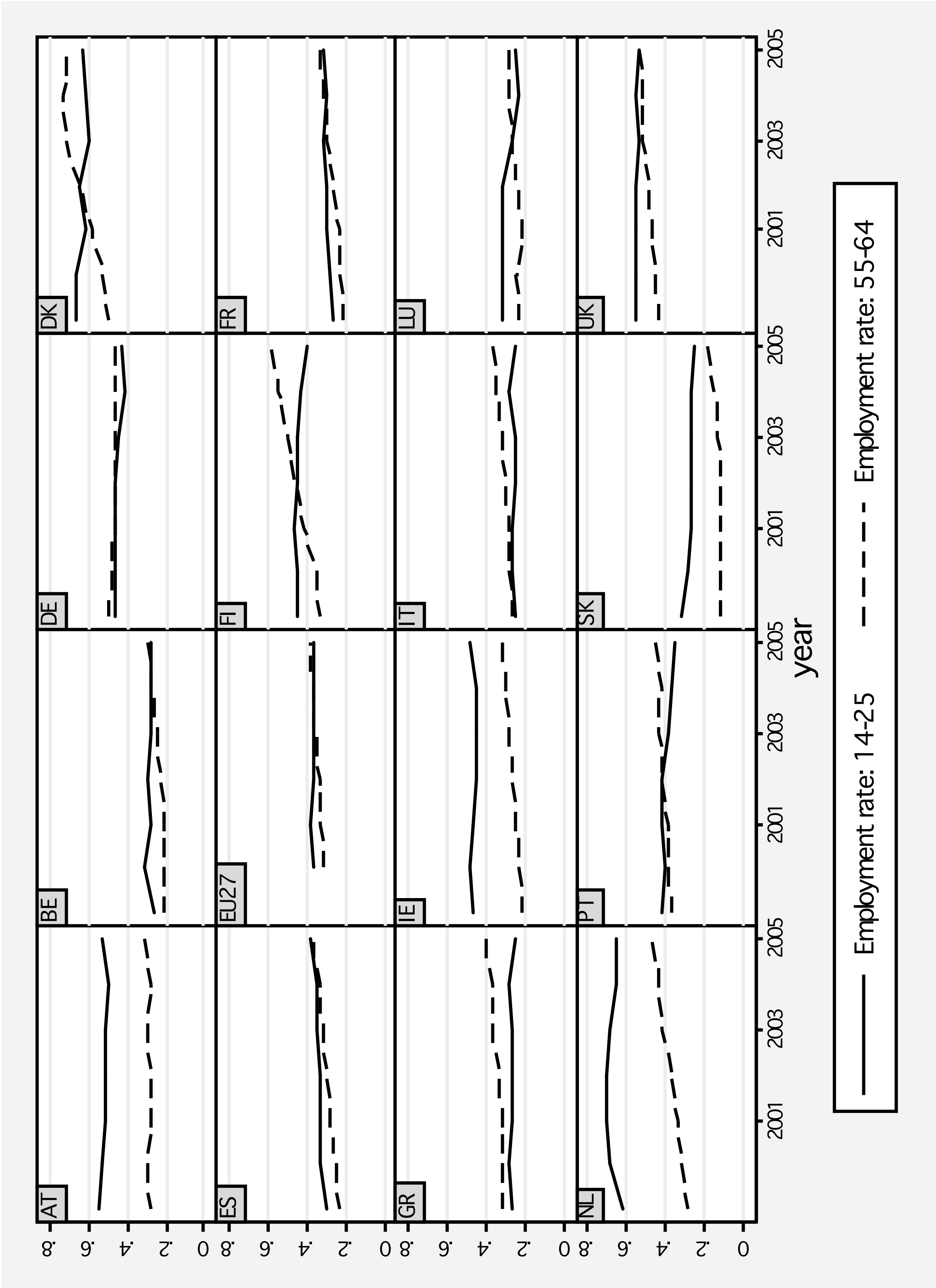

Figure A.1: Employment and unemployment rates of the young (15-24) and older (55-64) workers within the EU15 and in the EU27

Table A.20: The regression based on a transformed production function - fixed effect estimates on quarterly data

	FE1	FE2	IV1	IV2
lnEmprO	0.0330	−0.0635	0.694	0.694
	(0.060)	(0.055)	(1.55)	(1.55)
lnEmprP	1.712***	1.172***	1.875***	1.875***
	(0.29)	(0.26)	(0.51)	(0.51)
lnPopJ	1.994***	1.246***	2.799	2.799
	(0.36)	(0.31)	(1.93)	(1.93)
lnPopO	0.155	0.131	−0.476	−0.476
	(0.096)	(0.097)	(1.48)	(1.48)
lnPopP	−1.470***	−0.861***	−1.421***	−1.421***
	(0.35)	(0.32)	(0.42)	(0.42)
lnGDP	−0.253***	−0.347***	−0.516	−0.516
	(0.085)	(0.082)	(0.62)	(0.62)
lntime	−0.585***		−1.321	
	(0.15)		(1.73)	
Constant	0.102	−1.009	5.596	5.596
	(1.49)	(1.48)	(13.0)	(13.0)
Observations	415	415	415	415
Number of countries	14	14	14	14
R-squared (within)	0.26	0.23	0.02	0.02

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Bibliography

Altonji, J. G. and R. M. Blank (1999). Race and gender in the labor market. In O. Ashenfelter and D. Card (Eds.), *Handbook of Labor Economics*.

Augusztinovics, M. (1999). Pension systems and reforms in the transition economies. In *Economic Survey of Europe*, Number 3. Geneva: United Nations, Economic Comission for Europe.

Behar, A. (2008). Are skilled and unskilled labour complements or substitutes? Master's thesis, University of Oxfor, Nuffield College.

Bilsen, V. and J. Konings (1998). Job Creation, Job Destruction, and Growth of Newly Established, Privatized, and State-Owned Enterprises in Transition Economies: Survey Evidence from Bulgaria, Hungary, and Romania. *Journal of Comparative Economics 26*(3).

Blundell, R. and S. Bond (2000). Gmm estimation with persistent panel data: an application to production functions. *Econometric Reviews 19*(3), 321–340.

Boeri, T. (2000). *tructural change, welfare systems, and labour reallocation : lessons from the transition of formerly planned economies*. Oxford University Press.

Boeri, T. (2005, November). The Lisbon process and european women at work. Prepared for the Conference Political Economy and Social Policy of Western Europe.

Borghans, L., A. Duckworth, J. J. Heckman, and B. t. Weel (2008). The Economics and Psychology of Personality Traits. *SSRN eLibrary*.

Börsch-Supan, A., S. Kohnz, and R. Schnabel (2002). Micro modelling of retirement decisions in germany. Mannheim institute for the economics of ageing discussion papers, Mannheim Institute for the Economics of Ageing.

Bowles, S., H. Gintis, and M. Osborne (2001, December). The determinants of earnings: A behavioral approach. *Journal of Economic Literature 39*(4), 1137–1176.

Brown, A. N. (Ed.) (1999). *When is transition over?* Western Michigan University.

Brown, D. and J. S. Earle (2006). The Microeconomics of Creating Productive Jobs: A Synthesis of Firm-Level Studies in Transition Economies. Research working paper series, The World Bank.

Burniaux, J.-M., R. Duval, and F. Jaumotte (2004, June). Coping with ageing: A dynamic approach to quantify the impact of alternative policy options on future labour supply in oecd countries. OECD Economics Department Working Papers 371, OECD Economics Department.

Burns, A. and J. Cekota (2002, August). Coping with population ageing in hungary. OECD Economics Department Working Papers 338, OECD Economics Department.

Carlson, K. M. and R. W. Spencer (1975). Crowding out and its critics. *Review, Federal Reserve Bank of St. Louis* (Dec), 2–17.

Carneiro, P., C. Crawford, and A. Goodman (2006, July). Which skills matter? CEE Discussion Papers 0059, Centre for the Economics of Education, LSE.

Carneiro, P. M. and J. J. Heckman (2003). Human Capital Policy. Discussion paper series, IZA.

Chesher, A. (2003). Identification of nonseparable models. *71*(5), 1405–1441.

Coile, C. (2003, February). Retirement incentives and couples' retirement decisions. NBER Working Papers 9496, National Bureau of Economic Research, Inc.

Commander, S. J. and J. Köllő (2008, April). The Changing Demand for Skills Evidence from the Transition. *Economics of Transition 16*(2), 199–221.

Costa, P. J., A. Terracciano, and R. R. McCrae (2001). Gender differences in personality traits across cultures: Robust and surprising findings. *Journal of Personality and Social Psychology 81*(2), 322–331.

Cragg, J. G. (1971, September). Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica 39*(5), 829–44.

Cseres-Gergely, Z. (2005a). County to county migration and labour market conditions in hungary between 1994 and 2002. *Zeitschrift für ArbeitsmarktForschung 37*(4), 425–436.

Cseres-Gergely, Z. (2005b). Inactive middle-aged people and households: incentives and constaints. Technical report, Hungarian Ministry of Finance.

Dobos, G. (1998). Inflow to inactivity on the hungarian labour market (in hungarian: Inaktivitásba áramlás a magyarországi munkaerőpiacon). Master's thesis, Budapesti Közgazdaságtudományi Egyetem.

Fazekas, K. and G. Kézdi (Eds.) (2008). *The Hungarian Labour Market*. Institute of Economics, Hungarian Academy of Sciences.

Fertig, M. and C. M. Schmidt (2003, December). Gerontocracy in motion? european cross-country evidence on the labor market consequences of population ageing. IZA Discussion Papers 956, Institute for the Study of Labor (IZA).

Flinn, C. J. and J. J. Heckman (1983, January). Are unemployment and out of the labor force behaviorally distinct labor force states? *Journal of Labor Economics 1*(1), 28–42.

Gere, I. (1997). Retirement as a device of preventing and controlling unemployment (in hungarian: A nyugdíjazás, mint a munkanélküliség megelőzésének, levezetésének eszköze). *Munkaügyi Szemle 41*(10), 13–16.

Grant, J. H. and D. S. Hamermesh (1981, August). Labor market competition among youths, white women and others. *The Review of Economics and Statistics 63*(3), 354–60.

Greene, W. H. (1998). Gender economics courses in liberal arts colleges: Further results. *Journal of Economic Education 29*(4), 291–300.

Greene, W. H. (2000). *Econometric Analysis* (fourth ed.). Prentice Hall International, Inc.

Hamermesh, D. (1985). Substitution between different categories of labour, relative wages and youth employment. OECD Economic Studies 5, OECD.

Hamermesh, D. S. (1987, october). The demand for labor in the long run. In O. Ashenfelter and R. Layard (Eds.), *Handbook of Labor Economics*, Volume 1 of *Handbook of Labor Economics*, Chapter 8, pp. 429–471. Elsevier.

Hausman, J. A. and D. A. Wise (1978). A conditional probit model for qualitative choice: Discrete decisions recognizing interdependence and heterogeneous preferences. *Econometrica 46*(2), 403–426.

Heckman, J. (1979). Sample selection bias as a specification error. *47*(1), 152–61.

Heckman, J. and Y. Rubinstein (2001, Jan). The importance of noncognitive skills: Lessons from the ged testing program. *The American Economic Review*.

Heckman, J., J. Stixrud, and S. Urzua (2006, Jan). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*.

Herbertsson, T. T. (2001). Why do icelanders not retire early? Technical report, Pensionsforum, Stockholm.

Hicks, J. (1970, November). Elasticity of substitution again: Substitutes and complements. *Oxford Economic Papers 22*(3), 289–96.

Hopenhayn, H. and R. Rogerson (1993, October). Job turnover and policy evaluation: A general equilibrium analysis. *Journal of Political Economy 101*(5), 915–38.

Jacob, B. A. (2002). Where the boys aren't: non-cognitive skills, returns to school and the gender gap in higher education. *Economics of Education Review 21*(6), 589–598.

Jimeno, J. F. and D. R. Palenzuela (2003, March). Youth unemployment in the oecd: Demographic shifts, labour market institutions and macroeconomic shocks. Economics Working Papers 019, European Network of Economic Policy Research Institutes.

Johnson, G. E. (1980, August). The theory of labour market intervention. *Economica 47*(187), 309–29.

Jousten, A., M. Lefebvre, S. Perelman, and P. Pestieau (2008). The effects of early retirement on youth unemployment: The case of belgium. Working paper series, IMF.

Juhász, F. (2008). Asessing work capacity. In Z. Cseres-Gergely, K. Fazekas, and Á. Scharle (Eds.), *The Hungarian Labour Market, Review and Analysis 2008*, Chapter In Focus, pp. 101–102. Institute of Economics, Hungarian Academy of Sciences.

Kim, H. Y. (2000). The antonelli versus hicks elasticity of complementarity and inverse input demand systems. Technical report, Australia Economic Papers.

Köllő, J. (2001). The patterns of on-employment in hungary's least developed regions. Budapest Working Papers on the Labour Market 2001/1, Institute of Economics, Hungarian Academy of Sciences.

Korenman, S. and D. Neumark (1997, May). Cohort crowding and youth labor markets: A cross-national analysis. NBER Working Papers 6031, National Bureau of Economic Research, Inc.

Kőrösi, G. (2003). Job Creation and Destruction in Hungary. Working paper series, Central European University, Economics Department.

Layard, R., S. Nickell, and R. Jackman (1991). *Unemployment: Macroeconomic Performance and the Labour Market*. Oxford University Press.

Lee, L.-F. (1978). Unionism and wage rates: A simultaneous equations model with qualitative and limited dependent variables. *International Economic Review 19*(2), 415–433.

Lelkes, O. and Á. Scharle (2004). Why is one third of the 50 year old hungarian men inactive? (in hungarian: Miért inaktív az 50 éves magyar férfiak egyharmada?). In T. Kolosi, T. I. György, and V. György (Eds.), *Társadalmi Riport*. TÁRKI.

Levinsohn, J. and A. Petrin (2003, April). Estimating production functions using inputs to control for unobservables. *Review of Economics and Statistics*, 317–342.

Lumsdaine, R. L., J. H. Stock, and D. A. Wise (1990, December). Three models of retirement: computational complexity versus predictive validity. NBER Working Paper Series 3558, NBER.

Maddala, G. S. (1983). *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge University Press.

Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of Political Economy 66*(4), 281–302.

Mincer, J. (1974). *Schooling, Experience and Earnings*. New York: Columbia Univeristy Press.

Ministry for Youth, Families, S. A. and E. Opportunity (2005). National strategy report on pensions on adequate and sustainable pensions for hungary.

Molnár, G. (2005). The data set and the rotation panel (in hungarian: Az adatállomány és a rotációs panel). In Z. Kapitány, G. Molnár, and I. Virág (Eds.), *Háztartások a tudás- és munkapiacon*. MTA KTI.

Molnár, G. (2006). On the sample of the hungarian household budget survey. in Hungarian, notes for the 17. october 2006 session of the Statistics Committee of the Hungarian Academy of Sciences.

Nagy, G. (2000). Unemployment insurance in hungary in the 1990s (in hungarian: Munkanélküli segélyezés magyarországon a kilencvenes években). Technical Report 9, Institute of Economics, Hungarian Academy of Sciences.

Olley, S. and A. Pakes (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica 64*(6), 1263–1298.

ONYF (2004). Retirement ages between 1997-2002 in case of old-age and old age-type pensions (in hungarian: Nyugdíjazási életkorok az 1997-2002 közötti öregségi- és öregségi jellegű nyugdíjazásoknál). Technical report, Országos Nyugdíjbiztosítási Főigazgatóság.

Pagés, C. and C. E. Montenegro (2007, December). Job security and the age-composition of employment: evidence from chile. *Estudios de Economía 34*(2), 109–139.

Peracchi, F. and F. Welch (1994, April). Trends in labor force transitions of older men and women. *Journal of Labor Economics 12*(2), 210–42.

Sato, R. and T. Koizumi (1973, March). On the elasticities of substitution and complementarity. *Oxford Economic Papers 25*(1), 44–56.

Scharle, Á. (2008). A labour market explanation for the rise in disability claims. In K. Fazekas, C.-G. Zsombor, and Á. Scharle (Eds.), *The Hungarian Labour Market, Review and Analysis 2008*, Chapter 4, pp. 91–102. Institute of Economics, Hungarian Academy of Sciences.

Simonovits, A. (2008). The pay-as-you-go systems and permanent reform: The first pillar. In R. I. Gál, I. Iwasaki, and Z. Széman (Eds.), *Assessing Intergenerational Equity*. Akadémiai Kiadó.

Skans, O. N. (2005). Age effects in swedish local labor markets. *Economics Letters* (86), 419–426.

Stern, D. I. (2004, February). Elasiticities of substitution and complementarity. Technical Report 0403, Rensselaer Polytechnic Institute.

Stewman, S. (1988). Organizational demography. *Annual Review of Sociology 14*, 173–202.

Stock, J. H. and D. A. Wise (1990, September). Pensions, the option value of work, and retirement. *Econometrica 58*(5), 1151–80.

Széman, Z. and L. Harsányi (2008). Social aging. In R. I. Gál, I. Iwasaki, and Z. Széman (Eds.), *Assessing Intergenerational Equity*. Akadémiai Kiadó.

Vanhuysse, P. (2006, November). *Divide and Pacify: Strategic Social Policies and Political Protests in Post-Communist Democracies*. Central European University Press.

Weiss, Y. and R. Gronau (1981). Expected Interruptions in Labor Force Participation and Sex Related Differences in Earnings Growth. *SSRN eLibrary*.