Research Report

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Retirement Behaviour in Austria
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Eco & Fin APPLIED RESEARCH Vienna

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Abstract

In this project we develop a microsimulation model for retirement behaviour in Austria based on two administrative datasets. We match data from the Austrian social security database (ASSD) to a dataset (VVP) that contains very detailed information on all pension-relevant information on the individual level, e.g. insurance records as well as complete earnings histories. Based on this data we develop a comprehensive microsimulation model of the Austrian pension system. This model allows us to calculate the retirement benefit entitlements for each and every individual, and to double-check our calculation rules with the actual, administratively calculated pension entitlements. We construct a range of (forward-looking) incentive measures that describe the individual decision problem. Specifically, we compute social security wealth, accrual rate, peak and option values for more than 300,000 individuals within each year of the observational period (2002-2009). Based on this characterisation of the incentive structure we develop an econometric model and provide robust evidence for the effects of the incentive measures on old age labour supply. Simulation of several reform scenarios shows that a stronger emphasis on financial incentives in the pension system (the introduction of additional bonusses and deductions) reduces the out-of-labour-force ratio of individuals aged 56-65 by 16.3% for females and 13.4% for males.

Executive Summary

Most European countries, just as other developed countries around the world, are facing funding problems in their public pension systems. In particular, pay-as-you-go pension systems are confronted with two major developments: the trends of declining fertility and increasing life expectancy led to population ageing and therefore to an increase of the number of retirees relative to the working age population. Compounding this demographic development is the tendency towards later entry and earlier exit from the labour market. The total number of years spent in the labour force thus decreased in all European countries during the past decades, putting further financial pressure on those currently in the labour force (see chapter 1).

In Austria this development is particularly pronounced since life expectancy and living conditions are comparatively high while actual retirement age is among the lowest in all OECD countries. As has been repeatedly argued, for instance by Gruber and Wise (1999), the incentives delivered by the pension system are a major driving force of individual retirement behaviour. However, a more thorough analysis of the incentive structure of the Austrian pension system hinges on the ability to capture the full complexity of the Austrian retirement regulations while linking them to individual level data. This project thus offers a major contribution to evidence-based policy evaluation by making use of a newly available administrative dataset and developing a full-scale microsimulation model capable of simulating (ex-ante) the employment effects of reforms in the Austrian retirement regulations.

Via social security identification, the Austrian social security database (ASSD) is merged with a dataset (VVP) containing a detailed account of all pension-relevant information on individual level, e.g. insurance records as well as complete earnings histories. The connected datatset contains information on 314,805 Austrian individuals who have been exiting the labour market between 2002 and 2009. It is described in chapter 3, while chapter 2 gives an overview of the Austrian pension system. Based on this data we develop the **I**HS-Micro-Simulation-Model-for-**REt**irement-Behaviour-in-**A**ustria (**IREA**) following the framework laid out in (Gruber and Wise, 2002, 2004).

To describe the incentive structure as perceived by the individual decision makers we adopt an option value framework. This approach is built on the empirical observation that retirement is an absorbing state and it thus captures the opportunity costs of immediate retirement as measured by the maximum utility gain that could be obtained from staying in the labour market. To implement this approach it is thus not sufficient to calculate retirement benefits corresponding to the observed retirement date of a given individual. It is, however, necessary to calculate them for each possible retirement year in the planning period 2002-2014 taking counterfactual employment careers into consideration. Being able to access complete insurance and employment records on individual basis allows us to do these calculations and construct several incentive measures, including social security wealth, accrual rate, peak and option value (as described in chapter 4), thus characterising the incentive structure of the Austrian pension system as faced by individual decision makers.

The procedures needed to calculate the incentive measures are discussed in chapter 5. First, we project annualized gross incomes beyond the actual retirement year based on the individual income time series. Second, we calculate individual assessment bases based on contribution and substitution periods, including childcare. Third, we calculate gross retirement benefits as defined by the assessment base, retirement plan and insurance record and define eligibility for all relevant retirement plans as implicated by the individual insurance record. However, since in the Austrian context it is vital to account for different forms of disability pensions, we additionally estimate individual probabilities to obtain disability status and use these to define expected eligibility. Fourth, we apply the Austrian income tax and social security legislation of the corresponding planning year (as modelled in the tax-benefit microsimulation model ITABENA, Hofer et al. (2003)) in order to obtain net retirement benefits as well as net labour income.

Since our dataset additionally contains the actual outcome of the calculations of the Austrian pension insurance office, we initially compute gross retirement benefits for the actual retirement date so that we are able to double-check our calculations against actual outcomes. Having thus calculated net retirement benefits and labour income for every possible work-retirement pathway allows us to construct the incentive measures for each year of the observational period 2002 to 2009 based on a consistent 5-year planning horizon.

In order to model retirement behaviour we estimate several binary probit models with retirement in the planning year as dependent and social security wealth plus an additional incentive measure as the main independent variables. The introduction of forward-looking independent variables into our econometric specification thus allows us to capture intertemporal variation within a comparatively simple framework. To account for the effects of aging on retirement we let age enter the model in two different ways, either linearly or through a full set of age indicators. In addition, we differentiate between females and males, thus resulting in a total of 12 model specifications. The results are described in detail in chapter 6, indicating that the parameter estimates of the incentive measures have the expected sign and are highly significant throughout all specifications. Although the magnitude of the effects varies depending on the incentives included, these results imply a robust relationship between the incentive structure of the Austrian pension system and retirement behaviour as observed for the individuals in our dataset.

Simulations show that our model replicates expected retirement ages and empirical hazard rates very well (see section 6.4). These are therefore used to assess the full quantitative impact of several reform scenarios on (cumulative) hazard rates, expected retirement ages and out-of-labour-force ratios (in chapter 7). We implement two standard reforms as laid out in Gruber and Wise (2004). The first reform evaluates the effect of an increase in the statutory retirement age by three years and is shown to reduce the out-of-labour-force ratio of individuals aged 56-65 by 6.5% and 14.3% for females and males respectively. The second common reform scenario pronounces financial incentives through additional bonusses and deductions, thus reducing the ratio by 16.3% for females and 13.4% for males. As a more policy relevant application, we also shortly discuss the abolition of the hard-worker-rule, which is a specific pathway into retirement that was originally aimed at blue-collar workers.

Direct international comparison on the basis of the results in Gruber and Wise (2004) is somewhat hindered by the fact that current legislation differs substantially among countries. However, it is apparent from our results that the Austrian case is characterised by several special features. Although the estimation results show a very robust relationship between incentive measures and retirement behaviour, the overall quantitative impact is somewhat lower than in comparable countries, especially when considering the fact that actual retirement ages are among the lowest in Europe. Another characteristic feature, which is of course related to the low actual retirement ages, is the importance of several health-related pathways into early retirement. Although our approach captures this feature quite well, the magnitude of this phenomenon in Austria is likely to countervail the pure incentive effects delivered by the pension system. A third relevant aspect is hidden in the fact that the Austrian retirement regulations are characterised by a considerable degree of diversity, especially for individuals retiring within the time frame of our dataset. This complexity, combined with the uncertainty of future reforms, makes it more difficult for Austrian individuals to form rational expectations about their future entitlements. However, as this situation will give way to more transparent regulations in the future, it is to be expected that the observed incentive effects are further strengthened along with this development.

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Chapter 1

Introduction

1.1 Motivation

Most EU countries, just as other developed countries around the world, are facing funding problems in their public pension systems. In particular, pay-as-you-go pension systems are confronted with two major developments: the trends of declining fertility and increasing life expectancy led to population ageing and therefore to an increase of the number of retirees relative to the working age population. Compounding this demographic development is the tendency towards later entry and earlier exit from the labour market. The total number of years spent in the labour force decreased in all European countries during the past decades, putting further financial pressure on those currently in the labour force (Wise, 2005). The fact that people live longer and retire earlier leads to adults spending about a third of their lifetime in retirement (Lumsdaine et al., 1992).

Knowing what determines retirement decisions and being able to carry out successful reforms is therefore crucial for ensuring the solvency of western public pension systems going forward. Adding to the practical and political importance of this issue are methodological advances and the establishment of large micro-datasets that enable the meaningful analysis of individual (retirement- and labuor force participation) behaviour.

Many factors influence individual retirement decisions. The economic literature is mostly concerned with financial incentives to retire inherent in the design of (public) pension systems. That the incentive structure of the pension system has a significant impact on individual retirement behaviour is well established in the literature, and has been investigated using data from many countries around the world — see, among others, Gruber and Wise (1999); Boersch-Supan (2000); Wise (2005) for cross-country comparisons. These papers corroborate the thesis that cross-country differences in actual retirement ages are largely due to differences in the incentive structures of the respective pension systems.

The gap between statutory and actual retirement age is especially high in Austria, as actual retirement age is among the lowest in all OECD countries (OECD, 2011). Yet, not a lot of empirical research has been done regarding retirement behaviour in Austria. Though cohort discontinuities have been used to evaluate labour supply effects of specific reforms ex-post (see Mastrobuoni, 2009; Liebman et al., 2009; Karlstrom et al., 2008; Duggan et al., 2007), only Staubli and Zweimueller (2011) apply this approach to Austrian data. They make use of the gradual increase in statutory pre-retirement ages that came about with the reforms of the Austrian pension system in 2000 and 2004, and find that retirement ages increased by 19 and 25 percentage points among affected males and females respectively. Though this lead to an increase in employment of 7 and 10 percentage points, sizeable spillover effects imply that parts of the old-aged workforce moves into unemployment as retirement ages are increased. Hofer and Koman (2006) use a case study approach to directly analyse the incentive effects of the pension system on retirement. They conclude that the Austrian pension system is likely to be (at least) part of the reason for the sharp decline of old-age labour force participation by providing strong incentives to retire before statutory retirement age. Mara and Narazani (2011) employ the microsimulation model EUROMOD to approach this issue empirically, and present a simplified econometric approach that allows them to evaluate pension and tax reforms on the basis of a purely cross-sectional analysis. However, their approach has severe limitations as (i) the EU-SILC (Survey on Income and Living Conditions) neither contains employment nor insurance records, and (ii) they disregard the dynamic nature of retirement since their econometric model only captures static aspects of the income-leisure trade-off faced by old-age individuals. Raab (2011) accounts for these effects by developing a model based on the approach of Gruber and Wise (2004) to Austria. However, the data he uses also lacks information on individual insurance and employment records and he therefore has to rely on a range of strong assumptions in order to be able to calculate retirement benefits and define eligibility.

This project thus aims to fill this gap by developing a full-scale microsimulation model capable of simulating (ex-ante) the employment effects of reforms in the Austrian retirement regulations based on the option value framework as developed by Stock and Wise (1990) and Gruber and Wise (2004). We model retirement decisions in Austria based on data from two administrative sources: Via social security identification, the Austrian social security database (ASSD) is merged with a dataset containing a detailed account of all pension-relevant information (VVP), including individual insurance records and earnings histories (cf. chapter 3 and A). This enables us to model the Austrian pension system in detail, calculate retirement benefits for every individual, and double check our calculation rules with the actual, administratively calculated pension entitlement. This approach thus allows us to construct a range of (forward-looking) incentive measures that characterise the decision problem as faced by the individuals. Specifically, we compute social security wealth, accrual rate, peak and option values for more than 300,000 individuals within each year of the observational period 2002-2009. Based on this characterisation of the incentive structure we develop an econometric model and provide robust evidence for the effects of the incentive measures on old age labour supply. Simulations of several reform scenarios underline the incentive effects on retirement behaviour, and highlight a wide range of potential applications.

This report is organised as follows. We dedicate the rest of this chapter to a discussion of some of the important funding problems of European pay-as-you-go pension systems, highlighting the effect the incentive structure of these pension systems had on the labour market participation of older workers. Chapter 2 provides an overview of the basic workings of the Austrian pension system, and the economic situation of Austrian retirees. In chapter 3, we provide a detailed account of how we construct our dataset from the complex administrative data at hand. We discuss key concepts for the assessment of the incentive structure of pension systems in chapter 4. Chapter 5 describes how retirement benefits are calculated and discusses the implementation of the incentive maesures in our model. We present the econometric model in chapter 6, and the simulation results in chapter 7. As supplements to this report we provide an overview of the historical development of pension systems in Europe in section F, and a country comparison of pension systems in chapter G.

1.2 The Sustainability of European Pension Systems

In this section, we want to discuss the two major threats to the solvency of public pension systems — what Gruber and Wise (2004) call "unused labour force capacity" due to population ageing and the decreasing labour force participation of older workers - from an EU perspective, thus emphasising the Austrian situtation relative to a topical selection of European countries (see also G).

1.2.1 Ageing Populations

1.2.1.1 Fertility

Presently, birth rates fall short of the replacement rate of 2.1 children per woman in all European countries. However, fertility has historically been subject to fluctuations. In the inter-war years, a time of high unemployment and poor economic prospects in parts of Europe, birth rates were also below the replacement level; this situation persisted until the baby boom started in the 1950s. In Britain, concerns about future pensions were already raised at that time. But then economic conditions brightened with employment and wages on the rise and low prices, and fertility rates picked up. They reached a climax in 1964 with 6.25 million live births (Willetts, 2007). Only after the first oil crisis all European countries experienced a decline in fertility. In Austria fertility has decreased by 50 percent since 1960; the fertility rate was 1.39 in 2009, which is below the EU average (see table 1.1). There was a strong decline in the new EU Member States' fertility rate between 1980 and 2000. E.g. in the Czech Republic fertility is now below the EU-15 average. The same holds for Germany, whereas Sweden and the United Kingdom have fertility rates closer to the replacement rate.

Table 1.1: Fertility Rates

	1960	1970	1980	1990	2000	2009
AT	2.69	2.29	1.65	1.46	1.36	1.39
CZ	2.09	1.92	2.08	1.90	1.14	1.49
DE					1.38	1.36
SE		1.92	1.68	2.13	1.54	1.94
UK				1.90	1.83	1.64

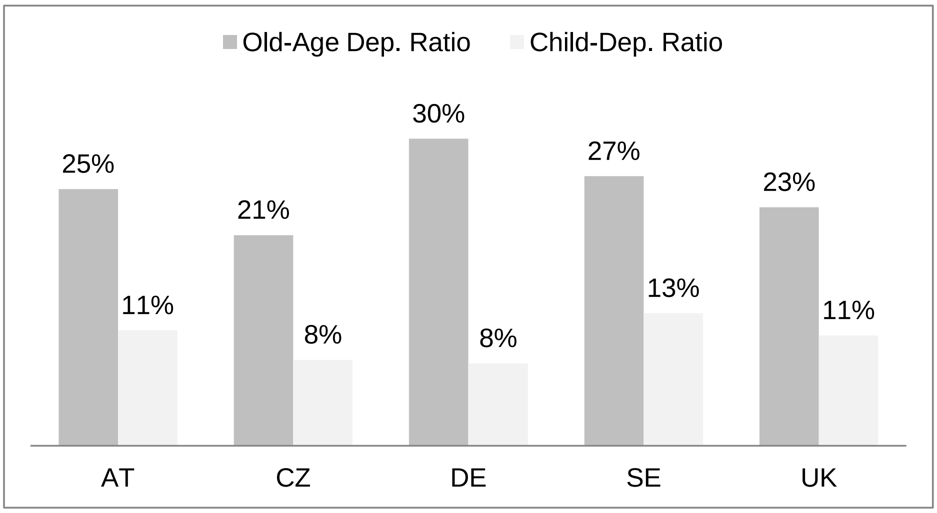
Source: Eurostat (a)

This decline in fertility has been described as a second demographic transition that is linked to overall changes in social and family life. Marriage rates have decreased over the past decades, while the age at marriage has increased. Cohabitation is on the rise as is the number of children born out of wedlock. An increase in the education and labour market participation of women lead to higher opportunity costs of the time of women (European Commission, 2007). Improvements in the availability and reliability of contraception have decreased the incidence of stochastic fertility.

But also public policy has to take part of the blame for the decrease in fertility. In all European countries except Austria and Romania, the average desired number of children is two or slightly more, a number relatively constant across cohorts and genders. Only in Austria and Belgium, the number of childless women between 25 and 39 who do not wish to have children exceeds ten percent. However, the percentage of women who actually remain childless lies above this number in all EU countries, indicating that there is unrealised fertility potential that governments could exploit with appropriate family-friendly policies. One also has to keep in mind that small family sizes might have knock-on effects for future generations, as their ideal might be shaped by their own experience. Actual trends however point into a different direction. In the early years of this millennium, fertility rates have increased in most member states and stood at 1.5 in 2004/2005. The EU projects the fertility rate to increase to 1.6 until 2030 and remain at this level until 2050 (European Commission, 2007).

Since children are the future labour force, a high fertility rate is desirable from a pension-funding perspective. The child ratio relates the number of working age (15-64 years) people in a country to the total number of dependent children (below the age of 15). Austria's child ratio is 11.3, that is, there are almost ten working age people per child (Eurostat, b). The UK's child ratio is comparable, in the Czech Republic and Germany the child ratio is about eight percent while in Sweden it is higher at 13 percent, see figure 1.2.1.1. The child dependency ratio for the EU-27 population is projected to rise moderately (Giannakouris, 2008).

Figure 1.1: Old Age and Child Dependency Ratios in selected EU Countries



Source: Eurostat (b), IHS 2011

1.2.1.2 Life Expectancy

Life expectancy has been increasing in Europe for decades. In Austria, life expectancy at birth increased from 72.8 to 81.1 for women and from 66.5 to 75.1 for men between 1961 and 2000 (Statistik Austria, 2011). In 2010 life expectancy was 83.2 and 77.7 for women and men, respectively. Average life expectancy in Austria was a year above the EU-27 average and about a third of a year below the EU-15 average between 2000 and 2007 (Eurostat, a). In 2006 men aged 65 could expect to live 4 years, women 5 years longer than 65-year-olds in 1978. Not only overall life expectancy, but also years of good health have been increasing since 1978, while years of poor health have decreased.

Table 1.2: Life Expectancy and Expected Years in Good/Bad/Moderate Health at age 65 in Austria

		Health status in years			
		(very) good	moderate	(very) bad	Life Expectancy
1978	Men	4.1	5.3	3.1	13
	Women	3.6	7.6	4.7	16
2006	Men	8.7	6.0	2.5	17
	Women	8.9	8.4	3.2	21

Source: Statistik Austria (2012c)

It is widely assumed that this positive trend will continue, although forecasts are not unanimous. In the early 20^{th} century, the added years of life expectancy that were won due to medical advancements and increasing job security were largely spent in the labour force (Willetts, 2007). In the future, the main increases in life expectancy will come from lower mortality at older ages, but also health at higher ages is expected to improve. The effects future lifestyle choices will have on life expectancy are, however, difficult to predict. The decrease in smoking was found to have a positive effect; uncertainty remains about the future impact of rising obesity rates (European Commission, 2007).

There still exists a strong albeit decreasing difference in life expectancy between men and women, now amounting to 6 years in the EU-25. Women, however, are less healthy later in life. The difference between New Member States and Old Member States is also considerable. In the former, men die on average 6.3 years and women 3.7 years earlier. Most of these higher mortality rates could be prevented by different lifestyle choices or safety measures. Furthermore, life expectancy differs along socio-economic lines (European Commission, 2007). The European Commission (2007) predicts life expectancy to increase to 86.8 years for women and 81.7 for men in 2050. The number of persons aged 80 or over will almost triple from 20 million to 60 million between 2010 and 2060 in the EU-27. The share of Austrian population over 80 is predicted to increase to almost 12 percent of the total population until 2053 and then to start decreasing. The share of over 80-year-olds of the EU-27 population is not forecasted to decrease in the next 50 years.

This development is of course straining pay-as-you-go pension systems. The old age dependency ratio relates the working age population of a country to the population of retirement age; it is therefore a good basic indicator for the demographic sustainability of a pension system. Austria's old-age dependency ratio, for example, is about 25 (there are four working age people for every person of retirement age). The fastest rate of growth of the old-age dependency ratio will be reached in 2013, but for most countries the rise will continue at least until 2050. For most northern countries (like Denmark, Sweden, the Netherlands) the peak in the dependency ratio is predicted to occur before 2050 (OECD, 2009b). Currently, Germany, Italy, Sweden and Greece have the highest dependency ratios, all close to 30 percent (Eurostat, b). Some new member states have slightly lower dependency ratios. However, especially the New Member states will experience the fastest increase in dependency ratios until 2050 (OECD, 2009b). By 2050, southern European countries already starting from a higher level, namely Italy, Spain and Greece will have dependency ratios between 64 and 66 percent, meaning there will only be 1.5 working age people for every person of retirement age. The most favourable conditions are predicted to be in northern Europe, namely Iceland, Luxembourg, Norway and the Netherlands with a ratio between 38 and 44 percent. These are also the countries with the smallest growth in the old age dependency ratio (OECD, 2009b).

As a consequence of the decrease in fertility and therefore numerically small younger cohorts, and the increase in life expectancy, the fraction of the population that is of working age has shrunk in recent decades, putting pressure on publicly funded pay-as-you-go pension systems. Although low birth rates have been around for a while, related sustainability problems in the pension system are just about to start, since the large baby boom cohorts who were born between 1955 and 1975 have not reached retirement age yet. The EU projected the share of working age population to peak at 67 percent in 2010. After this point, an increasing share of the baby-boomers will retire and cause the dependency ratio to rise.

1.2.1.3 Migration

According to forecasts, continuing high levels of immigration into the EU would delay the start of population decline that is caused by low birth rates in Europe (European Commission, 2007). In 2008 nearly 3.8 million people immigrated to and 2.3 million people emigrated from the European Union, which yielded a net migration of about 1.5 million people. In Austria net migration was 8,451 in 1998 and 34,436 in 2008. Austria's net migration reached 0.4 percent of its population, which is above the EU average of 0.3 percent (see table 1.3).

The southern European countries Spain, Italy, Cyprus and Malta, which, a century ago, experienced important emigration to America, now observe the largest inflows of migrants relative to their population (although in the case of Spain and Italy this is mainly due to the regularisation of illegal immigrants). In 2008, Germany, Poland and the Baltic countries had more emigrants than immigrants.

Table 1.3: Migration between 1999 and 2009

	Immigrants		Emmigrants		Net Migration		
	1999	2009	1999	2009	1999	2009	% of Pop. 2009
AT	86,710	73,278	66,923	56,397	19,787	16,881	0.20%
CZ	9,910	75,620	1,136	61,782	8,774	13,838	0.13%
DE	874,023	346,216	672,048	286,582	201,975	59,634	0.07%
SE	49,839	102,280	35,705	39,240	14,134	63,040	0.68%
UK	354,077	566,490	245,340	368,150	108,737	163,034	0.26%

Source: Eurostat (a), IHS 2011

A diminishing of the European labour force might become a strong pull factor for immigration, since skill shortages are likely to arise. Flexible labour markets with high employment rates — predominantly found in the northern countries and the UK — are accessible more easily than heavily regulated ones and are therefore likely to be more attractive to immigrants (European Commission, 2007). The Austrian labour force is projected to decrease continuously for the next 40 years if there were no immigration and remain more or less constant with migration (European Commission, 2007). In addition to the direct effect of migrants on the labour force, they also increase the future labour force because they often have a higher birth rate than the native population. UK government projections estimate that it takes around 15 years for migrants to adopt fertility patterns of their new home country (Willetts, 2007).

However, immigration is the most uncertain factor influencing the size of the working age population for the next 30 years. The EU projections for the period 2015 to 2050 forecasts the net migration to fall to 800.000 persons per year — a number insufficient to offset a decrease in total population (European Commission, 2007). According to the forecasts immigration can hold the labour force constant even when national working age population declines; however, this does not affect the change in the share of the old age population. Therefore migration is not a viable solution to the ageing problem, neither in Austria nor in other European countries. According to estimates by the European Commission (2007) a net immigration of about 56 million people of working age, who actually find jobs, would be required for the EU-27 to keep the population of working age constant. Such high levels of migration might cause social and political problems, as societies struggle to accommodate large influxes of people of foreign descent.

While the demographic trends of fertility and longevity do have an important impact on the solvency of public pension systems, they are not easily influenced by public policy. The second contributing factor, the low labour market participation of older workers, on the other side has been shown to be responsive to public policy, most crucially to pension reforms (see, e.g. Wise, 2005). We now turn to discuss the trends in labour market participation of older workers in Europe, and the interesting differences that can be observed between countries.

1.2.2 Labour Market Participation of Senior Workers

Starting in the late 1960s, labour force participation of older men has dropped in almost all western countries, with EU countries like Belgium and Spain experiencing some of the largest drops (Wise, 2005). Although the official regular retirement age for men is 65 in most European countries (women are allowed to retire earlier than men in Italy, Poland, the UK, Belgium, the Czech Republic and Austria (OECD, 2006)), the average actual retirement age is lower than the official age in all European countries; 61 years in the European average (see table 1.4). In the EU-15 on average 14 percent of the population in their late 50s and around half of the population between the ages of 60 and 64 are already retired (OECD, 2006). Early retirement has been introduced in many

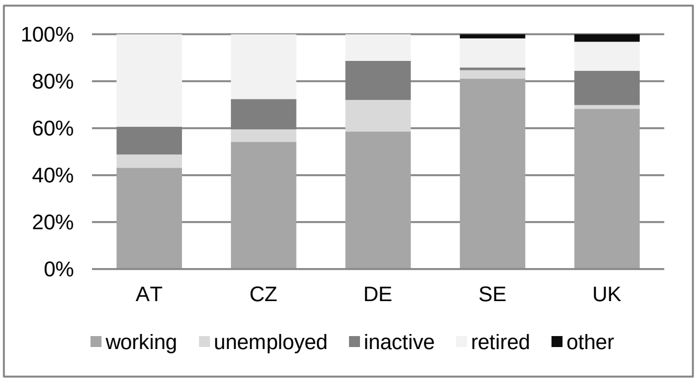
Table 1.4: Actual and Official Retirement Age in 2007

	Actual Average	Official
EU	61.2	
AT	60.9	65/60
CZ	60.7	62
DE	62	65
SE	63.9	65
UK	62.6	65/60

Source: Eurostat (a) , IHS 2011

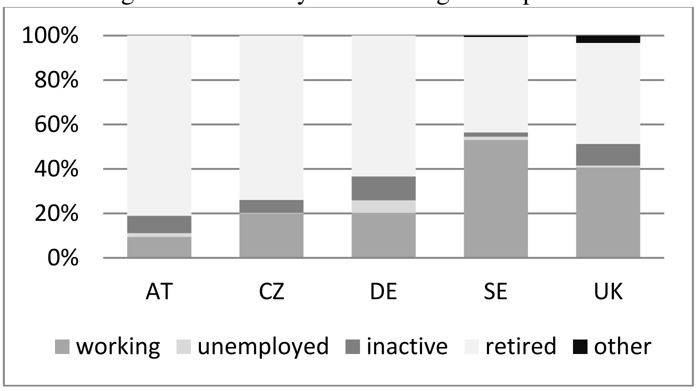
European countries as a measure to decrease the rising youth unemployment, or has been rationalised as such ex-post. The conjecture that early retirement creates employment opportunities for young people can however not be backed up empirically — there is no evidence that increasing the employment rate of older persons has

Figure 1.2: Activity Status of the Age Group 55-60



Source: Eurostat (b), IHS 2011

Figure 1.3: Activity Status of Age Group 60-65



Source: Eurostat (b), IHS 2011

detrimental effects on youth employment (Gruber et al., 2009). The introduction of early retirement provisions, however, had a large effect on older workers' participation rates (OECD, 2006).

Most countries allow those with a long insurance history to retire before reaching the regular retirement age.Additionally, many European countries provide other benefits, like unemployment or disability benefits, that are equivalent to early retirement provisions — this is evidenced by the striking differences in the number of claimants of disability benefits between European countries that are unlikely to be due to actual differences in health status (Milligan and Wise, 2011). Defining ones activity status may depend on which kind of benefit is easier to obtain at a given age in each country OECD (2006), which is why the labour force status of older workers who are not currently employed differs so much between EU countries (see figures 1.2 and 1.3).

Austria and the Czech Republic display high numbers of young pensioners, indicating that early retirement is comparatively accessible in these countries. In Austria, more than 80 percent of those aged 60 to 65 are already retired, half of all early retirees retire because they fulfilled the eligibility criteria for early retirement, without having to refer to health reasons. The same is true for the Czech Republic (Statistik Austria (2007), Eurostat (a), see table 1.5). For Austria, other reasons for early retirement include ill health, being pushed into retirement by their employer, lay-offs or redundancy, being offered financial retirement incentives, or care responsibilities. Asked under what conditions they would have continued working, 61.4 percent of Austrian early pensioners stated that they would have worked longer if they were healthier, 30.6 percent would have worked longer for higher earnings and a low percentage of early pensioners stated that they would work longer if flexibility, work atmosphere and education possibilities were better (Statistik Austria, 2007).

In Sweden, less than a third in the 60-65 age group are retired; but of those who are retired, more than a third retired because of ill health. In fact, more than a third of 64-year-old Swedish men are collecting disability benefits, indicating that this is a loophole into early retirement in the Swedish system (Milligan and Wise, 2011). Italy, Spain and the Netherlands display quite high shares of non-participation in the labour force for this age group, while in Germany, Spain and Finland the unemployment rates for this age group are high. In countries with stricter regulations for early retirement, like the United Kingdom, Sweden and Germany, around a third of early pensioners retire early because of health problems, see table 1.5. In Germany and the UK, a high percentage of early retirement decisions is caused by a job loss (Eurostat, a).

Table 1.5: Self-reported Retirement Reasons in the Age Group 50-69

	Total in 1000	Lost Job	Reached Retirement Age	Health Reason
EU	23321,4	16%	61%	22%
CZ	885,4	12%	81%	7%
DE	3842,5	23%	42%	31%
AT	571,6	14%	62%	23%
SE	540,9	14%	56%	31%
UK	2295,1	27%	39%	34%

Source: Eurostat (a), IHS, 2011

Once established it seems rather difficult to abolish these schemes. Because those desiring to retire divert to other social benefits, such as unemployment and sickness benefits or employer sponsored early retirement, the reform of early retirement schemes has to be considered in conjunction with other benefits for which older people are in general eligible.

One frequently quoted reason for the low labour force participation of older people is unemployment, as senior workers often struggle to find a new job which may be less appealing than moving into early retirement (Eurostat, a). More senior workers might find it harder to find jobs because employers hold negative preconceptions about older workers' productivity or flexibility, or may worry about their skill set being out of date. Also, higher wage costs due to seniority wages and special protection rules can make more senior workers undesirable on the labour market (OECD, 2006). Any policy aiming to effectively increase labour force participation of older workers has to address this issue. Education is also an important determinant of the retirement decision — more highly educated individuals tend to continue working longer than unskilled workers, just like the self employed work longer than the employed (Statistik Austria, 2007)[1]. A better educated workforce is therefore

[1]Austrian civil servants retire earlier than the general population (Statistik Austria, 2007), which is due to attractive early retirement

desirable from a labour force participation perspective.

The target employment rate (according to the Stockholm Euopean Council of 2001) for 55- to 65- year-olds was 50 percent in 2010 (Eurostat, 2010). The employment rate for older workers increased in almost all countries from 1998 to 2010. Across the EU-27 the employment rate for older workers increased from 40 percent in 2003 to 45.6 percent in 2008. Twelve Member States achieved 50 percent: Iceland shows the highest share of employed 55- to 65-year-olds, followed by Sweden, Norway and the United Kingdom (see figure 1.7). In Austria, the employment rate for 55- to 64- year-olds has increased from 29 percent in 1995 to 42 percent in 2010 which is still far below the target (Eurostat, a).

As a result of stagnant or decreasing retirement ages over time and increasing life expectancy, time spent in retirement became longer. Hungarian men enjoy the longest retirement phase in Europe, followed by Austrian and Italian men (OECD, 2006). The longest retirement phase for women can be found in Belgium, followed by France and Austria (2006). At the same time, entry into the labour force has been delayed as a consequence of prolonged education and training. In Austria the average entry age increased from 17 in 1971 to 23 in 2001 (see table 1.6). As a result, working years decreased too from 44 to 36 years between 1971 and 2001.

Table 1.6: Evolution of Average Entry Age, Working Years and Exit Age in Austria since 1971

	entry age	working years	exit age
1971	17	44	61
1981	18	42	60
1991	19	40	59
2001	23	36	59

Source: Eurostat (b), IHS 2011

Table 1.7: Retired People in Absolute Numbers, by Age Groups

	55-60	60-64	over 65	**total**	% of total population
AT	205.295	329.825	1.213.416	1.851.019	22.46
CZ	206.676	472.654	1.299.012	1.982.001	19.38
DE	557.072	3.012.601	14.800.000	18.604.325	22.87
SE	70.958	276.946	1.428.375	1.898.215	20.65
UK	454.021	1.527.571	7.463.051	9.579.429	15.82

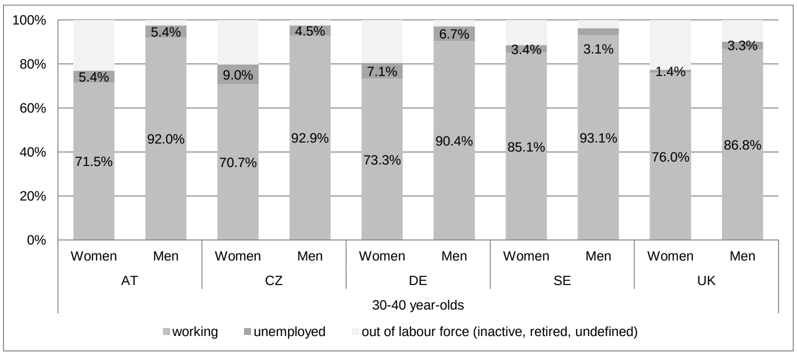
Source: Eurostat (b), IHS 2011

1.2.3 Female labour force participation

The evolution of female labour force participation in Europe over the life cycle and between generations is more complex than the development of male employment rates. While labour force participation of women in general

provisions.

Figure 1.4: Labour Force Status by Sex, 30-40 Year-olds



Source: Eurostat (b), IHS 2011

Figure 1.5: Labour Force Status by Sex, 40-50 Year-olds

Source: Eurostat (b), IHS 2011

has gone up during the second half of the last century, there is also a trend to early retirement among older women, mirroring the trend for men. Female labour force participation has been on the rise since the 1960s, due to better education and training of women (Eurofound, 2010). However, women's labour force status is more dependent on life cycle events than men's (see figures 1.4, 1.5 and 1.6) — young women between 30 and 40 often withdraw from the labour market to take care of small children.

The activity rates of older women are lower than the activity rates of older men in all EU countries (see figure 1.7); in fact, the gender difference in activity rates is higher in the 55-65 age group than across all ages (30-65) for most EU countries, as can be seen in figures1.4 1.5 and 1.6. This is a cohort effect: many women who are now this age dropped out of the labour force when they had small children and never returned to the labour market. Even though this phenomenon is still prevailing in Austria, it is declining over time (Statistik Austria, 2007). High labour force participation among women aged 40-50 might thus point into the direction of higher labour force attachment of older women in the years going forward.

Although men of all age groups display higher activity rates than women in all European countries, differences in labour force participation rates between men and women are higher in Austria, the Czech Republic and

Figure 1.6: Labour Force Status by Sex, 50-55 Year-olds

Source: Eurostat (b), IHS 2011

Germany than it is in Sweden and the UK, indicating that it is easier to combine work with child rearing in the latter countries.

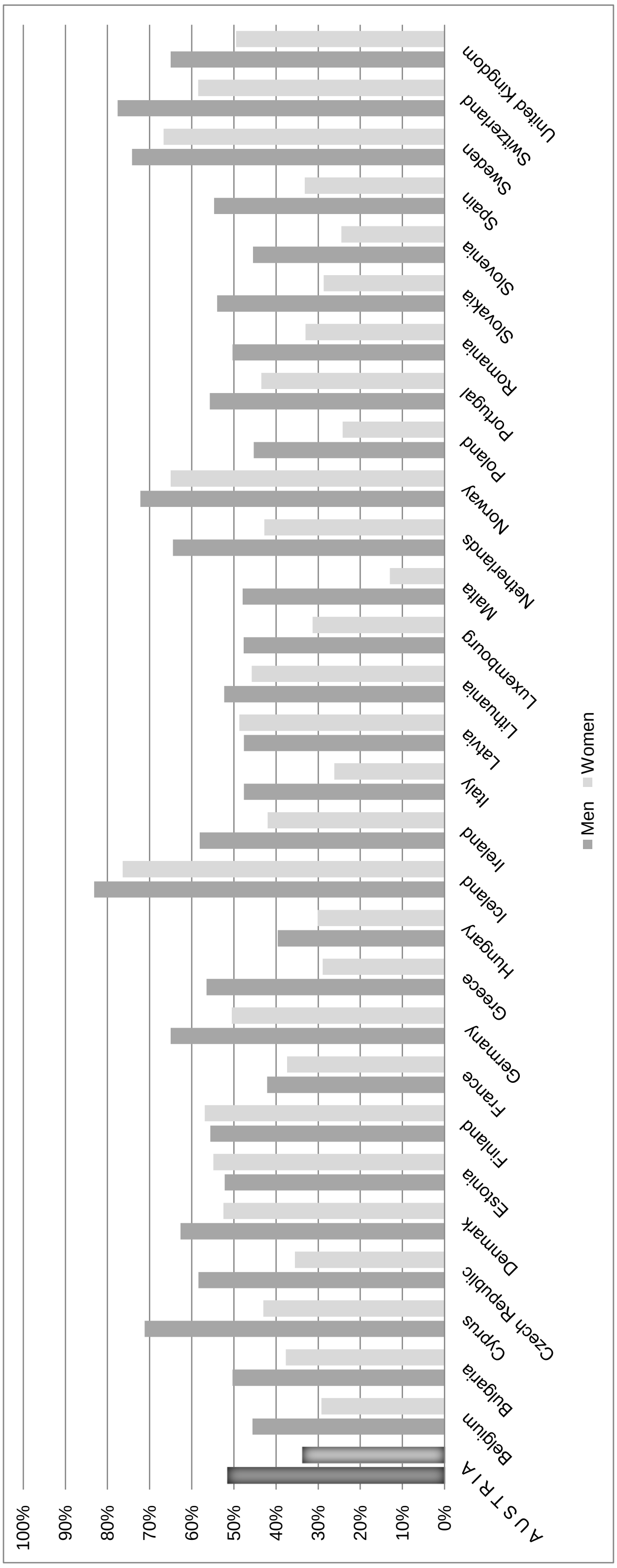
Women's propensity to work part-time is higher than men's (Eurostat, a). Consequently, the increase in female labour force participation brought about an increase in the overall proportion of workers working part-time, from 15.9 percent in 1998 to 18.2 percent in 2008 in EU-27 (Eurofound, 2010). In Germany around half, in Austria and the UK around 40 percent and in Sweden and the Czech Republic about a third of all working women work part time (see table 1.8). This points to a potential of increasing employment and the labour force in the face of the insolvency of pay-as-you-go pension systems: by facilitating the combination of work and family responsibilities, countries could motivate women to increase their working hours and labour force attachment throughout the life cycle.

Table 1.8: Part-time Working Women as a Share of all Working Women, by Age Groups

	30-40-year-olds	40-50-year-olds	50-60-year-olds
AT	44.7%	41.3%	37.9%
CZ	7.3%	3.9%	5.9%
DE	49.5%	51.9%	48.7%
SE	35.6%	31.9%	33.8%
UK	40.0%	39.7%	38.9%

Source: Eurostat (b), IHS 2011.

Figure 1.7: Employment Rates of Older Workers (55-65), by Gender



Source: Eurostat (a))

Chapter 2

The Austrian Pension System

2.1 Legal Framework

The main tier of the Austrian pension system is statutory, publicly organised and part of the social security system that further comprises unemployment, accident and health insurance. It is a pay-as-you-go system, financed by social insurance contributions (75 percent) and means out of the general budget (25 percent) (Bundesministerium für Arbeit, Soziales und Konsumentenschutz, 2012). Individual pension entitlements depend on the assessment base and the number of insurance years. In case of early retirement deductions are apply, in the case of retirement later than the statutory age premiums are paid. Next to this earnings-related scheme small pensions are topped-up to the minimum pension amount of 815 Eurow for one person and 1,222 Euros for a couple in 2012. Elderly people without the right to a pension might apply for social benefits of the same amount as the minimum pension, these benefits are however means tested (on both income and wealth). Compared to other European countries occupational and individual private pensions are of little importance in Austria. Nevertheless, the number of contribution payers as well as benefit receivers has increased during the last decade. The number of prospective beneficiaries has increased from 307,421 to 715,649 from 2002 to 2010. The number of individuals who draw a private pension benefit has increased from 37,525 to 63,449 during this period. (Wirtschaftskammer, 2012)

Over the last fifteen years, the public pension system has experienced a numerous reforms and changes, all aimed at increasing the sustainability of the system in light of increasing life expectancy and low fertility. The biggest change came with the so-called pension harmonisation. In 2005, the formerly independent pension systems for the self employed, private sector employees and farmers were joined into one single system (*Allgemeines Pensionsgesetz*, (APG)). The rules for public sector employees, covered by a separate retirement system, are gradually adapted to the APG.[1] The APG was built around the 45/65/80 formula: After 45 insurance years, retiring at the age of 65 leads to a replacement rate of 80 percent of the average lifetime income. The current contribution rate on income varies from 22.8 percent for private sector employees (12.55 paid by

[1] Our data does not comprise public sector employees, thus we will not model their retirement decisions. Within this text specific rules and differences to the private sector are sometimes mentioned, however these will not be covered in a complete way.

the employer and 10.25 by the employee), to 17.5 percent for the self employed and 15.5 percent for farmers. All contributions are listed on an individual pension account, set up to increase transparency. Times with pension insurance but without direct contributions, such as parental leave, sickness, unemployment, military/civil service, are treated like contribution periods using a defined contribution base.[2] Once in the pension account, entitlements are supposed to be unchangeable for future reforms. Past contributions are to be reevaluated by the growth of the average contribution base, while the revaluation factor for existing pensions is set equal to the annual consumer price inflation.

However, this system will only come into full effect in 45 years, when the cohort who started to pay contributions in 2005 retires. For everyone with contribution periods before 2005, the pension calculation follows transition rules: The pension is calculated twice, following old and new rules, and the individual entitlement is calculated as a weighted average between the two. People born before 1955 are not affected by the pension account system even if they retire after 2004. Their pension calculation is the result of a mixture of rules that were in force in 2003 and rules that apply from 2004 onwards. Before 2004, the assessment base was calculated by averaging over the 15 years with the highest income. From 2004 onwards this period is extended by 1 year every year, reaching 40 years in 2028.[3] Each year of insurance before 2004 is valued with an accrual rate of 2%, after 2004 the accrual rate decreases stepwise to 1.78 until 2009. Deductions for early retirement used to be 2-3 percentage points for every year up to a maximum of 10 points. From 2004 onwards, deductions are 4.2% per year, with a maximum of 15% of the pension. If a person was entitled to a pension before 2004, their pension is calculated according to the old rules. If not, 2004 rules are applied; however, the maximum loss due to the change from 2003 to 2004 rules is capped at 5-7%.

Apart from new calculation rules the objective of all pension reforms was to increase effective retirement age and abolish early pathways into retirement. The statutory retirement age is 65 for men and 60 for women. The lower retirement age for women will be increased to 65 between 2024 and 2033.[4] In the new pension account system early retirement is replaced by the corridor pension. This allows retiring from the age of 62 onwards with deductions of 4.2% per year. Until the end of 2013, individuals who have having acquired 45 (men) or 40 (women) years of contributions into the pension system, and who were born before 1954/1959 can retire at the age of 60/55 without any deductions on the basis of the hard-worker-rule.[5] Later cohorts' earliest possible retirement age will be 62, deductions will apply. Additional pathways into early retirement that were already abolished include retirement due to unemployment as well as the so-called gliding pension. However, we do not consider three more retirement pathways within our framework: These include regulations concerning heavy and night-time labour and a specific programme that subsidises working time reductions beginning at ages 58.5 and 53.5 for males and females respectively (cf. Hofer et al. (2011)).

In 2010, 33% of male retirees and 15% of female retirees entered retirement on the basis of one of several

[2]Payments for these periods are transferred to the pension agency, e.g. by the unemployment agency or by the public health insurance.

[3]For every child the averaging period is reduced by 3 years with the minimum of 15 years.

[4]Female civil servants retire regularly at 65.

[5]The classification of contribution years applied in this rule was changed several times. Apart from contribution periods based on employment, other periods were considered as well, e.g. sickness, education or, for some cohorts, even unemployment spells. The German term 'Hacklerregelung' is translated as hard-worker rule, although this retirement pathway does not depend on the type of occupation. Quite to the contrary, this pathway is typically used by civil servants, because it is easier to accumulate of 45/40 contribution years in a steady occupation within the public sector than in blue-collar occupations.

disability pension options (Arbeiterkammer, 2012). Disability is defined as the incapacity to exercise the occupation that was predominantly exercised within the last 15 years due to health reasons. Disability pensions are calculated similar to old-age pensions, depending on the years of insurance, the assessment base and deductions for retiring before the statutory retirement age. Taking into consideration the high share of retirees using this pathway into retirement, we will later on treat it as another form of early retirement (see section 5.4.1).

In spite of several pension reforms that took place in the last fifteen years, the Austrian pension system can still be called generous. According to the OECD, the median net replacement rate is 89.9% percent. Individuals at the 25^{th} income decile receive a replacement rate very close to the median replacement rate (91.3%), whereas individuals at the 75^{th} decile receive a lower replacement rate of 84.6 percent (OECD, 2011). The following section discusses the income situation of Austrian retirees compared to the working age population and to other European countries.

DEFINITIONS

Disposable Income: The sum of all household members' gross personal income components (gross employee cash or near cash income; gross non-cash employee income; gross cash benefits or losses from self-employment including royalties; unemployment benefits; old-age benefits; survivor benefits, sickness benefits; disability benefits and education-related allowances) plus gross income components at household level (income from rental of a property or land; family/children related allowances, housing allowances, regular inter-household cash transfers, interests, dividends, profit from capital investments in unincorporated business, income received by people aged under 16) minus regular taxes on wealth, regular inter-household cash transfers, tax on income and social insurance contributions (note that disposable income can be negative). The disposable household incomes are equalised according to the modified OECD scale.

Modified OECD scale: All household incomes are summed up and divided by an equalised number of household members. The first household member gets a weight of 1, each additional adult gets a weight of 0.7, children get 0.5.
Retiree: The person's basic activity status is "retired" (as opposed to "at work", "unemployed" or "inactive") and self-defined current economic status is "in retirement".

Retired-Couple-Household: 2 retirees and nobody else in the household.

Retired-Single-Household: One retiree and nobody else in the household.

non-Retired-Couple-Household: 2 individuals between 18 and 65 years (not retirees) in a household.

non-Retired-Single-Household: 1 person between 18 and 65 years (not retirees) in a household.

2.2 Old-age Income and Living Conditions

As discussed at length in supplement F, pension systems generally serve multiple purposes. On the one hand, mandatory schemes oblige people to save during their working career to avoid a drop in consumption caused by the loss of labour income after retirement. Maintaining the standard of living of retirees is the consumption smoothing function of the pension system (Borella and Fornero, 2009). On the other hand, the pension system has to ensure an adequate standard of living for those who could not accumulate enough contributions because of health problems, disability or other reasons.

According to the OECD typology (see supplement F), pension systems focus mainly on these two objectives: the first tier ensures adequate levels of retirement incomes such to avoid the risk of poverty in old age, while the second tier ensures that the standard of living does not excessively change after retirement (OECD, 2009b). By focusing on the replacement of earnings the Austrian pension system mainly concentrates on the second tier, although, as described above, a minimum pension is foreseen to address the first objective as well. Countries which focus on the replacement of labour income generally provide higher pension incomes, but they also have higher public pension expenditures (OECD, 2009b). In 2007 Austria had the third highest public expenditures on old-age and retirement benefits compared to the GDP of all OECD countries, 12.7% (OECD, 2011). Only Italy and France spent more than Austria, 14.1% and 12.8% respectively.

Table 2.1: Sample Sizes EU-SILC 2008

(a) Sample Size given *Activity Status* is "Retired"

Economic Status	AT	DE	CZ	SE	UK
In Retirement	2,963	7,399	6601	2,952	3,913
Disabled	22	0	0	304	0
Domestic and Care Tasks	61	0	0	0	0
Other Inactivity	2	0	0	0	0

(b) Sample Size given *Economic Status* is "in Retirement"

Activity Status	AT	DE	CZ	SE	UK
At work	38	0	154	0	0
Unemployed	9	0	0	0	0
Retired	2,963	7,399	6,601	2,952	3,931
Inactive	20	0	0	0	0

Source: Eurostat (b), IHS 2011

The EU Statistics on Income and Living Conditions (EU-SILC 2008) allow a closer look at the disposable incomes of the elderly and enable us to compare the situation of Austrian retirees to those in other European countries. We discuss the pension systems of four specific countries, the Czech Republic, Sweden, Germany and the United Kingdom alongside Austria, because they represent different types of public pension systems (supplement F gives a description of Esping-Andersen's typology that leads us to choose these countries). Within this group Austria devotes the highest share of public expenditures on retirement benefits (12.7% of GDP), while Germany (10.7%), Sweden (9.5%), the Czech Republic (7.7%) and the United Kingdom (5.9%) all spend less (OECD, 2011). The box 2.1 on the opposite page shows some definitions that we will use in this section.

Tables 2.1 and 2.2 show the number of observations as well as their weighted equivalent by status and economic activity.

Table 2.2: Retired Households

Retired-Couple-Households	AT	DE	CZ	SE	UK
Sample Size	1,020	29,707	2,866	3,816	22,259
Weighed Sample Size	534,652	9,414,384	794,384	803,816	4,100,418

Retired-Single-Households	AT	DE	CZ	SE	UK
Sample Size	893	1,671	1,980	626	1,213
Weighted Sample Size	592,043	6,010,470	559,036	636,504	3,421,488

Source: Eurostat (b), IHS 2011

Table 2.3 shows the average equalised household income per income decile for every country. To get an idea of the financial situation of retirees in comparison to the rest of the population the average income of retired couple households and retired single households are shown separately. The average income per decile of retired households can be compared to that of non-retired households. Consistent with the aim of the Austrian pension system to maintain the standard of living, Austrian retirees achieve a comparatively high income. Compared to the other countries, retired couples and singles of each decile have a high mean income throughout the income distribution. Looking at income inequality in Austria, the lowest two deciles of couple retirees and the lowest decile of single retirees enjoy a higher income than the equivalents of non-retired couple and single households. Similarly, in the Czech Republic and in Germany the lowest deciles of retired couples and singles on average dispose of a higher income than non-retired couples and singles. In Sweden retired couples seem to have very low incomes; however, the standard deviation is very high, thus indicating that some extreme cases with negative incomes (for example due to losses in self-employment) reduce the average. In the United Kingdom, the first decile of retired couples also has lower incomes than the first decile of non-retired couples; the small standard deviation indicates that this is system-immanent. In Germany, especially the incomes of single retirees are quite low compared to Austria. In all these countries the mean equalised disposable houshold income is higher for couples than for singles in almost every decile. This is true for retirees as well as for non-retirees.

With regards to the second objective of public pension systems, poverty prevention, an increase in the risk of poverty with age could be explained by the cohort effect, the age effect and the compositional effect (OECD, 2009b). The cohort effect occurs because real income at the time when those now aged 65-year-olds and older were active in the labour force used to be lower than it is now; this depresses their present income because pension schemes are typically related to past labour market earnings. The age effect occurs because of the way the relative value of the pension evolves after retirement according to the index scheme. The compositional effect occurs because women tend to live longer; because many women have to rely on a survivors pension they obtain on average lower pension incomes. The compositional effect, however, can also go the other direction: since rich people tend to live longer, older retirees may have higher average pension incomes (OECD, 2009b).

Table 2.3: Mean Equalised Disposable Household Income per Decile (std.dev. in parentheses)

	AUSTRIA				CZECH REPUBLIC				GERMANY				SWEDEN				UNITED KINGDOM			
Mean in Decile	Couple-Household		Single Household		Couple-Household		Single Household		Couple-Household		Single Household		Couple-Household		Single Household		Couple-Household		Single Household	
	Retired	Active	Retired	Active	Retired	Active	Retired	Active	Retired	Active	Retired	Active	Retired	Active	Retired	Active	Retired	Active	Retired	Active
1	10,955	9,282	8,476	6,246	4,152	2,956	3,054	1,795	8,309	7,060	5,264	2,859	3,740	8,367	8,440	3,529	7,448	9,093	5,700	3,722
	(1,749)	(2,182)	(1,830)	(2,368)	(8,348)	(763)	(348)	(688)	(2,999)	(3,303)	(7,844)	(6,149)	(51,911)	(4,169)	(2,046)	(2,199)	(2,130)	(3,801)	(3,335)	(4,982)
2	14,148	14,063	10,390	10,831	4,581	4,549	3,511	3,396	11,864	12,293	9,218	7,726	13,554	16,047	10,944	9,268	10,537	15,980	9,157	10,627
	(520)	(1,050)	(387)	(909)	(57)	(382)	(69)	(360)	(532)	(1,041)	(498)	(590)	(479)	(1,366)	(314)	(1,058)	(663)	(1,550)	(489)	(945)
3	15,903	16,969	11,909	13,562	4,780	5,605	3,750	4,351	13,532	15,612	10,885	10,079	14,859	19,911	11,958	12,514	12,360	21,067	10,834	13,974
	(466)	(725)	(475)	(836)	(55)	(241)	(63)	(224)	(477)	(781)	(418)	(766)	(336)	(1,114)	(251)	(883)	(366)	(1,219)	(528)	(760)
4	17,567	19,609	13,328	16,097	4,931	6,416	3,935	5,064	14,961	18,234	12,369	12,887	15,972	23,080	12,635	15,283	13,763	24,900	12,405	16,816
	(533)	(726)	(393)	(693)	(40)	(209)	(43)	(190)	(356)	(690)	(429)	(819)	(312)	(739)	(156)	(721)	(502)	(975)	(374)	(897)
5	19,161	21,969	14,867	18,253	5,069	7,152	4,100	5,785	16,234	20,742	13,967	15,685	16,989	25,643	13,206	17,873	15,483	28,004	13,860	19,790
	(405)	(816)	(498)	(560)	(38)	(203)	(53)	(240)	(355)	(778)	(470)	(781)	(307)	(714)	(173)	(768)	(471)	(987)	(444)	(978)
6	20,990	25,023	16,612	20,573	5,210	7,981	4,273	6,556	17,772	23,258	15,452	18,240	18,294	27,800	13,770	20,015	17,382	31,570	15,351	23,453
	(689)	(836)	(470)	(685)	(44)	(251)	(42)	(178)	(495)	(680)	(427)	(802)	(419)	(561)	(209)	(531)	(620)	(1,027)	(492)	(1,144)
7	23,472	27,620	18,626	22,797	5,399	8,842	4,452	7,466	19,660	26,094	17,161	21,017	19,849	29,954	14,638	21,749	19,693	35,817	17,317	27,832
	(890)	(727)	(756)	(704)	(55)	(285)	(58)	(298)	(572)	(958)	(549)	(754)	(434)	(752)	(292)	(573)	(658)	(1,462)	(563)	(1,479)
8	26,852	31,783	21,617	26,148	5,631	9,969	4,670	8,506	22,129	29,731	19,417	24,041	21,916	32,869	15,998	24,310	22,832	41,774	19,968	33,863
	(928)	(1,493)	(907)	(1,033)	(86)	(352)	(74)	(317)	(903)	(1,205)	(728)	(1,025)	(696)	(938)	(471)	(695)	(1,236)	(2,069)	(1,053)	(1,944)
9	31,188	37,894	25,547	29,856	5,994	11,807	5,023	9,806	26,412	35,152	23,124	28,087	24,832	36,843	18,254	26,984	28,070	49,917	23,949	40,938
	(1,739)	(2,489)	(1,356)	(1,375)	(133)	(755)	(132)	(568)	(1,629)	(2,057)	(1,606)	(1,623)	(1,039)	(1,631)	(906)	(894)	(1,769)	(3,059)	(1,478)	(2,779)
10	45,663	55,782	41,643	46,092	7,503	18,575	6,573	16,316	40,658	58,096	36,589	47,028	37,026	52,003	28,875	35,833	45,190	84,138	41,927	87,876
	(14,666)	(21,645)	(31,645)	(17,157)	(3,104)	(9,468)	(3,670)	(9,137)	(16,887)	(40,165)	(13,675)	(28,139)	(12,963)	(23,478)	(22,402)	(13,168)	(15,135)	(35,265)	(28,795)	(116,825)

Source: Eurostat (b), IHS 2011;

Note: Each line represents the mean of disposable equalised household income of people within the same decile according to the group and country they belong to.

Table 2.4 shows the average, gender specific risk-of-poverty-rate for retired people in five countries[6].

Table 2.4: At-risk-of-Poverty Rates

Total Population		Retired People, by Age Group			
Women		55-60	60-65	older than 65	Retired Women
AT	13.5%	12.1%	10.1%	16.2%	14.9%
CZ	10.1%	8.7%	7.4%	10.5%	9.5%
DE	16.2%	20.9%	12.5%	16.4%	15.9%
SE	13.1%	9.9%	13.8%	21.3%	19.5%
UK	20.2%	19.9%	31.0%	34.0%	32.5%
Men		55-60	60-65	older than 65	Retired Men
AT	11.2%	9.4%	7.6%	11.9%	11.6%
CZ	8.0%	6.1%	3.1%	3.5%	3.5%
DE	14.3%	16.0%	16.8%	11.2%	12.6%
SE	11.4%	16.0%	7.7%	9.6%	10.5%
UK	17.7%	29.0%	32.2%	29.9%	30.1%

Source: Eurostat (b), IHS 2011

In Austria, the average risk-of-poverty rate of the total population is 12.4%, lower than in Germany (15.2%) and the United Kingdom (18.8%), but higher than in Sweden (12.1%) and the Czech Republic (9.0%). The risk-of-poverty rate is higher for women than for men in all countries.

Comparing retirees to the total population, retired women in Austria aged 65 and below face a lower poverty risk than the average Austrian woman, while women aged 65 and above have a slightly elevated poverty risk. This might be due to the fact that a fifth of all women who receive a public pension only receive a widow's pension (Statistik Austria, 2012b). Also, older retired women are more likely to rely exclusively on a survivor's pension than younger cohorts of female retirees, since female labour participation rates have increased over time. Having said that, the risk of poverty rate for retired women is still much lower than in the United Kingdom and Sweden, and comparable to the poverty risk German women in this age group face.[7] The same pattern holds for all other countries, except Germany, where a fifth of all retired women between the ages of 55 and 60 live in risk of poverty; in the UK, risk-of-poverty rates are more than ten percentage points higher than the national female average for retired women above the age of 60.

For Austrian men, a similar although milder pattern emerges — poverty rates for men aged 65 and younger are below the national average, and while men 65 and older do have a minimally elevated risk of poverty, retired men taken together are not more at risk of poverty than the average Austrian man. This is a further indication

[6]The risk-of-poverty rate is defined as the share of the population receiving less than 60 percent of the median equalised disposable income of the total population.

[7]The lower risk-of-poverty-rates in the Czech Republic fit into a common picture of Eastern European countries where disposable incomes are generally lower, which leads to lower poverty rates, because the definition of the poverty risk depends exclusively on the income distribution, not on actual standard of living.

that the somewhat higher poverty risk of Austrian women aged 65 and above is in fact due to a high share of women whose only source of income is a survivor pension. As was the case for women, Germany displays higher poverty risks for male pensioners aged 65 and younger, while male retirerees over the age of 65 have a lower risk of poverty. Also in Sweden, poverty rates for young pensioners (early retirees below the age of 60) are elevated as compared to the national average. In this country comparison, pensioners in the United Kingdom clearly fare worst; with male retirees in the UK displaying almost the double, female retirees a third more than the national risk-of-poverty rates.

This indicates a satisfactory performance of the Austrian pension system with regards to the prevention of old-age poverty. Although care must be taken to preserve a decent standard of living especially for older female pensioners, retired men and women below the age of 65 actually have a lower risk of poverty than the general population. Thus, it can be argued that there is leeway for reforms geared at improving the sustainability of the Austrian pension system for the future, especially if these reforms aim at increasing the retirement age and thus decreasing the years spent in retirement (as opposed to cutting the pensions of older retirees at the lower tail of the income distribution).

Chapter 3

Data: Sources and Definitions

3.1 Data Sources

Our dataset combines data from two different sources: the Austrian Labour Market Database and the Condensated Insurance-periods and Pension Calculation Dataset (*Verdichtung von Versicherungszeiten und Pensionsberechnung, VVP*). The Austrian Labour Market database is compiled from the Austrian Social Security Database and data from the Austrian Job Centre; it is provided and maintained by the Austrian Ministry of Labour, Social Affairs and Consumer Protection (BMASK).

The data collected in the Austrian Social Security Database comprises data from the Umbrella Institution of Austrian Social Security Institutions (*Hauptverband der Österreichischen Sozialversicherungsträger*). It collects individual data that is relevant for a variety of social benefits such as unemployment and health insurance, calculation of pension entitlements or maternity leave. It contains detailed information on unemployment spells, sick-days, days on parental leave etc. Spells of employment are typically associated with a firm identifier (matched employer-employee data). Data is available from January 1972 to 2009. There is also information on labour market history before 1972 for a subset of individuals, but no matched firm data is available before 1972.[1] The dataset is organised according to individual spells of *qualifications* that can roughly be translated into labour market states. The more than 200 different types of spells were converted into seven categories. At any given time, a person can

- Be employed as a civil servant, a blue or a white collar employee,
- be working as a farmer or in a free profession
- work "atypically" (timed contracts, free contracts etc.) or have an income too low to be subject to social insurance contributions, or be in an apprenticeship program,
- be unemployed, irrespective of unemployment benefit entitlement,

[1] We do not need this information because we have access to the VVP database, see below.

- be on parental leave, whether or not the person has been working before, or is planning to go back to their job afterwards,

- be out of the labour force (military or civil service, retired, in full time education)

- miscellaneous (missing data, person died, in between labour market states etc).

Demographic information is the most recent at the time of data delivery, and includes sex, year and month of birth, academic degree, nationality, nationality in 1999 and information on the date of death. Firm specific information is also accurate at the time of data delivery and includes the year of data delivery, geographical information and industry affiliation (for a very useful and detailed description of this data-set, see Zweimueller et al., 2009). The Austrian Labour Market Database (AMDB) matches this data to additional data from the Austrian Job Centre. This data-set only covers individuals who were registered job seekers at some point during their working lives, and contains additional information on education, migration status etc.

The second data-set we use is the Condensated Insurance-periods and Pension Calculation Dataset (VVP), that is collected by the Austrian Public Pension Association (*Pensionsversicherungsanstalt*). It contains the complete insurance history of the majority of individuals who received a positive adjudication for a pension in the years 2001-2009 (for a discussion of the representativeness of the data set, see section 3.3.2). That is, this dataset contains all the information the Austrian Pension Association uses to calculate pension entitlements (employment history, assessment base etc.). This unique dataset enables us to replicate the Austrian pension system in great detail. We can calculate pension entitlements using an individual's exact employment history, substitution periods (these are periods for which a person did not pay insurance, but are counted as insurance months, for example parental leave and child rearing periods, or military service), and assessment base (the assessment base is related to gross earnings). Because the dataset also contains the actual pension entitlement, as calculated by the Austrian Public Pension Association, we can double-check that we model the complex Austrian pension system correctly. For our simulation, we can therefore use actual pension entitlements, without having to resort to assumptions about pension entitlements as has been done in previous work (e.g. Raab, 2011).

3.2 Adjustements and Definitions

Our dataset is a sample of people who have received a positive adjudication of one or more types of pension (except the so called *Ruhegenuss* of public servants) between 2001 and 2009. In total, there are 513,182 pension adjudications registered. Because the dataset entries are pension adjudications, not retired individuals, we have to modify it so it fits our purpose of modelling *individual retirement decisions*. A pension adjudication does not automatically imply that a person retired: An adjudication might be objected by the retiree and revised by the agency or people might already ahve retired, their pension claim, however, was temporary and is now renewed. The matched data from the labour market data base is of help in identifying actual retirement dates. In this section, we discuss how we define retirement dates and retirees and restrict the dataset to a sample that fits our purposes.

3.2.1 Retirement Status

The data from the Austrian Public Pension Association contains all information required to calculate individual pension entitlements, including the *pension valuation date* (*Stichtag*). The *pension valuation date* is the date the Public Pension Association uses as the start-date for retirement in calculating the amount of pension an individual is entitled to. An individual wishing to retire can ask for his or her pension to be calculated from the day he or she wants to retire, as long as this day is after the earliest possible pension valuation date (which depends on the individual's age and insurance history).

For our purpose, it is paramount that we know the actual, exact *retirement year* of a person. This is why we match this data to data from the Austrian Job Centre. It contains the date when a person retires for the first time, the so called *first labour market exit date*. The *pension valuation year* and the *first labour market exit year* coincide in 423,244 cases, so for these cases we can assume that the pension valuation year is the actual retirement year. However, in some cases, the first labour market exit date is missing, or the *pension valuation year* from the Social Security System and the *first labour market exit year* of the Austrian Job Centre do not coincide, causing uncertainty about the actual retirement year. 21,174 registrations have their *first labour market exit year* before their pension valuation year. These people might have received a disability pension once, then they either returned to their jobs before retiring later due to old-age, or the disability pension was temporary and is now renewed, or they switched directly from disability to any kind of old-age pension. Since the dataset covers only registrations from 2001 to 2009, such (interrupted) careers cannot be reconstructed, so we eliminate these cases from our dataset. 24,436 pension registrations miss a *first labour market exit date* — either these people have not retired yet (but are receivers of a pension) or the datea is imprecise with regard to their *retirement year*, which is why they, too, are omitted from the dataset. We only keep individuals whose *first labour market exit year* is in the same year or after the *pension valuation year*, 467,572 individuals.

3.2.2 Multiple Registrations

As mentioned above, the data entries are pension adjudications, not individuals retiring. Individuals can be registered more than once during the observation period (2001-2009) because

- They are registered once for a survivor pension, and then subsequently (during the observation period) for any kind of old-age pension, or they are registered for a disability pension, and later for any old age pension.
- They receive a temporary disability pension, and are registered each time this temporary pension is renewed.
- They are re-registered every time they ask for a recalculation of their pension entitlement.

Table 3.1 shows the number of multiple registrations in the system. 15,106 people show up two times, 599 people show up three times and 46 people show up even more often. In total, there are 513,182 registrations, but only 496,730 individuals.

In order to construct a dataset of individuals instead of registrations, we have to eliminate multiple registrations so that information according to actual *retirement dates* are preserved. For multiply registered individuals,

Table 3.1: Number of Adjudications per Person

number of positive adjudications per person	number of people
1	480,979
2	15,106
3	599
4	39
5	5
6	1
7	1
Total	**496,730**

Source: AMDB and VVP, IHS 2011

we keep the pension registration with the *pension valuation year* and *month* closest to the Job Center's *first labour market exit month* while we delete the other registrations. 2,534 registrations are deleted in this way.

Each registration also has a *pension notification date*, which is the date of the pension adjudication. If the *pension valuation date* is the same for a person with different *pension notification dates*, then we keep the registration where the notification date is closest to the first *first labour market exit date*. 8,926 registrations are thusly deleted (most likely recalculations of pensions).

For individuals who are registered more than once, but with identical *pension valuation* and *notification dates*, we retain the registration with the highest pension. In this manner, another 466 registrations are deleted. The remaining 377 double registrations are identical with respect to valuation and notification dates and pension incomes; in these cases we eliminate the entry with the lowest ID number.

3.2.3 Further Restrictions

After the previous two steps, 455,269 individuals who have retired for the first time in the same year as the *pension valuation year* or afterwards remain in our dataset. Of these, 65,718 have worked abroad at some point in the past, and therefore receive pension incomes which depend on various international agreements. Since we are interested in evaluating the incentive effects of the Austrian pension system, we eliminate these people from our dataset.

Furthermore, there are 12,042 survivor pension registrations — since we simulate retirement decisions at the individual level, we have to exclude those drawing survivor pensions from our dataset. If data on household income and the income of the deceased person were available, it would be interesting to include survivor pensions into the simulation of retirement decisions — unfortunately this is not possible at the moment due to data limitations. This further reduces the dataset to 388,562 individuals.

Additionally, we limit the simulations to old-age pensions (*Alterspension*, AP), corridor pensions (*Korridor-Pension*, KOP), pensions due to long insurance history (*vorzeitige Alterspension aufgrund von langer Ver-*

sicherungszeit, VAPL) and disability pensions. Disability pensions can be further subdivided into disability pensions for the self-employed (*Erwerbsunfähgikeit*, EU), for white collar employees (*Berufsunfähigkeit*, BU) and for blue collar workers (*Invaliditätspension*, IP). People with gliding pensions and pensions due to unemployment are eliminated from the dataset because these pension schemes have been abolished since 2004. Furthermore, we do not consider miner pensions and heavy labour pensions because only a small, homogeneous group of people is affected by these regulations. This eliminates 9,853 individuals.

701 men who were born before 1937, and 7,898 women born no later than 1941, are drawing pensions according to out-dated regulations and are therefore eliminated. This leads to the sample of individuals who retired in 2001 being relatively small, which is why we drop 9,576 who retired in this year. Similarly, 45,734 people, who were born in 1955 and later, are deleted from the dataset, because this age group will fall under a new regulation (the draft of an individual pension account). We do not consider this new regulation because the sample is relatively small, given that only younger cohorts are eligible. Our final dataset covers 314,805 individuals.

3.3 Descriptive Statistics

3.3.1 Final Dataset

In this section, we want to briefly present the dataset we use for our simulation exercises, the "final dataset" of the last step detailed in table 3.2. This final dataset contains information on 314,805 individuals, slightly more women than men. Women have a higher share of old age pensions than men (35% as compared to 6%). As more men than women exhibit long and steady contribution periods more men than women qualify for early retirement pathways. Similarly, because the corridor pension enables individuals to retire between the ages of 62 to 65 with deductions to their pensions, only men draw this type of pension (women can retire with full pension amounts at the age of 60) — 5,242 or 3% of all men in our dataset, see table 3.3. Conversely, the share of men drawing disability pensions is higher (43% as compared to 18%). Disability is defined by the incapacity for health reasons to exercise the occupation that was predominantly exercised within the last 15 years. Disability pensioners can further be subdivided into the self-employed (including farmers) and blue- or white collar employees. As can be seen from table 3.3, a similar percentage of men and women who were self-employed or white-collar employees retire under the disability pension scheme, whereas the huge majority of men retiring due to disability were blue-collar workers. The pension type "early pension due to a long insurance history" was subject to pension reform during our reference period (that is, the regulations and eligibility criteria for this pathway into retirement changed during the period 2001 to 2009, depending on the birth cohort and retirement year, cf. 2). Early retirement due to a long insurance history starts at 55 for women and 60 for men, respectively (with the age being increased for later cohorts). This is why the mean age of men and women who retire in this scheme is so dense around 56 and 61 years for women and men respectively — individuals basically retire as soon as they are entitled to do so (see table 3.4).

Most individuals retire before the statutory retirement age — 96,129 or 65% of all women retire before the statutory age of 60, 133,239 or 64.23% of all men retire before the age of 65. Because of the higher share of disability pensions among men and the higher share of men eligible for early retirement schemes the mean age

Table 3.2: Data Adjustements

initial dataset		**513,182**	513,182
from registration-based	**to person-based dataset**	24,436 missing Labour Market Exit Date	488,746
		21,174 Labour Market Exit Date before Valuation Date	467,572
		467,572	467,572
		2,534 Multi-Registrations with different Valuation Dates	465,038
		8,926 Multi-Registrations with different Notification Dates	456,112
		(the registrations furthest away from Labour Market Exit Date are deleted)	
		456,112	456,112
		466 Multi-Registrations with different pension income (lowest income is deleted)	455,646
		377 Multi-Registrations with identical dates and income (lowest ID is deleted)	455,269
restrict dataset to	**relevant pensioners**	**455,269**	455,269
		65,718 People with pension income from foreign countries	389,551
		989 Survivor Pensioners	388,562
		388,562	388,562
		9,853 People with: Gliding Pension, Heavy Labour Pension, Miner Pension or Early Pension due to unemployment/unemployability	378,709
		701 Men born before 1937; 7,893 women born before 1942	370,115
		45,734 People born after 1955	324,381
		9,576 People with Valuation Year 2001	314,805
final dataset		**314,805** included: Old Age and Corridor Pensions, Disability Pensions, Early Pensions due to long insurance history	

Source: AMDB and VVP, IHS 2011

Table 3.3: Number of Individuals by Retirement Plan and Age

Total	**Women**		**Men**	
314,805	161,406	51%	153,399	49%
Pension Type	**Women**		**Men**	
old-age pension	56,007	35%	8,748	6%
disability				
self-employed	7,572	5%	12,920	8%
white-collar	10,336	6%	13,096	9%
blue-collar	11,782	7%	39,193	26%
corridor pension	0	0 %	5,242	3%
long insurance hist.	75,709	47%	74,200	48%
Total	**161,406**	**100%**	**153,399**	**100%**
Age Structure	**Women**		**Men**	
below 51	1,633	1.0%	1,755	1.1%
51 to 55	33,949	21.0%	14,650	9.6%
56 to 60	121,740	75.4%	88,609	57.8%
61 to 65	4,006	2.5%	47,788	31.2%
66 to 70	78	0.05%	591	0.39%
70+	0	0.0%	6	0.00%
Total	**161,406**	**100%**	**153,399**	**100%**

Sample of new pension accruals 2002-2009, samplesize: 314,805, standard deviations in parenthesis. Disability pensions include white-collar, blue-collar and the self employed. All monetary values inflated to base year 2009.
Source: AMDB and VVP, IHS 2012

difference between men and women is less than half of the difference in statutory pension ages (see table 3.4).

Table 3.4 also gives information on mean assessment bases and benefits. The assessment base is crucial for the determination of benefit entitlements. For individuals retiring before 2004, it was calculated as the average wage income of the 180 months of highest earnings throughout the individual's labour market career; since 2004 this averaging period is extended by one year each year until 480 months are reached in 2028.

The mean benefits of women who retired according to the old age or disability scheme are roughly half of men's mean benefits, women with a long insurance history get pensions about a third lower than the mean male pension. Male assessment bases are about a third higher than women's, except for pensioners who retired according to the normal old age pension — in this group, men's mean assessment base is nearly twice the women's. It is interesting to see that individuals who retire according to both the old age and the disability scheme have nearly the same number of *contribution years* (about 23 years for women and 33 years for men). Disability pensioners however do have more insurance years, probably due to past illnesses. As was to be expected, men of this generation (born from 1937 to 1954) have almost no child-rearing episodes accounted for in their pensions; women who retire of old age had on average 6.6 years of child rearing, female disability pensioners 6.9 and women with a long insurance history 5.3 years. Note that these are not years spent out of the labour force primarily taking care of children; instead for every child 4 insurance years are granted[2], not depending on the actual labour market status.

[2]In case a second child is born within in these 4 years only the years until the birth of the second child are counted.

Table 3.4: Descriptive Statistics - Final Sample

	women				men			
retirement plan	obs.	mean age	mean benefit	assessment base	obs.	mean age	mean benefit	assessment base
old age	56,007	60.1 (0.6)	741 (503)	1,221 (601)	8,748	65.1 (0.6)	1,503 (911)	2,164 (951)
disability	29,690	55.2 (2.5)	681 (349)	1,234 (521)	65,209	56.7 (2.7)	1,980 (658)	1,854 (618)
corridor	0	-	-	-	5,242	62.0 (0.0)	1,752 (537)	2,253 (698)
long insurance history	75,709	56,3 (1,1)	1,350 (536)	1,830 (716)	74,200	60.7 (0.9)	1,996 (500)	2,649 (638)
total	161,406	57.4 (2.4)	1,015 (597)	1,509 (712)	153,399	59.2 (3.0)	1723 (679)	2,325 (744)

	contribution years	insurance years	child-rearing years	contribution years	insurance years	child-rearing years
old age	22.6 (8.0)	30.1 (7.2)	6.6 (3.8)	32.6 (12.3)	35.9 (11.4)	0.0 (0.3)
disability	22.9 (7.6)	31.4 (6.1)	6.9 (4.2)	33.5 (8.2)	37.8 (7.2)	0.0 (0.2)
corridor	-	-	-	37.8 (5.6)	44.8 (2.7)	0.0 (0.3)
long insurance history	35.7 (4.6)	40.3 (1.6)	5.3 (3.6)	43.4 (3.2)	45.5 (1.8)	0.0 (0.1)
total	28.8 (9.2)	35.1 (7.1)	6.1 (3.9)	38.4 (8.2)	41.6 (6.9)	0.0 (0.2)

Sample of new pension accruals 2002-2009, samplesize: 314,805, standard deviations in parenthesis. Disability pensions include white-collar, blue-collar and the self employed. All monetary values inflated to base year 2009.
Source: AMDB and VVP, IHS 2012

3.3.2 External Representativeness

Our sample does not provide data on everybody who retired (or got a positive pension adjudication) in the years 2002-2009 — according to official statistics, 659,944 individuals were granted a "direct pension" (an individual pension, excluding survivors' pensions) during those years (Bundesministerium für Arbeit, Soziales und Konsumentenschutz, 2009-2010, Sozialbericht 2007-2008,p.199 and p.68f, respectively). If we disregard observations with missing or inconsistent labour market exit dates and multiple registrations as measurement error, and subtract survivors' pensions from our initial dataset, we have data on 454,280 individuals, or nearly 69% of the population of new pensioners. Because we further need to eliminate individuals who draw pension income from foreign countries and individuals who draw pensions according to outdated regulations, our sample shrinks to just below half of the population (we "loose" most individuals because they have a work history abroad). As can be seen from table 3.5, our data is more representative for old age pensioners than for those drawing a disability pension — we have data on 54% of old age pensioners, but only 40% of disability pensioners.[3] Another striking feature of our data is that we do not have the same coverage across our observation period — while our final data set includes 57% of all individuals who retired in 2008, we only have data on 24% of those who retired in 2004. Men are slightly under-represented in our dataset (with a coverage rate of 45% as compared to 51% for women). Note that this is not due to our under-coverage of disability pensioners, because men are in fact more likely to retire on a disability pension.

Table 3.5: Sample as a Fraction of the Population

	total	**women**	**men**	**disability**	**old age**
2002	0.50	0.51	0.50	0.53	0.57
2003	0.56	0.55	0.57	0.66	0.56
2004	0.24	0.25	0.22	0.21	0.24
2005	0.48	0.52	0.44	0.45	0.53
2006	0.58	0.64	0.52	0.48	0.69
2007	0.40	0.44	0.38	0.33	0.50
2008	0.57	0.63	0.51	-	-
2009	0.50	0.55	0.45	0.31	0.71
total	0,48	0,51	0,45	0,40*	0,54*

Disability pensions include white-collar, blue-collar and the self employed, old-age pensions aggregate the standard old-age pension, early pension due to long insurance history, and corridor pension (population data not available on a less aggregated level).
* Disaggregated data on disability and old-age pensioners not available, total statistic is therefore calculated without 2008.
Source: Bundesministerium für Arbeit, Soziales und Konsumentenschutz (2007-2008, 2009-2010, p.199 and p.68f, respectively), for the population of new pensioners, 2002-2009, and IHS: Sample of new pension accruals 2002-2009 (AMDB and VVP, IHS 2012).

[3] For 2008, we do not have information on how many individuals retired under the old-age or disability scheme, we only know the total number of retirees. These statistics are calculated disregarding the year 2008 and are therefore subject to measurement error.

3.3.3 Key Statistics on the Austrian Pension System

Here we present some more detailed summary statistics on the dataset of Austrian pensioners, who have received a positive adjudication of any type of old-age or invalidity pension between 2001 and 2009 (excluding those who are entitled to a pension from a foreign country, survivor pensioners and civil servants, the data set of 388,562 from table 3.2). In contrast to section 3.3.1, these statistics include individuals who draw miner pensions, heavy labour pensions, or retired according to the gliding pension or early-retirement-due-to-unemployment scheme that were both abolished in 2003. It is therefore more representative of the Austrian population than the sub-sample we use for our micro-simulation purposes.

Table 3.6 gives an overview of the composition of the dataset according to the different pension types. Most individuals that are included in table 3.6, but not in the sample we use for our simulations, are individuals born after 1955 (45,734), or individuals born before 1942 (women) and 1937 (men) or retiring in 2001; the additional pension types we include in this sample do not quantitatively add much information. Disability pensioners are better represented in this bigger sample, they now constitute 27% of all retiring women and 59% of all retiring men (as opposed to 18% and 43% respectively). This makes this dataset more representative for Austrians who retired between 2001 and 2009, which is why we provide more detailed summary for this sample.

From table 3.7 it is apparent that mean retirement ages for men and women cluster closely around the statutory retirement age for each type of pension.[4] The density of the distribution of retirement age around the mean further indicates that few individuals postpone retirement beyond the lowest statutory retirement age, this is further corroborated by the fact that there is a larger variation in retirement ages among disability pensioners (were there is no lower age limit).

[4]Individuals who worked under exceptionally strenuous conditions for at least part of their career can retire at 60 (men) or 55 (women) according to the heavy labour pension. For miner pensions, a variety of regulations apply. Gliding pensions were granted under special regulations for women between 56 and 60 years old, and for men between 60 and 65 years old.

Table 3.6: Number of Individuals by Retirement Plan and Age

Total	**Women**		**Men**	
388,562	199,328	51%	189,234	49%
Pension Type	**Women**		**Men**	
old-age pension	63,239	32%	9,440	5%
disability				
self-employed	12,232	6%	14,733	8%
white-collar	18,234	9%	18,813	10%
blue-collar	24,004	12%	58,807	31%
corridor pension	0	0%	5,242	3%
long insurance hist.	77,249	39%	76,716	41%
unemployment	4,125	2%	702	0%
heavy labour	0	0%	1,270	1%
heavy labour, night	1	0%	2,583	1%
gliding pension	73	0%	123	0%
miners	171	0%	805	0%
Total	**199,328**	**100%**	**189,234**	**100%**
Age Structure	**Women**		**Men**	
below 51	22,165	11.1%	23,424	12.4%
51 to 55	39,656	19.9%	18,204	9.6%
56 to 60	128,682	64.6%	97,003	51.3%
61 to 65	7,070	3.6%	49,610	26.2%
66 to 70	1,268	0.7%	813	0.4%
70+	487	0.2%	180	0.1%
Total	**199,328**	**100%**	**189,234**	**100%**

Sample of new pension accruals 2002-2009, samplesize: **388,562** (including early pensions due to unemployment or heavy labour, gliding pensions and miner pensions), standard deviations in parenthesis.
Source: AMDB and VVP, IHS 2012

Table 3.7: Descriptive Statistics — Complete Sample

	women				men			
retirement plan	obs.	mean age	mean benefit	assessment base	obs.	mean age	mean benefit	assessment base
old age	63,239	60.5 (1.8)	734 (511)	1,210 (606)	9,440	65.4 (1.6)	1,485 (918)	2,158 (953)
disability	54,502	49.9 (8.4)	691 (357)	1,242 (557)	92,354	52.8 (8.1)	1,218 (571)	1,897 (746)
corridor	0	-	-	-	5,242	62.0 (0.0)	1,752 (537)	2,290 (707)
early pension*	81,374	56.3 (1.1)	1,318 (563)	1,802 (716)	77,418	60.7 (0.9)	2,100 (537)	2,642 (657)
heavy labour	0	-	-	-	1,270	60.2 (0.5)	1,593 (480)	2,029 (596)
heavy labour, night	1	-	-	-	2,583	57.1 (0.5)	1,963 (382)	2,741 (401)
gliding pension	73	56 .4 (1.1)	1,722 (540)	2,383 (693)	123	60.1 (0.9)	2,502 (312)	3,182 (341)
miners	139	55.2 (3.4)	1,336 (758)	1,802 (716)	804	59.1 (5.3)	2,086 (474)	2,460 (484)
total	199,328	55.9 (6.1)	961 (580)	1,463 (702)	189,234	57.0 (7.1)	1,625 (713)	2,241 (801)

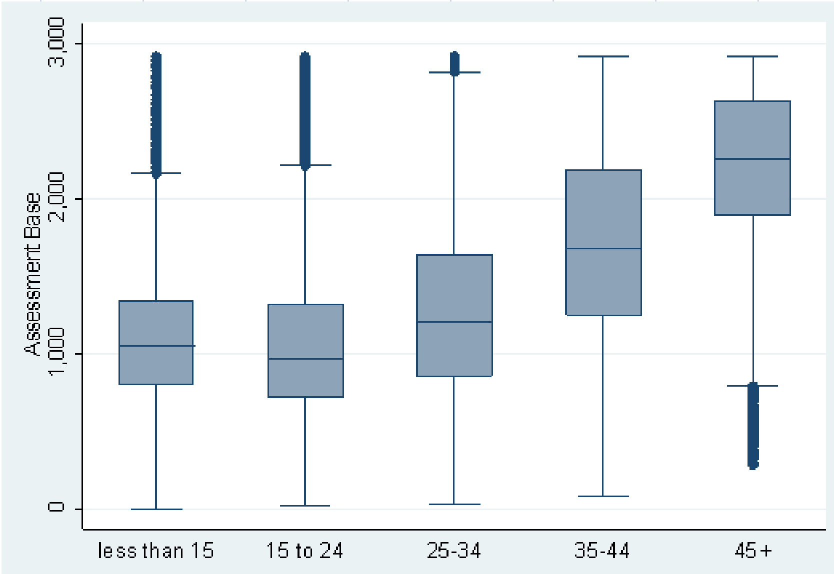
	contribution years	insurance years	child-rearing years	contribution years	insurance years	child-rearing years
old age	22.2 (8.1)	29.8 (7.3)	6.7 (3.9)	32.2 (12.5)	35.6 (11.7)	0.0 (0.3)
disability	19.9 (8.8)	27.8 (8.1)	5.8 (4.2)	29.5 (11.0)	33.9 (10.1)	0.0 (0.2)
corridor	-	-	-	37.8 (5.5)	44.8 (2.7)	0.0 (0.3)
early pension*	35.1 (5.2)	39.9 (2.4)	5.4 (3.6)	43.2 (3.5)	45.3 (2.1)	0.0 (0.1)
heavy labour	-	-	-	40.5 (2.7)	45.5 (1.3)	0.0 (0.2)
heavy labour, night	-	-	-	39.0 (3.7)	41.0 (3.4)	0.0 (0.1)
gliding pension	37.1 (4.2)	40.0 (2.3)	4.8 (2.8)	43.9 (3.0)	44.9 (2.4)	0.0 (0.2)
miners	27.8 (9.0)	34.3 (7.1)	5.4 (4.4)	34.9 (5.4)	43.8 (5.9)	0.0 (0.0)
total	26.9 (10.1)	33.4 (8.2)	5.9 (3.9)	35.7 (10.8)	39.2 (9.5)	0.0 (0.2)

* Early pension includes early pension due to long insurance history and unemployment.

Sample of new pension accruals 2002-2009, samplesize: **388,562** (including early pension due to unemployment or heavy labour, gliding pensions and miner pensions), standard deviations in parenthesis. All monetary values inflated to base year 2009.

Source: AMDB and VVP, IHS 2012

Figure 3.1: Boxplot of the Assessment Base, by Insurance Years



For ease of illustration, the 10% of the population with the highest assessment base have been excluded from this graph. 46% of these individuals have 35 to 44 insurance years and 48 percent of them have 45 or more insurance years, which is why they do not substantially alter our results. Values in Euro and valorised according to the Austrian Consumer Price Index
Sample of new pension accruals 2001-2009, samplesize: **349,706**
Source: AMDB and VVP, IHS 2012

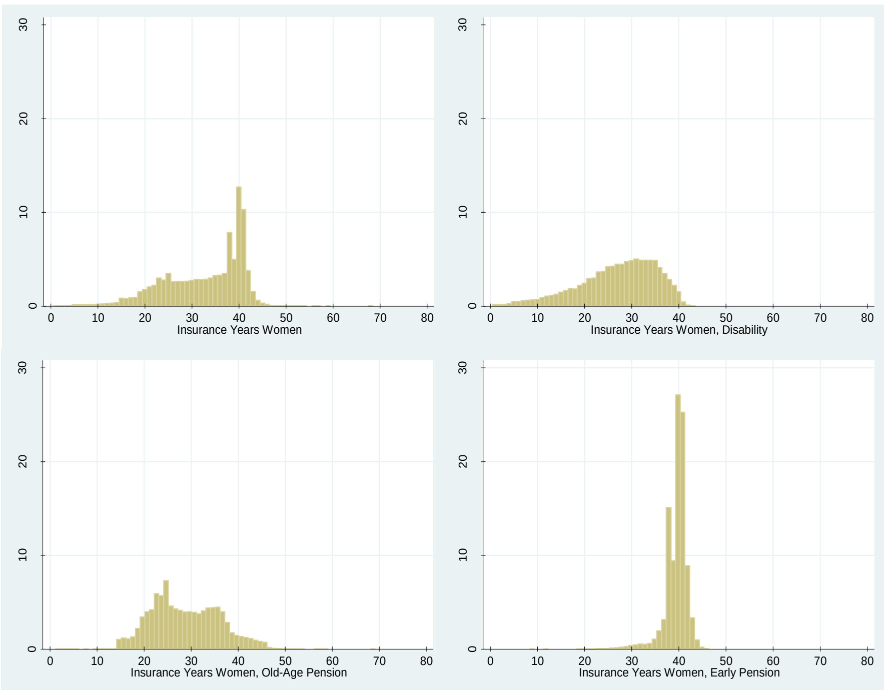
As for mean benefits and assessment bases, the discussion in section 3.3.1 also applies here with regards to the old age, disability and early pensions. (Male) pensioners who retired under the heavy-night-labour provision have a mean benefit and a mean assessment base very similar to men retiring in one of the early pension schemes, although the distribution of both values is a little less dispersed. Gliding pensioners have the highest assessment base and pension income for men and women, but these pension schemes are not very important quantitatively.

The assessment base is the average of the insurance years with the highest earnings over a certain period (15 years until 2003, increased by 1 year each year from 2004 on). Because of the importance of seniority as a determinant of wages in Austria, we would expect that more insurance years lead to a higher assessment base. The boxplot in 3.1 illustrates this positive association of assessment bases and insurance years. As always, the line in the rectangle is the median of the distribution for each sub-group. There is hardly any difference in the median assessment base between the group with less than 15, and the group with between 15 and 24 insurance years. For the groups with longer insurance histories, however, more insurance years clearly do imply a higher assessment base. This effect does not differ substantially for women and men.

Figure 3.2 plots the percentage of women who retire against the number of their insurance years, for all women and by their pension type. Retiring with less than 15 years is only possible within a disability pension scheme, which is why we observe women with less than 15 insurance years only in the second histogram. The first wave of women retires after 25 insurance years. This peak is mainly due to old-age retirees. The next peaks occur after 38, 40 and 41 insurance years, as can be seen from the fourth histogram, these are women retiring under early pension schemes.[5] For women drawing a disability pension, there is no striking peak, but a smooth increase in pension adjudications for every insurance year until, after 35 years, the number of retiring women decreases drastically. The reason is that anyone fulfilling the requirements for an old age pension is not eligible for a disability pension. Only 0.4% of women achieve 45 or more insurance years.

Figure 3.3 shows the same histograms for men. At first glance, men's histograms show higher peaks than womens. The first peak of the retirement wave is reached only after 40 insurance years, which is likely due to disability retirees — the number of men who retire remains relatively constant between 40 and 45 insurance years. The peak at 45 is mostly due to the early pension schemes; i.e., men who have either reached the age of 55 (or older, depending on the valuation year), having accumulated 37.5 years of insurance, or reached the age of 60 and have attained 45 years of contribution. In the old-age pension scheme there are no striking peaks. According to the first histogram, 34% of men achieve 45 and more insurance years.

Figure 3.2: Insurance Years by Pension Types, Women

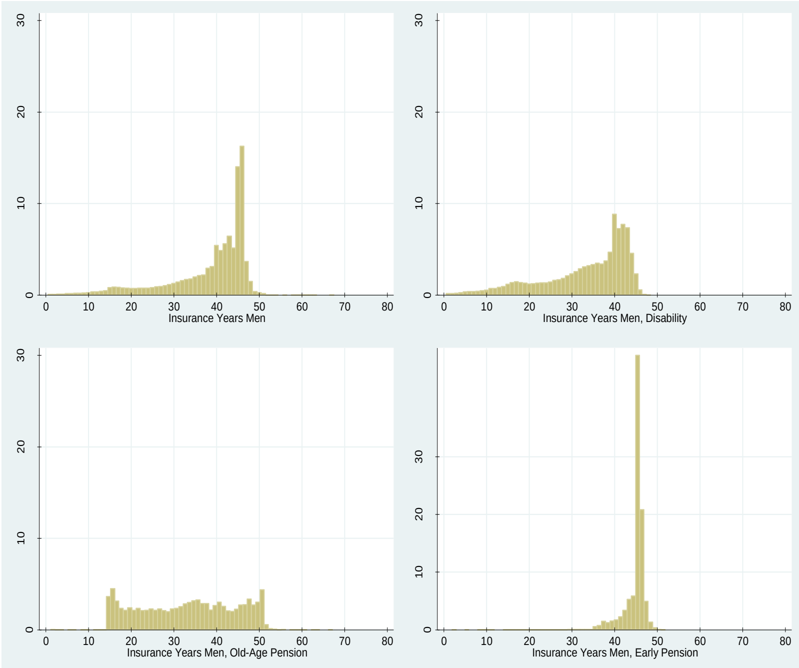


Note: Sample of new pension accruals 2001-2009, samplesize: **388,562**
Source: AMDB and VVP, IHS 2012

Table 3.9 shows the corresponding statistics for women. Eighteen years before their pension valuation year, women have on average more unemployment days than men; but they experience less increments over time

[5] After 40 contribution years retiring at 55 is possible without deductions. After 37.5 insurance years retiring at 55 (or older, depending on the cohort) is possible with deduction.

Figure 3.3: Insurance Years by Pension Types, Men



Note: Sample of new pension accruals 2001-2009, samplesize: **388,562**
Source: AMDB and VVP, IHS 2012

than their male peers. Women who later draw a white collar disability pension average the highest number of unemployed days eighteen years before retirement, and the biggest increases over time.

Our dataset furthermore allows us to examine individual's labour market careers leading up to retirement. We have information on individual labour market status and on their sick days from the data (in addition to their occupational industry). We have information on the complete labour market status histories for the four years leading up to the pension valuation date for our entire sample; for 94% of the sample, we even have data on eighteen years before the pension valuation date.

Table 3.8 shows the development of mean days in unemployment per year for men for the eighteen years leading up to their pension valuation year. Eighteen years before retirement, those who later retire within the blue collar disability scheme or corridor pension scheme display the most unemployed days.[6] The mean days of unemployment are increasing among all pension types as the pension valuation year approaches. Those drawing a disability or corridor pension experience the biggest increases in unemployment over time. Heavy labour workers and workers with long insurance history have the fewest unemployment days in the year before retirement (51 and 34 days, respectively).

Table 3.10 shows the evolution of the mean number of sick days per pensioner for the ten years leading up to

[6]Men being unemployed and eligible to the corridor pension are obliged to retire by the job centre.

the pension valuation year. Sick days are clearly increasing as people approach retirement. Corridor pensioners seem to be an exception, but this might be due to the fact that a large share of prospective corridor pensioners was unemployed when they approached their retirement year. Looking at men and women separately shows that women have on average slightly more sick days than men.

Table 3.8: Men's Mean Number of Unemployed Days in the 18 Years until Pension Valuation

years before pension valuation	old-age pension	disability white-collar	disability blue-collar	long insur. history	corridor pension	heavy labour
18	12 (52)	14 (53)	27 (62)	5 (31)	28 (76)	6 (25)
17	13 (54)	15 (57)	29 (66)	5 (32)	30 (78)	7 (29)
16	15 (59)	16 (59)	32 (69)	5 (34)	36 (88)	7 (29)
15	17 (62)	18 (63)	33 (71)	6 (36)	41 (93)	7 (31)
14	18 (66)	20 (68)	36 (75)	6 (37)	46 (100)	8 (31)
13	19 (70)	22(70)	39 (79)	7 (40)	52 (107)	9 (34)
12	22 (75)	24 (74)	42 (84)	8 (43)	62 (115)	10 (38)
11	23 (77)	26 (78)	45 (88)	9 (48)	70 (123)	10 (38)
10	24 (80)	28 (82)	49 (92)	10 (53)	79 (131)	10 (39)
9	24 (81)	31 (86)	52 (96)	12 (57)	84 (133)	12 (42)
8	25 (82)	34 (91)	56 (99)	13 (61)	89 (135)	13 (46)
7	26 (84)	38 (95)	60 (103)	15 (66)	98 (140)	16 (53)
6	28 (88)	42 (100)	65 (108)	17 (70)	111 (147)	19 (60)
5	30 (92)	48 (106)	71 (113)	18 (74)	124 (154)	20 (65)
4	33 (97)	55 (114)	78 (119)	21 (79)	132 (158)	23 (71)
3	37 (104)	64 (121)	88 (125)	23 (85)	140 (161)	29 (82)
2	40 (108)	76 (129)	101 (132)	27 (91)	148 (163)	37 (95)
1	43 (113)	91 (135)	116 (137)	34 (102)	162 (165)	51 (110)

Notes: SD in parentheses. Sample of new pension accruals 2001-2009, samplesize: **388,562**
Source: AMDB and VVP, IHS 2012

Table 3.9: Women's Mean Number of Unemployed Days in the 18 Years until Pension Valuation Year

years before pension valuation	old-age	disability pension white-collar	disability pension blue-collar	long insur.
18	10 (43)	26 (62)	19 (70)	10 (44)
17	11 (46)	29 (65)	21 (73)	10 (45)
16	12 (48)	31 (67)	23 (76)	11 (46)
15	13 (51)	34 (69)	24 (81)	11 (47)
14	14 (53)	37 (72)	26 (83)	11(47)
13	15 (55)	39 (75)	27 (86)	11 (48)
12	15 (57)	42 (76)	28 (89)	12 (50)
11	16 (59)	45 (79)	30 (93)	12 (52)
10	17 (62)	47 (83)	32 (94)	13 (54)
9	17 (64)	50 (84)	33 (98)	14 (57)
8	18 (66)	52 (88)	36 (100)	15 (60)
7	19 (68)	55 (91)	39 (102)	16 (64)
6	20 (71)	59 (95)	42 (105)	19 (69)
5	22 (76)	64 (99)	46 (110)	21 (75)
4	26 (82)	70 (105)	51 (114)	24 (82)
3	30 (91)	79 (111)	58 (120)	28 (89)
2	34 (98)	90 (116)	66 (127)	34 (98)
1	39 (105)	105 (121)	78 (132)	45 (118)

SD in parentheses. Sample of new pension accruals 2001-2009
Source: AMDB and VVP, IHS 2012

Table 3.10: Mean Number of Sick Days 10 to 1 year before Pension Valuation, by Pension Type

years before pension valuation year	old-age pension	disability pension	early pension	corridor pension	heavy labour
10	47 (59)	44 (57)	41 (52)	51 (65)	38 (52)
9	48 (64)	46 (61)	45 (58)	50 (62)	33 (41)
8	49 (62)	49 (61)	47 (61)	50 (62)	39 (51)
7	51 (66)	51 (63)	48 (59)	54 (65)	37 (49)
6	53 (62)	53 (65)	51 (61)	52 (57)	41 (49)
5	53 (62)	56 (66)	53 (63)	55 (62)	49 (59)
4	52 (60)	61 (70)	55 (64)	50 (55)	48 (58)
3	50 (60)	67 (72)	57 (64)	49 (54)	53 (60)
2	53 (63)	74 (76)	59 (66)	49 (52)	50 (56)
1	54 (64)	98 (87)	60 (65)	51 (56)	57 (60)

SD in parentheses. Sample of new pension accruals 2001-2009
Source: AMDB and VVP, IHS 2012

Chapter 4

IREA: Incentive Measures

4.1 Introduction

In order to analyse retirement behaviour within a systematic framework we develop the **I**HS-Micro-Simulation-Model-for-**REt**irement-Behaviour-in-**A**ustria (**IREA**). As described in chapter 3 the model is based on a large adminstrative dataset that contains information on 314,805 Austrian individuals who were exiting the labour market in the period 2002 to 2009. Since we do not allow for gradual retreat from the labour market (see 3.2.1), each individual is associated with a unique retirement date.

Being able to access the complete insurance records on an individual basis allows us to compute gross benefits for the observed retirement date with very high precision. However, since our main interest is to quantify the extent to which retirement behaviour is affected by the incentive structure of the Austrian pension system, we need to consider counterfactual scenarios. We therefore want to compute retirement benefits not only for the actual retirement date, but also for a certain range of years before and after that date.

To describe the incentive structure as perceived by the individual decision makers we adopt an *option value* framework. This approach has originally been developed by Stock and Wise (1990) and it is built on the empirical observation that retirement is basically irreversible. Typically, an individual acquires pension entitlements over his or her employment career depending on work duration and income. However, once he or she becomes eligible and decides to transform these entitlements into actual benefits, it is very uncommon to return to the labour market and begin another employment spell[1]. To account for this irreversibility, the option value captures the opportunity costs of immediate retirement as measured by the maximum utility gain that can be obtained by staying in the labour market.

Framing the decision problem in this way implies that an individual compares the utility value of immediate retirement with the utilities associated with *any* future retirement option. Immediate retirement can thus be an optimal choice only if the individuals expected present discounted utility cannot be further increased through an extension of the employment career. The inclusion of the option value in a (pooled) cross-sectional analysis

[1]Although part-time work might be relevant in certain contexts, we do not model gradual pathways into retirement since these seem to be of lesser importance for age cohorts in our dataset.

thus implies that each individual reevaluates all future options associated with a continuation of work at each point in time. This forward-looking character of the option value therefore allows for the construction of an essentially static model that is still able to account for the intertemporal nature of retirement behaviour, albeit within a comparatively simple framework.

Although this representation of individual behaviour can be derived from the standard dynamic model of labour supply in discrete time on the basis of some additional assumptions (for a formal statement of this model see e.g. Cahuc and Zylberberg (2004)), it is not equivalent to a discrete choice dynamic programming (DCDP) model. The latter approach would entail individual decision makers that maximise their expected intertemporal utilities over the full sequence of states of the world. As Aguirregabiria and Mira (2010) point out, the main advantage of the dynamic programming approach is that the structural parameters of the econometric model have a natural interpretation in terms of the related theoretical model. However, the necessity to solve the dynamic optimisation problem while simultaneously evaluating the estimation criterion leads to a considerable increase in computational complexity.

While Rust and Phelan (1997) were among the first to apply a DCDP approach to model retirement behaviour, recent applications of this approach in our field are rather limited[2]. Karlstrom et al. (2004) developed a dynamic programming approach to model retirement decisions in Sweden. They present two versions of their model, where the general version allows for a flexible specification of the preferences for leisure while the restricted version assumes constant preference parameters over different ages. Although both specifications perform quite well in the within-sample predictions of labour force participation, the authors report large discrepancies between the out-of-sample predictions based on the two specifications. Heyma (2004) investigates retirement behaviour in the Netherlands based on a DCDP approach. Although the author cites the richness of the resulting dynamic structure as one of the advantages of this approach, he also recognizes the sensitivity of his results with regard to data limitations and errors in the model setup. Both studies, however, find significant effects of the incentive structure on retirement. In addition, Heyma (2004) reports that eligibility conditions and strong preferences for leisure are the most important driving forces of labour market behaviour at old-age.

The option value framework, on the other hand, corresponds to a simplified decision rule as compared to the dynamic programming approach. Although the former approach thus has some deficits in terms of the dynamic structure, Stock and Wise (1990) argue that the validity of either approach ultimately rests on the question which decision rule offers the best representation of the behaviour of real-life subjects. Although their original article devotes quite some space to this discussion, only very limited effort has been excerted since then to resolve this issue. The most comprehensive discussion is presented by Lumsdaine et al. (1992) who compare the predictive validity of both approaches within a unified framework. Their results show that both approaches do equally well in predicting in-sample and out-of-sample retirement probabilities and the authors thus conclude that the option value framework offers a good approximation to actual retirement behaviour.

The question of the behavioural realism inherent in the different modelling approaches has also been taken up from other perspectives. While sophisticated modelling techniques typically rely on detailed information on individual insurance records as collected e.g. in administrative or employer-provided datasets, some recent research also resorts to other data sources. Vonkova and van Soest (2009), for instance, analyse retirement behaviour based on stated preference data. In addition to clear evidence on the impact of financial incentives

[2] Keane and Wolpin (2009) present a survey of six applications of the DCDP paradigm in other research fields.

on preferred retirement ages, they are also able to distinguish between income and substitution effects based on their experimental design. Chan and Stevens (2008) combine administrative data sources with self-reported information on retirement behaviour, expectations and income sources. Although a significant amount of the individuals in their dataset is misinformed about the financial factors underlying their retirement options, they find that retirement behaviour is strongly influenced by the incentive structure. However, as misinformed individuals do not respond to the incentive structure, the results seem to be driven by the minority of well-informed individuals.

Mastrobuoni (2011) exploits a natural experiment based on the stepwise introduction of a social security statement in the US containing information on expected individual retirement benefits at various ages. Although the individuals' knowledge about their own retirement benefits is found to be incomplete, the additional information does not have any significant effect on observed retirement behaviour in this study. The role of information in planning individual retirement decisions is also highlighted by Duflo and Saez (2003). In this paper the authors study an economic experiment where a random sample of university employees of a subset of departments is financially encouraged to attend an information fair related to an (actuarially fair) voluntary retirement scheme. The results from this experiment show that fair attendance increases the probability to enroll not only for the treated employees but also for their department members, thus suggesting that individual participation decisions are not exclusively driven by the informational content. Rather, the authors argue that these results are largely due to social network effects.

However, while the behavioural interpretations underlying actual retirement decisions remain an unresolved issue, there have been several studies adopting the option value framework so as to quantify the incentive effects of social security on old-age labour supply (see e.g. Boersch-Supan (2000) Blundell et al. (2002) Coile and Gruber (2007)). In addition, research based on this approach has been actively promoted by the Economics of Aging Programme located at the National Bureau of Economic Research (NBER) as well as by the Munich Institute for the Economics of Aging[3] (MEA). Two regular book series collect empirical results from different country groups in order to consolidate findings and compare results within a unified framework (see Gruber and Wise (2010); Wise (2011) for the latest editions). Since the data necessary for a thorough implementation of this approach in the Austrian context became available only through this research, we closely follow the modelling approach outlined in an earlier NBER publication (Gruber and Wise, 2004).

4.2 Social Security Wealth

A key measure for the description of the incentive structure as faced by the individuals is the Social Security Wealth (SSW), laid out for example in Boersch-Supan et al. (2002) or Gruber and Wise (2002). SSW is the expected present discounted value of all future pension benefits minus all applicable social security contributions that will be levied on gross labour income in the future. In contrast to the option value (that will be discussed subsequently) it is a pure accounting identity, however, it will also serve as a basis for other incentive measures.

[3]The institute recently changed its name since it moved from Mannheim to Munich.

Explicitly, SSW at planning age S, given retirement at age R, is defined as:

$$SSW_S(R) = \sum_{t=R}^{\infty} YRET_t^{NET}(R) \cdot \nu_t \cdot \delta^{t-S} - \sum_{t=S}^{R-1} INSC_t \cdot \delta^{t-s} \tag{4.1}$$

With $YRET_t^{NET}(R)$ being the net retirement benefit at age t for retirement at age R; $INSC_t$ the insurance contribution (levied on gross labour income) at age t; ν_t the probability to survive at least until age t given survival until age S (as computed on the basis of the survival tables[4] Statistik Austria (2012a)); δ is the discount factor $1/(1+r)$ with rate $r = 0.03$. In general, the insurance contributions to the pension system are often calculated as a simple rate (potentially depending on age), however, as will be discussed in section 5, we are able to compute them with much higher precision based on the complete tax-benefit code as modelled in ITABENA (**IHS**-**TA**x-**BE**nefit-model-for-**A**ustria, see Hofer et al. (2003) for a detailed documentation).

In general, we expect the level of SSW and its trend over time to have a significant impact on retirement decisions. Individuals with higher levels of SSW should be, all other things equal, associated with higher probabilities to retire. Since leisure is assumed to be a normal good, individuals are expected to demand more of it as their SSW increases. This wealth effect on retirement is documented e.g. in Coile and Gruber (2004) and Palme and Svensson (2004). On the contrary, an increase in SSW in the future is expected to reduce the retirement probability at planning age, an effect which is often called the accrual effect. In order to be able to describe different features of the decision problem we calculate not only SSW, but several incentive measures. All of these will be calculated for all feasible combinations of planning age S and retirement age R within our period of interest (see 5 for a detailed discussion).

4.3 One Year Accrual

Apart from the effect of the current wealth level on retirement, it is reasonable to believe that individuals also consider the expected future development of their SSW. If individual decision makers only considered changes from one year to the next, their retirement behaviour would be influenced by the one year accrual in SSW[5]. This incentive measure compares the SSW of immediate retirement with the SSW associated with retirement in the subsequent year. At planning age S given postponement of retirement from age R to $R+1$ it is defined as:

$$ACC_S(R) = SSW_S(R+1) - SSW_S(R) \tag{4.2}$$

Postponing retirement by one year has three effects: First, working an additional year means social security contributions have to be paid for one more year. Second, the individual foregoes one year of receiving retirement benefits, which consequently reduces the total years of benefit receipt[6]. Both effects reduce SSW and are therefore seen as incentives to retire immediately. Third, working an additional year increases the per year retirement benefit through additional years of contribution and, in some cases, a higher assessment base, thus

[4] Although Kuhn (2010) argue that early retirement increases mortality of blue-collar workers due to changes in health related behaviour, we do not account for this in our analysis.

[5] Note that this definition is not equivalent to perfect myopia since the formulation of the SSW implies an infinite planning horizon.

[6] For this to be true one has to assume that one additional year in the labour force has no detrimental effect on life expectancy. While this assumption might not hold in special cases (e.g. in occupations with hard work), we expect the effect to be negligible.

representing a positive incentive for staying in the labour force. Therefore, a social security system that offers no substantial growth (or even decline) in the SSW due to a postponement of retirement from one year to the next, hence a low or negative one year accrual, will be associated with high individual probabilities of immediate retirement.

The relative change of the SSW for a one year postponement of retirement, which is the one year accrual divided by the level of social security wealth, defines the accrual rate:

$$ACCR_S(R) = \frac{SSW_S(R+1) - SSW_S(R)}{SSW_S(R)} \tag{4.3}$$

Although this incentive measure additionally accounts for the scale of the one year accrual relative to current SSW, its expected effect on retirement probabilities is analogue to that of the simple one year accrual.

Boersch-Supan et al. (2002) define another incentive measure which directly links the one year accrual to the amount of net labour income earned through an additional year of employment, $YLAB^{NET}_{R+1}$. Since a negative one year accrual can be seen as a tax on next years labour income (and a positive accrual as a subsidy), this incentive measure is called implicit tax rate. The implicit tax rate at planning age S if retirement is postponed from R to $R+1$ is defined[7] as:

$$TAXR_S(R) = -\frac{SSW_S(R+1) - SSW_S(R)}{YLAB^{NET}_{R+1}} \tag{4.4}$$

In an actuarially fair adjusting pension system[8] the one year accrual would be zero and, hence, the accrual rate and the implicit tax rate as well. Again, we expect the effects on retirement probabilities of the current period to be determined through the same three channels as for the one year accrual (although with an inversed sign).

4.4 Peak Value

Although it is often hypothesized that individuals are rather myoptic in terms of their planning horizon, it is natural in our context to allow for a more forward-looking retirement behavior. Limiting the scope of the planning horizon has an obvious weakness: the design of the social security system may lead to discontinuous changes in SSW over time. Even though increases in SSW due to a postponement of retirement from one year to the next might occasionally be very low, it could very well be the case that an increase in the employment career by two or three years (or even longer) pays off substantially. Not accounting for such longer term changes in SSW could lead to a suboptimal (or even wrong) representation of retirement behaviour and consecutive errors in prediction.

The peak value takes these issues into consideration. So as to construct this incentive measure SSW has to be calculated for every possible future retirement age or, at least, until a certain planning horizon has been

[7] The minus on the right side of the equation is included to get a genuine tax rate in the usual meaning of the word. A positive $TAXR_S(R)$ therefore corresponds to a tax rate, while a negative $TAXR_S(R)$ can be seen as a subsidy.

[8] The term actuarially fair is used in different ways in the literature. While Gruber and Wise (2004) or Hofer and Koman (2006) refer to a pension system with a one year accrual equal to zero as actuarially fair, Queisser and Whitehouse (2006) call this characteristic actuarially neutral. However, we follow the former in their use of the term.

reached. The peak value at planning age S for retirement at age R is then defined as the maximum value of all the future SSW (i.e. for all $T > R$ within the planning horizon) minus the SSW of retiring at age R:

$$PEAK_S(R) = \max_{T>R} [SSW_S(T)] - SSW_S(R) \tag{4.5}$$

A higher peak value is associated with higher future gains in SSW (measured in money terms) and is, therefore, expected to lower the probability of retirement at planning age S, all other things held equal.

4.5 Option Value

All of the above incentive measures are defined in money terms, thus only taking financial aspects of retirement into account. To allow for a utility based incentive measure that is able to capture the labour-leisure trade-off inherent in this decision, one has to turn to the option value framework (see 4.1). The option value is defined by the difference between the maximum attainable utility through postponing retirement to some later age and the utility derived through immediate retirement at planning age. The introduction of a utility framework thus allows us to take into consideration not only the retirement benefits, but also the stream of net labour income until retirement as well as the utility gain associated with the increase in leisure time while retired.

To derive a definition of the option value from the life-cycle model we have to make some simplifying assumptions (cf. Cahuc and Zylberberg (2004) p.19-27 for a general definition of the intertemporal maximisation problem). First, we assume that the utility function of the individuals is temporally separable so that the utility gathered in each time period is described by an instantaneous utility function[9]. Second, instantaneous utility depends only on after-tax income thus implying that we assume a direct link[10] between after-tax income and consumption: $u(Y_t) = Y_t^{\gamma}$ where γ measures the marginal utility of consumption. Third, we assume that the labour-leisure trade-off can be represented by the weighting parameter α, where $\alpha > 1$ implies a relative utility increase in retirement due to additional leisure time. Correspondingly, $1/\alpha$ can be interpreted as the marginal disutility of work.

The expected present discounted utility at age S if retirement occurs at age R can thus be formulated as follows:

$$V_S(R) = \sum_{t=S}^{R-1} u(YLAB_t^{NET}) \cdot \nu_t \cdot \delta^{t-S} + \alpha \cdot \sum_{t=R}^{\infty} u\left(YRET_t^{NET}(R)\right) \cdot \nu_t \cdot \delta^{t-S} \tag{4.6}$$

Where $YLAB_t^{NET}$ is after-tax labour income at age t, $YRET_t^{NET}(R)$ after-tax retirement benefits at age t given retirement at R; ν_t is, as before, the probability to survive at least until age t given survival until age S; δ is the discount rate. The utility parameters α and γ measure the relative utility increase from leisure and the marginal utility from consumption respectively.

The option value at planning age S of continuing work beyond retirement age R is denoted as follows:

$$OV_S(R) = \max_{T>R} [V_S(T)] - V_S(R) \tag{4.7}$$

[9]Note that this representation of utility is restrictive only in the sense that it does not allow for an influence of past on current decisions. However, we argue that this assumption is appropriate in our case since we have defined retirement as an absorbing state.

[10]Although we do not model consumption and saving dynamics, we control for the stock of individual wealth in our econometric model, see 6.2

Where we allow for T to lie between planning age S and age 100. Given the utility parameters α and γ (see 6.2 for a description of our econometric approach), the OV can thus be computed for every planning age S within the time period of interest.

Within this framework postponing retirement has three effects on utility: First, later retirement is associated with additional labour income, which increases utility for all those individuals who are still well integrated in the labour market (see 5.2 for details on this issue). Second, it decreases the time spent in retirement and, consequently, the amount of retirement benefits received, thus decreasing utility. And, third, additional periods of contribution to social security lead to a higher per-year retirement benefit when retired, which again has a positive effect on utility. The latter two effects have additional weight due to the consideration of α, the relative utility of leisure. In general, current retirement probabilities should depend negatively on the option value up to the point where no utility gains can be achieved through further employment. Once this point is reached, the option value turns negative and the individual is expected to retire with certainty.

Chapter 5

IREA: Microsimulation

5.1 Outline

To implement the option value framework on the basis of the dataset described in chapter 3, it is our aim to calculate individual net retirement benefits for each year in the planning period 2002-2014 contingent on the individually relevant retirement plans. In our basic datatset we observe each individual from the beginning of his or her employment career until retirement which takes place in any year within the window period 2002 to 2009. Although the data includes all relevant information necessary to compute gross retirement benefits in the year of actual retirement, we need to consider counterfactual retirement decisions in order to calculate incentive measures (see 4).

Specifically, we proceed in the following way. First, we project annualised gross incomes beyond the actual retirement year, e.g. for $t \geq R$, based on the individual income time series. Second, we calculate individual assessment bases based on contribution and substitution periods, including childcare. Third, we calculate gross retirement benefits as defined by the assessment base, retirement plan and insurance record and define eligibility for all relevant retirement plans as implicated by the individual insurance record. However, since in the Austrian context it is vital to account for different forms of disability pensions, we additionally estimate individual probabilities to obtain disability status and use these to calculate expected eligibility. Fourth, we apply the Austrian income tax and social security legislation of the corresponding planning year (as modelled in the tax-benefit microsimulation model ITABENA, Hofer et al. (2003)) in order to obtain net retirement benefits as well as net labour income.

Since our dataset additionally contains the actual outcome of the calculations of the Austrian pension insurance office, we initially compute gross retirement benefits for the actual retirement date so that we are able to validate our outputs. Having thus calculated actual and counterfactual net retirement benefits we calculate the incentive measures for each year of the planning period 2002 to 2009 based on a consistent 5-year planning horizon.

5.2 Prediction of Future Labour Income

Our approach requires full individual employment records from the beginning of the career until retirement. To allow for retirement dates after observed retirement we thus have to consider counterfactual extensions of the employment career. As can be seen from the definition of the incentive measures (see chapter 4), future labour income is expected to influence retirement behaviour in two major ways: First, it can alter the assessment base through affecting the average life income (or the average income of e.g. the best 15 years). Second, receiving labour income, which is usually higher than retirement benefits, acts as an incentive to stay in the labour market in its own right.

5.2.1 Projection versus Estimation Methods

While, in our case, backward projection of labour income is not necessary, we have to consider alternative approaches with regard to the prediction of future labour income. In general, the respective literature offers two alternative ways to deal with this question. First, projection methods based on some assumptions regarding real income growth rates can be adopted. Typically, authors either assume constant or slightly increasing real wages, sometimes differentiated among age and/or work related subgroups. However, if individual income time series are available (as in our case) projections can also be based on individual average growth rates of the previous years, thus allowing for a fair amount of individual heterogeneity. A second, more sophisticated approach would be to estimate a full econometric model typically based on either a fixed effects specification or some autoregressive process. Table 5.1 summarises the favoured approaches for each of the country groups in Gruber and Wise (2004).

Table 5.1: Method used to predict future labour income

	Projection	Estimation
Belgium	constant real wage	-
Canada	3 years avg. real growth rate	-
Denmark	constant real wage	fixed effects
France	constant real wage (only for civil servants)	pooled cross-section
Germany	1% real wage growth	-
Italy	3 years avg. real growth rate	-
Japan	-	cross-section*
Netherlands	constant real wage	-
Spain	constant real wage or 0.5% growth	-
Sweden	3 years avg. real growth rate	-
United Kingdom	constant real wage	-
United States	1% real wage growth	-

Notes: * Model estimation on the basis of a cross-sectional data set. No further specifications available.
Source: Table refers to the country groups summarised in Gruber and Wise (2004)

The merits and demerits of the different approaches are fairly obvious. On the one hand, projection methods are straightforward to implement, however, in comparison with estimation methods they ignore some of the individual income dynamic. While some of the authors in Gruber and Wise (2004) specifiy various econometric models and compare them to simpler approaches, most of them find that projections on the basis of individual 3-year average growth rates yield satisfactory results (see table 5.1).

Mahieu and Blanchet (2004) use two different estimation methods based on french data. The first estimates wage equations without individual fixed effects. This method is used on wage levels as well as on first order differences. The second method estimates wage equations with fixed effects, though only on levels. The explanatory variables they use include indicators for socio-economic and professional groups and activity types (among others). For both methods they estimate several specifications with a varying number of wage lags. Their main conclusion is that a projection based on constant real wage growth performs quite good, while the second method leads to unsatisfactory results. Overall, method one, i.e., estimation on wage levels without lagged income or fixed effects, is their preferred specification (cf. France).

Brugiavini and Peracchi (2004) apply several methods to deal with income projections. Their simplest approach is to project future income on the basis of the average growth rate of the last three years of observed income. In a second approach they use group-specific growth rates obtained from their sample, with groups defined by sex, age, birth cohort and occupation. Finally, their third approach develops an econometric model based on a first order autoregressive process. However, the authors conclude that the first method is the most suitable one. In their view the second approach is flawed since individual-specific growth rates are found to differ quite substantially from those of the relevant group and, further, group-specific growth rates again differ from the macroeconomic growth rates. Regarding the third method they conclude that it does not give satisfactory results (cf. Italy).

Baker et al. (2004) also evaluate a range of different approaches. They compare a projection on the basis of a 1% real growth rate with estimates from a fixed-effects model including socio-demographic variables and lagged income. However, their conclusion is that the income projection yields more satisfactory results (cf. Canada).

In their original contribution Stock and Wise (1990) generate income predictions based on a second order autoregressive model with age, years in the labour force, age indicators and several interaction terms as control variables. However, this approach is developed on the basis of a firm-specific dataset that includes all workers from one large firm thus being able to neglect heterogeneity among different employers.

5.2.2 Empirical Patterns

Based on this short assessment we conclude that it is sensible to develop a full econometric model only in case longer term predictions are needed. However, due to the highly fragmented retirement legislation in Austria (cf. chapter 2) we base the calculations of the incentive measures on a consistent planning horizon of only 5 years. To predict future labour income in this time period we thus apply projection methods based on individual income time series. Under the assumption that income dynamics are rather minimal towards the end of the employment career, we construct individual average real growth rates based on the annualised gross income of the previous 5 years and use these to project the income trajectory 5 years into the future.

This approach corresponds to the empirical observation that Austrian labour markets are, in general, not among the most flexible compared to other European (or OECD) countries (Kiander and Viren, 2001; OECD, 2004). Research on specific aspects of old-age labour market outcomes confirms this result. Ichino et al. (2007) show that although displaced workers in the age group 45-55 face reduced re-employment probabilities compared to prime-age workers, their employment prospects catch up over a consecutive period of 2 years. However, displacement of older workers is hindered by employment protection legislation like, for instance, the layoff tax which has been shown to reduce displacement probabilities of older workers (Schnalzenberger and Winter-Ebmer, 2009). Winter-Ebmer et al. (2011) analyse the relationship between job quality and retirement for several European countries, arguing that job dissatisfaction induces early labour market exit, with job insecurity being a major predictor of early retirement. Although subsidisation of part-time employment of older workers yields modest increases in employment probabilities, Hofer et al. (2011) find that this policy has negative overall effects on labour supply, as most older workers simply substitute part-time for full-time work.

Although some simplifications are necessary in order to construct counterfactual employment careers, we give special consideration to these issues when predicting future labour income. In order to account for the limited reemployment possibilities of elder unemployed, we consider individuals that are without labour income for a period of 2 or more years up to their observed retirement date as basically out of the labour force[1]. For these individuals a postponement of retirement is associated only with an increase in insurance periods (due to the receipt of unemployment or social benefits), but not with any additional labour income. On the other hand, individuals who obtain labour income up to the year before their observed retirement date are assumed to continue their employment career thus being able to collect not only further insurance periods, but also additional labour income based on their individual real income growth rates. The results from the projection are depicted in table 5.2.

Table 5.2: Distribution of Real Growth Rates in Gross Income

	mean	std.dev.	skewness	kurtosis	p25	**p50**	p75	**N**
women	**0.0046**	0.1036	-3.286	34.05	-0.0022	**0.0129**	0.0271	**128,929**
men	**-0.0015**	0.1071	-3.292	33.61	-0.0034	**0.0117**	0.0211	**136,099**

Source: IREA, 2012

Based on the definition given in the previous paragraph, approximately 11% of males and 20% of females are already out of the labour force when they retire. For the remainder of the individuals the table shows that real income growth is very close to zero for both genders. Although the median is in the same region for both (somewhat above 1%), the female average is only slightly above zero (0.46%) while the male[2] average is negative (-0.15%).

[1]Note that other specifications have been applied in order to check the sensitivity of our results with regard to these assumptions. However, shortening the required unemployment spell to 1 year did not affect the results qualitatively. The same is true for a change in the averaging period to either 3 or 10 years.

[2]Since we do not observe working hours decreases in income due to a reduction in labour supply can not be identified, thus potentially leading to a downward bias in real income growth for some of the individuals.

5.3 Retirement Benefits

We take into consideration the following pathways into pension:

- **old-age pension (AP)**: at age 65 for men and 60 for women after 15 years of contribution or 25 years of insurance [3]

- **early retirement due to long insurance (VAPL)**: retirement age depends on cohort (60-65 for men and 55-60 for women)[4], after 37.5 insurance years or 35 years of mandatory contribution out of employment

- **hard-worker rule ("Hacklerregelung")**: a special rule allowing retirement at 60 for men and 55 for women after 45 and 40 contribution years, respectively

- **corridor pension (KOP)**: at age 62 after 37.5 insurance years

- **invalidity pension (BU/EU/IP)**: at any age, 15 contribution years, 25 insurance years or 5 insurance years within the last 10 years, conditional on the incapacity to exercise an occupation or the occupation predominantly exercised within the last 15 years

We ignore special rules for heavy labour, rules that were abolished soon after our observation period starts (gliding pension, early pension due to unemployment) or rules being not explicitly part of the pension system (like a programme of working time reduction which is paid partly by the unemployment service). As there are no civil servants in our data set we do not treat their, to some extent, special rules.

As displayed in section 2 pension benefits in Austria are calculated by multiplying the assessment base (an average of the best income years) with a percentage depending on the numbers of insurance years and the age of retirement. The following sections describe in more detail how we implemented the pension calculation rules of the years 2002 to 2014 into our model, how close our calculations of gross pensions are to the actually received pension and how we calculate net pensions.

5.3.1 Assessment Base

Until 2003 the assessment base was calculated by the average of 15 years with the highest income. From 2004 on the assessment period is extended by one year each year. For women the period is reduced for every child by 3 years until the minimum of 15 years.[5] In both regimes years of child-rearing are valuated with a special assessment base. For every individual we calculate the assessment base for retirement in the period 2002 to 2014. For some years income information in the data is sufficient as the true retirement date of the individual lies after the year of calculation. For other years we fall back to the income projection described in the beginning

[3] *Contribution* years are all years for which actual insurance contributions were paid (employment, self-employment, voluntary insurance or voluntary contributions for years of education). *Insurance* years are all contribution years plus so-called *substitution* periods like unemployment, military service, child rearing, illness.

[4] The retirement age depends on the month and year of birth. For reasons of privacy we do not dispose of the exact date of birth, but only of the year of birth. Thus, we have to be less exact in this point.

[5] We have no information on the number of children. For every child one parent gets 4 insurance years. However, if a second child is born within these 4 years, the next 4 years start such that the number of children remains unclear even with this information available. To account for this rule we use the information on the true assessment base in the data and search for the assessment period most suitable.

of this chapter. For 2002 and 2003 we calculate the assessment base according to the old rules only. For the other years we calculate two assessment bases, as the pension itself will be a mixture of both rules (see below).

5.3.2 Gross Retirement Benefits

According to the pathways into pension subscribed above we start the calculation of gross retirement benefits by deciding for every year in our period 2002 to 2014 whether an individual is eligibile to the pathways into pension considered. For invalidity pensions we check whether the relevant restrictions out of the pension system are fulfilled.[6] In the period of interest pension calculation rules changed every year. However, in case retirement was already possible the year before some rules were maintained for the individual. Thus, in order to choose the right rule we also define whether retirement was already possible in the years before the calculation year. Given eligibility to the different pathways and the assessment base for 2003 and 2004 gross benefits are calculated.

Until 2003 every insurance year is valuated with 2 percentage points. Thus, after 40 insurance years retiring at the regular retirement age leads to a pension of 80% of the assessment base. In case of early retirement due to long insurance contribution deductions were executed: Depending on the cohort[7] 2 or 3 percentage points per year of early retirement up to a maximum of 10 (10.5) points or 15% of the percentage rate are deducted. The maximum percentage rate after deductions is 80%. In case of postponed retirement after the regular age a bonus of 4 percentage points per year is given until a percentage rate of 80% is reached. Above this, a bonus of only 2 percentage points is granted. The highest achievable percentage rate with bonus is 90 %.

From 2004 on the percentage points granted for every insurance year were decreased steadily until 1.78 were reached in 2009. Thus, instead of 40 now 45 insurance years are necessary to reach a pension of 80% of the assessment base. However, in case a regular pension claim already exists for a preceding year the percentage points of that year are kept even if retirement occurs in later years. The highest percentage rate possible is 80 %. Possible deductions take place after this maximum rule is applied. Deductions for early pensions are 4.2% of pension per year of early retirement, with a maximum of 15 %. In case of retirement after the legal retirement age a bonus of 4.2% is granted, with a maximum percentage rate of 91.76. As already mentioned above, next to changes in the percentages points the averaging period for the assessment base is extended for one year each year.

In order to reduce the loss in pension that might occur due to the transition from 2003 to 2004, rules the reform effects were softened by a maximum loss cap: Pensions are calculated according to 2003 and 2004 rules; in case the loss due to the reform 2004 exceeds the loss cap (5% in 2004, increased by 0.25 percentage points every year) the 2003 pension minus the accepted loss is granted (eg. 95% of 2003 pension in 2004). In case a person retires in 2004 or later but could have already retired before in 2003 the old rules are applied.

The retirement age for early retirement due to long insurance is increased constantly until 65 for men and 60 for women is reached in 2017. Closing this pathway into early pension, another one was opened: The corridor pension allows retirement from 62 on, with additional deductions of 2.1% per year of retirement before the possible retirement age in the early retirement due to long insurance pathway. Instead of the deductions within

[6] We cannot check the *invalidity* of a person. In this step of the model we only assure if in case of invalidity a pension would be granted and how much this pension would be. 5.4.1 then shows how we acount for the uncertainty an individual faces regarding its invalidity status and the consequential pension benefits.

[7] Again we have to be imprecise on this point, as we do not dispose of the exact date of birth of a person.

the cap for every year of early retirement these deductions are drawn after the maximum loss cap is applied. Further, we model the so-called hard-worker rule ("Hacklerregelung"'), allowing retirement at 60/65 without any deductions and with a more generous validation of insurance years.

Invalidity pensions are calculated similar to regular pensions. For 2004 the same percentage points and deductions are applied, however, in case of retirement before a certain age[8] additional insurance years are granted, thus the pension is calculated as if retirement occured at this later age. Before, in the 2003 rules, the assignment of additional insurance years occured only until the age of 56.5, no deductions were applied, but the percentage points for every insurance year were lower than the ones applied for regular pensions. In case of additional insurance years granted the maximum percentage rate is 60% in both regimes.

5.3.3 Output Validations

Our data comprises the actual assessment base and actual gross pension benefits for every individual. Thus, we can compare our simulations with the pension calculation actually applied. 5.3 shows the ratio of simulated to actual assessment base. Looking at the mean the simulated assessment base exceeds the actual one by 2 % for women and 1 % for men. The range of deviation is quite low, with 0.99 at the border of the first decile and 1.01 between ninth and tenth decile for women and 0.97 and 1.01 for men, respectively. Looking at the pension calculation as a whole (5.4) the medium deviation is +1 % for women and +2 % for men. So both, simulated assessment base and pensions, are slightly higher than the actual values. Regarding pension calculations the range of deviations is higher. Reasons for the deviations might lie in missing information in the data, such as the exact date of birth or the number of children. The database might also lack the last update of some variables. However, the possibility admitted by this kind of data, to simulate the Austrian pension system with such a precision and even being able to double check the calculations, is unique for Austria.

Table 5.3: Distribution of Simulated/Actual Assessment Base

	mean	sd	p10	p25	**p50**	p75	p90	N
women	**1.020**	0.356	0.994	1.000	**1.003**	1.003	1.011	**161,330**
men	**1.009**	0.412	0.965	0.987	**1.000**	1.002	1.014	**153,388**

Source: IREA, 2012

Table 5.4: Distribution of Simulated/Actual Gross Retirement Benefits

	mean	sd	p10	p25	**p50**	p75	p90	N
women	**1.010**	0.461	0.927	0.980	**1.054**	1.125	1.164	**161,351**
men	**1.018**	0.499	0.944	1.001	**1.042**	1.122	1.140	**153,393**

Source: IREA, 2012

[8] 57 in 2004, this number is increased by several months every year until 60 is reached in 2009

5.3.4 Net Retirement Benefits

The pensions simulated so far are gross pensions. However, for calculating the present value of future pension benefits net pensions are needed. The Austrian tax system is quite progressive, thus, an increase in gross pension might lead to a much lower increase in net pensions and therefor lower or abolish a possible effect on retirement behaviour. For the calculation of net pensions the IHS tax-benefit model ITABENA was applied (Hofer et al., 2003). Gross pensions were reduced by social insurance contributions and income tax. We took into account the different contribution rates for all insurance carriers, different contribution and tax rates over the years and all kind of deductions and tax reductions where the information necessary was available. However, all kind of family or spousal benefits could nod be modelled, as we are lacking information on family status.

5.4 Eligibility Conditions

Our interpretation of the individual decision problem, as described in 4, basically views retirement as a dichotomous choice. This perspective entails specific assumptions with regard to the eligibility conditions for different retirement plans. On the one hand, we do not consider gradual retreat from the labour market e.g. through a subsidised part-time employment scheme for the elderly. On the other hand, we need to allow for the multiple pathways into retirement that the Austrian legislation provides.

5.4.1 Multiple Pathways into Retirement

As has been outlined in section 3 we model six different retirement plans. This includes old-age retirement (AP), pre-retirement due to long insurance records (VAPL), pre-retirement through the corridor option (KOP) as well as retirement due to disability (BU, EU and IP). While the former three retirement plans will be summarised as regular retirement schemes, we refer to the latter three as disability pensions. Old-age retirement (AP) as well as the two pre-retirement schemes (VAPL and KOP) are *regular* in the sense that there exists a set of deterministic rules that govern eligibility based on age, cohort, gender and individual insurance records. As long as only regular retirement plans are considered, it is therefore possible to compute incentive measures based on equations 4.1, 4.3, 4.5 and 4.7.

However, eligibility to any of the three disability pensions is not conditional on insurance records, but only on the individual health status. Accidents or diseases causing lifelong disability can, of course, occur without preannouncement and these retirement plans were initially created with the intention to insure the working population against such events[9]. In Austria workers are thus eligible for disability pension if their ability to work is reduced by 50% due to any kind of accident or illness. In case of application physicians judge whether this requirement is met in a specific screening process, which necessarily involves a certain degree of subjective evaluation.

In addition to the subjectivity of such decisions, further complications arise from the fact that applications for disability pension are potentially endogenous. Boersch-Supan (2001) argues that employers as well as employees might make strategic use of the disability option. Employers, on the one hand, have an incentive to

[9] See section 5.3 for a description on how benefits for these retirement plans are calculated.

restructure the labour force at the charge of the social security system. Likewise, employees have an incentive to claim disability pension for their own personal benefit in a misuse of the pension system. As a result, it has to be expected that eligibility for disability pension is, at least to some extent, manipulated, as the incentives to do so are often quite high.

Although the data includes ex-post information on the actual retirement plan, the probability of a positively evaluated application remains ex-ante uncertain. This issue is discussed in depth by Boersch-Supan (2001), where the author analyses retirement incentives in Germany based on the option value framework. Four different strategies to handle uncertain disability options are presented[10]:

a) The tough variant: All individuals are assigned retirement incomes according to the old-age retirement plan.

b) The generous variant: All individuals are assigned retirement incomes as if they were eligible for disability pension.

c) The endogenous variant: Ex-post disabled persons are assigned disability pension, all other individuals are assigned regular pensions.

d) The probabilistic variant: Individuals are assigned an expected value based on a probability p of obtaining disability status.

Variant *a* and *b* obviously represent extreme cases: While *a* ignores the disability pathway and only considers old-age retirement, *b* does the opposite and assigns the disability option to all individuals. Variant *c*, the endogenous variant, uses the disability status according to the rules that have ex-post been applied to a sample individual. This means that if, in retrospect, a person is granted disability status, this will be taken into consideration when calculating the incentive measures as if it was already known by the individual ex-ante. For persons who did not obtain disability pension, this option was not taken into consideration at all, similar to the tough variant. However, this method appears to be a serious misinterpretation of the decision problem faced by the individuals since the ex-ante uncertainty about his or her future health status is not properly accounted for.

Variant *d* clearly is the most promising approach, as it preserves a higher degree of individual heterogeneity. In this case, the main idea is to construct a weighted average on the basis of the probability p of obtaining disability status in the current period. In order to do that one first has to define two complementary event-paths depending on the specific institutional and legal setting. For instance, an application for disability pension in the current period can either be accepted or rejected. Correspondingly, an applicant might become eligible for disability pension in the current period if his case is positively evaluated. However, in the event of a negative evaluation, it needs to be defined what options he or she has until finally being eligibile for regular retirement[11]. Depending on the context there will, of course, be a wide range of complementary event-paths that are conceivable and, in general, a sensible approach should thus consider not only legislative context and empirical regularities but also the corresponding interpretation of the decision problem.

[10]Note that these approaches can be extended to account for more than two different pathways, however, this does not apply to out case.

[11]Note that it is obviously inconsistent with our approach to allow for an immediate return to the labour market once having applied for disability pension.

The second aspect that needs to be addressed in order ot implement this approach is how to derive the weighting probability *p*. A comparison of the models described in Gruber and Wise (2004) shows that it can be obtained either as the population frequency of being disabled or through the specification of an econometric model. Summing up, Boersch-Supan (2001) interprets variants *a* and *b* as boundary solutions, with the respective methods over- and underestimating the real effects. While method *d* performs best, variant *c* only gives poor results. As is shown in table 5.5 most country groups in Gruber and Wise (2004) apply variant *d* based on population frequencies, only few of them develop seperate models for the estimation of disability probabilities.

Table 5.5: Methods used to handle uncertain disability options

	not considered	population frequency	econometric model
Belgium		X	
Canada	X		
Denmark		X	
France		X	
Germany		X	
Italy	X		
Japan		X	
Netherlands		X	
Spain			X
Sweden			X
United Kingdom			X
United States	X		

Source: All countries refer to the country groups in Gruber and Wise (2004)

Specifically, Dellis et al. (2004), Bingley et al. (2004) and de Vos and Kapteyn (2004) all use variant *d* while taking the empirical take-up rates from their samples as probability weight *p*. Among these studies, Bingley et al. (2004) use the most subtle classification, as they distinguish subgroups according to age, year, gender and the degree of disability which can be either high, middle or low. Mahieu and Blanchet (2004) basically use approach *d*, although they represent a special case because they only include unemployment and early retirement pathways but not disability. Furthermore, they conclude that a distinction between sectors of activity is the most suitable approach for calculating probability weights based on their data. However, the authors acknowledge that this procedure does not full justice to the situation in France because access probabilities are likely to be firm specific. The lack of appropriate firm-level data thus presents a important restriction to their modelling efforts.

Palme and Svensson (2004) also apply probability weights to deal with multiple pathways to retirment in Sweden. The authors identify two major challenges. First, taking into consideration all possible pathways into retirement of the Swedish system, including the possibility of switching between different retirement plans, presents a very high degree of complexity[12]. They therefore concentrate on the most frequent retirement plans

[12]The labour market insurance programs in Sweden mainly consists of the disability, sickness and unemployment program.

observed in their sample. The second challenge refers to the computation of the probability weights, however, they approach this issue by specifying a probit model with the observed take-up of disability pension as dependent variable and an age polynomial, education as well as occupation indicators as independents.

Apart from the swedish researchers, Blundell et al. (2004) and Boldrin et al. (2004) both use a similar approach, where the former authors include some additional explanatory variables, i.e. indicators for tenure, marital status as well as spousal employment status. The latter, however, allow for some more heterogeneity by estimating separate models by gender and retirement plan, also including a set of regional dummies and a cubic time trend. From the remaining country groups, Baker et al. (2004), Brugiavini and Peracchi (2004) and Coile and Gruber (2004) do not use probability weights to model multiple pathways to retirement. Oshio and Oishi (2004) represent a special case as their research is based on a solely cross-sectional datatset.

5.4.2 Eligibility for Disability Pensions

In Austria there are basically three relevant disability options: BU, EU and IP (cf. chapter 3 for a more general description of retirement plans). However, as each of these is associated with a different occupational group, it can be ruled out that any person is eligible for two (or more) of these retirement plans at the same time. As in the German context, we expect applications for any of these disability options to reflect strategic behaviour by employers as well as employees (see 5.4.1 for a discussion). The fact that almost 30% of the individuals in our dataset retire via one of the disability options underscores the relevance of this issue. As shown in table 3.4 the mean retirement ages associated with these retirement plans are between 54-56 for women and 56-57 for men. It is thus not implausible, at least in the Austrian context, to speak of these disability options as a form of (very) early retirement.

To approach this issue in a comprehensive way, we deal with uncertain disability options by interpreting the incentive measures as expected values. Thus following variant *d* as set out in the previous subsection, we define two complementary event-paths and weight them by their respective probabilities. Taking the SSW from equation 4.1 as an example we define the expected social security wealth as follows:

$$E[SSW_S(R)] = p \cdot SSW_S^{DIS}(R) + (1-p) \cdot SSW_S^{DIS}(\hat{R}) \tag{5.1}$$

As the superscript *DIS* denotes the SSW associated with being eligible for any of the three disability options, the expected SSW of retirement at age R (at planning age S) is a weighted sum of the SSW associated with retirement at age R or at a later age $\hat{R}$. Since $\hat{R}$ is defined as the earliest possible date at which the individual is eligible for any regular retirement plan, this formulation implies that we allow for an early exit from the labour force (even before pre-retirement age) on a voluntary basis. However, due to the probability weights associated with either of the two event-paths, the expected SSW will reflect (i) how likely it is that the application receives a positive evaluation and (ii) how long it might otherwise take to become eligible for any possible pre-retirement plan (in case the initial application was turned down).

Our approach thus captures the two essential features of the Austrian system. On the one hand, individuals start retiring on the basis of the disability options already at a very early age and, on the other hand, applications can basically be repeated several times until early exit is finally granted[13]. Although it has been layed out only in case of the SSW, we apply exactly the same approach to all the other incentive measures.

[13]Note that due to the comparatively young retirement ages associated with the disability options, we do not allow for later switches

Table 5.6: Probability of Obtaining Disability Pension at Pre-Retirement Ages

	mean	sd	**skew**	**kurt**	min	max	**N**
women: all ages	0.042	0.060	3.67	24.32	0.0001	0.9850	1,134,662
age 56	0.060	0.072	3.02	17.12	0.0007	0.9850	143,167
men: all ages	0.083	0.097	2.18	9.06	0.0000	0.9543	1,466,506
age 57	0.120	0.115	1.78	6.67	0.0000	0.9543	120,754

Source: IREA, 2012

To preserve as much individual heterogeneity as possible, we estimate a probit model to derive individual probabilities to apply for and obtain disability pension. Therefore, we take observed (successfull) applications in our dataset as dependend variable and link these to an age-cubicle, migrational background, year indicators, average lifetime income as well as cumulative daily information on employment, industrial sector, unemployment and sick leave[14]. Regressions are run for men and women separately and are depicted in tables C.1 and C.2.

Based on these estimates we predict the individual probabilities to obtain disability pension at ages 50 to either 60 or 65 for females or males, respectively. Table 5.4.2 summarises some descriptive results. The mean probability over all possible pre-retirement ages is around 4.6% for females and 8.3% for males. Although individual results range from zero to more than 95%, most probabilities are close to zero, resulting in a rightward skewed distribution. For both genders, the mean (per age group) is rising from age 50 until 56 and 57 for females and males respectively. At the latter age the probabilities reach their maximum, which is about 6% for females and 12% for males. For older age groups the individual probabilities are declining rapidly, reaching zero at regular retirement ages.

5.5 Empirical Patterns of the Incentive Structure

The procedures laid out in sections 5.2, 5.3 and 5.4 allow us to calculate the incentive measures as discussed in chapter 4 for each planning year in the period 2002-2009. Specifically, we compute one-year accruals, one-year accrual rates, tax rates, peak values and option values. While the SSW measures an individuals current accounting balance versus the pension insurance office, the accruals consider changes in this balance from the planning year to the next. The two forward-looking variables, the peak and option values, are each calculated based on a 5-year planning horizon. Taken together, these variables therefore summarise the incentive structure of the Austrian pension system as faced by each individual in our dataset.

towards regular retirement plans. In our view this would be rather speculative, as specific assumptions would have to be taken with regard to the employment options of individuals who have already opted out of the labour market. Our present approach, however, avoids this since disability pensions are rather insensitive with regard to further employment spells and we allow for the accumulation of further contribution periods due to the receipt of social benefits.

[14]The latter four groups of variables come from the Austrian social security database, cf. 3.

Table 5.7: Social Security Wealth by Age

	Women							Men						
Age	p10	p25	p50	p75	p90	mean	sd	p10	p25	p50	p75	p90	mean	sd
47	3,067	5,226	9,819	21,361	39,709	16,638	18,125	1,052	2,072	5,302	15,052	32,576	12,066	17,085
48	802	1,190	2,316	5,856	15,126	5,912	9,918	918	1,910	4,899	13,713	31,200	11,693	17,682
49	443	656	1,194	3,132	8,387	3,509	7,003	946	2,056	5,144	14,030	32,309	11,964	17,419
50	428	759	2,368	173,806	288,157	77,948	123,884	917	1,748	4,551	13,634	32,788	11,728	17,738
51	556	1,176	6,505	234,608	337,160	114,792	140,095	1,330	2,492	5,462	15,526	36,528	13,340	19,355
52	1,529	10,098	189,651	269,277	358,628	176,937	132,501	2,031	3,794	7,689	19,957	43,829	16,528	21,907
53	1,302	20,617	193,769	270,648	361,339	183,175	133,357	1,987	3,656	8,827	21,085	46,695	17,701	23,415
54	1,386	9,187	193,928	275,592	370,176	182,112	141,245	2,942	5,162	11,140	25,093	52,999	20,727	25,529
55	94,395	140,359	213,218	301,794	404,843	232,300	122,885	5,984	14,790	48,570	258,341	329,920	127,179	132,118
56	92,569	138,638	217,961	309,890	419,201	237,468	129,108	9,076	23,206	109,895	288,368	347,811	157,915	139,367
57	91,543	137,286	220,356	311,722	423,089	238,674	130,842	16,795	52,184	240,100	312,810	362,683	204,062	137,465
58	90,963	135,787	223,545	312,919	424,451	239,413	131,683	56,999	195,660	269,350	329,033	376,289	251,410	122,565
59	87,197	126,918	214,583	302,958	415,021	231,351	131,090	140,991	215,694	286,975	346,861	394,212	273,406	122,535
60	88,725	123,965	205,267	291,887	403,046	224,666	128,378	165,630	234,935	311,024	374,498	422,109	302,063	119,698
61	93,042	126,004	205,488	295,473	411,628	227,879	130,647	170,178	244,036	319,751	383,309	424,105	308,518	120,753
62	96,969	128,837	206,443	302,436	422,608	232,251	132,191	172,244	248,101	324,555	387,208	423,432	311,441	117,001
63	97,400	125,956	182,625	267,244	382,179	213,118	119,077	172,416	251,154	328,125	388,255	422,054	312,891	116,912
64	100,187	130,071	185,109	264,810	380,767	214,067	117,298	166,335	251,381	328,513	387,407	418,475	310,384	116,725
65	103,221	134,917	187,008	260,896	374,227	214,254	116,516	157,179	246,995	327,317	384,892	413,554	306,412	117,940
66	107,047	139,565	186,722	253,908	362,997	211,949	105,705	150,272	247,369	333,391	388,141	412,123	308,223	115,387
67	109,200	140,358	184,702	245,724	343,930	207,277	104,970	142,192	239,824	329,994	388,931	407,255	302,644	105,528
68								102,357	166,851	285,109	377,391	389,176	266,525	118,470
69								99,318	157,705	260,676	366,355	374,581	254,194	119,575
70								95,644	149,646	245,926	356,654	367,018	243,289	109,877
71								97,406	147,504	227,557	345,508	355,058	234,506	105,071
72								100,923	144,237	218,559	340,778	341,918	228,341	101,193
Total	26,090	116,478	199,848	289,861	395,235	211,291	136,169	9,011	71,807	261,676	346,516	397,504	227,775	153,756

Source: IREA, 2012

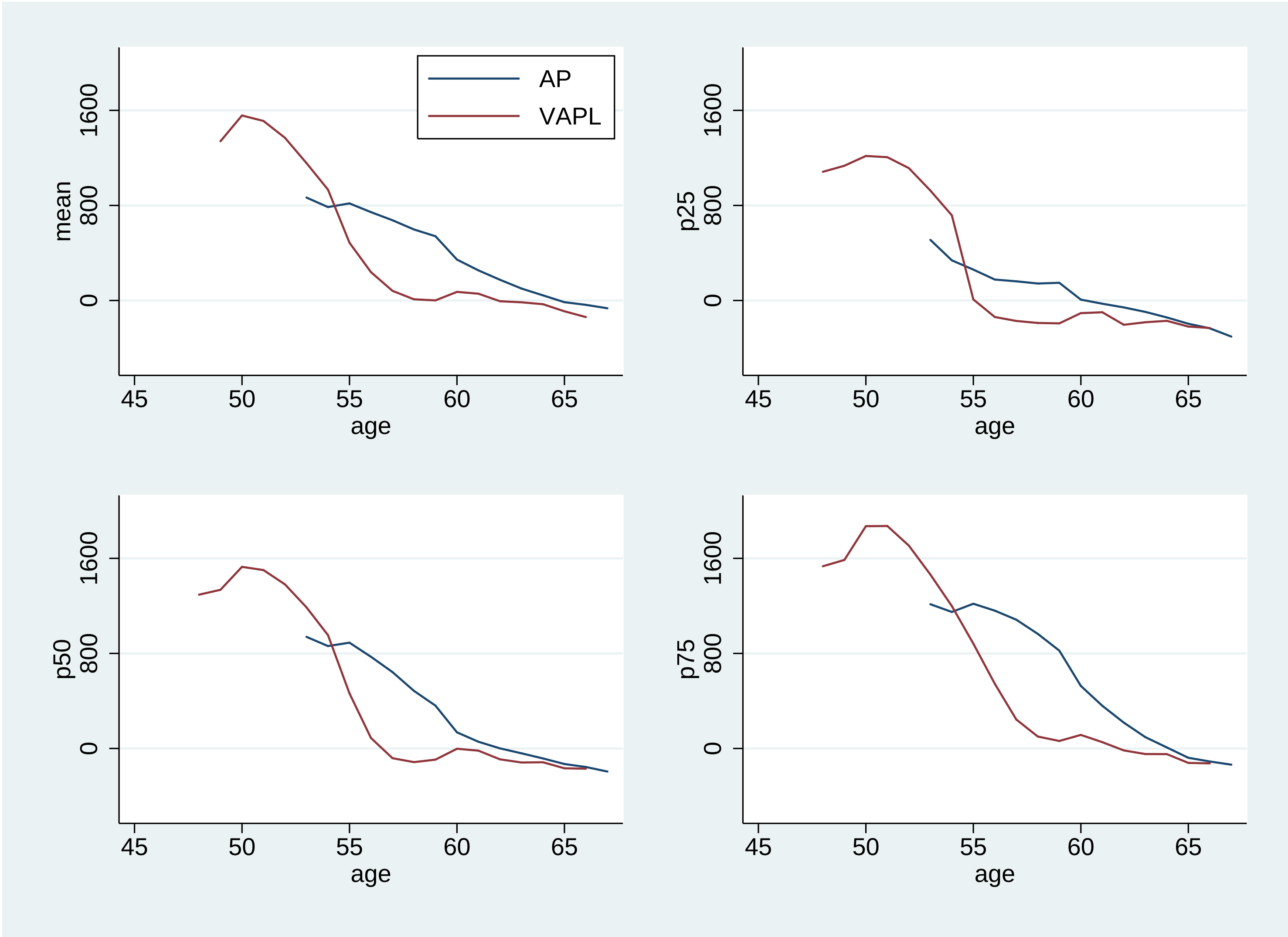
Table 5.7 summarises the distribution of the expected SSW by age and gender. For both genders eligibility effects are clearly visible. While for females a jump in SSW can be observed at age 55, a related increase is observed for men just before age 60. As has been laid out in section 5.4, SSW at pre-retirement ages is defined as an expected value with a 5-year planning horizon. Females of age 55 will thus just be able to take their future eligiblity, at the statutory retirement age of 60, into account. As a result, their expected SSW shows a strong increase at this age, a phenomenon that is more pronounced for individuals at the lower end of the distribution. Since some of the individuals will be eligible for pre-retirement (or have a high probability of receiving a disability option), their SSW will already be higher at younger ages thus placing them in higher percentiles. A similar picture evolves for males, though the latter are more likely to receive disability options therefore resulting in a smoother increase of expected SSW around age 60. However, a considerable amount of males is eligible for pre-retirement plans that typically start at age 60, thus leading to large increases in SSW already at age 55 for individuals in higher percentiles.

A further empirical result emerges from table 5.7. For both genders it is striking that the SSW is basically stagnant as soon as pre-retirement ages, at 55 for females and 60 for males, are reached. This result is even more relevant as it is clearly visible for all parts of the distribution, and emerges from observations on the individual level as well as from aggregate figures. Although the incentive measures are very dispersed and strongly dependent on individual characteristics, it is thus fair to say that (based on an analysis of the SSW) the incentive structure discourages individuals from continuing to work beyond the earliest possible retirement date.

However, this result is somewhat qualified when looking at the option values (see also table XX). Since we would expect incentive effects to be strongest for the old-age retirement (AP) and pre-retirement plans (VAPL and KOP), we take a closer look at these[15] in figures 5.1 and 5.2. The figures show the evolution of the option value by age for different parts of the distribution. Specifically, we seperate between genders and retirement plans and plot the option value at the 25^{th}, 50^{th} and 75^{th} percentile against age. Since a negative option value implies that a further extension of the employment career yields a loss in present discounted utility, we would expect individuals to retire as soon as this age threshold is reached.

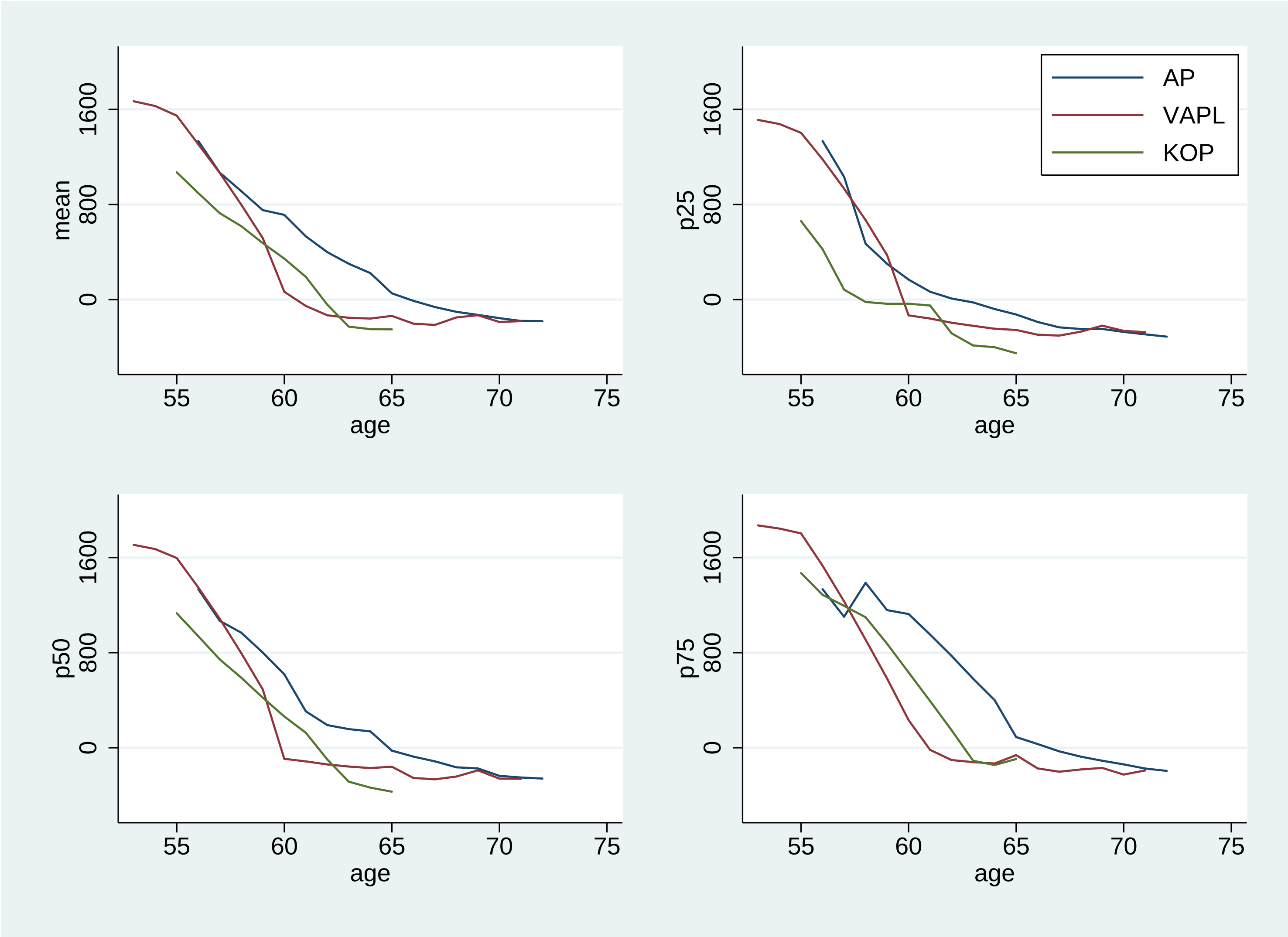
[15] Individuals retiring through one of the disability options are generally much younger and, since eligibility for regular retirement plans is reached only later on, their incentive measures are mostly driven by the probability to obtain disability status.

Figure 5.1: Evolution of the OV with Age, Women



Source: IREA, 2012

Figure 5.2: Evolution of the OV with Age, Men



Source: IREA, 2012

In fact, for women whose observed retirement plan is VAPL, the Austrian pension system gives more incentive to delay retirement for individuals at higher percentiles. While for women at the 25^{th} percentile of the distribution the option value turns zero at age 55, this is the case at age 56 for women at the median and at age 57 for those at the highest quartile. Regarding women retiring through the old-age retirement plan (AP) similar results can be observed, although threshold ages are higher. For women at the 25^{th} percentile, the option value is zero at 60 which is exactly their statutory retirement age. For those at the median it is around 63 while at the 75^{th} percentile this is only the case at around age 65.

For men, the evolution of the option value with age is more similar across the distribution. The option value hits zero for men retiring through VAPL at 60 which is, again, the age they become eligible for this retirement plan. Although this result is true for the largest part of the distribution, men at the 75^{th} percentile have an incentive to delay retirement for another year. Men who retire according to the old age retirement plan (AP), however, do not have an incentive to continue working until they reach 65 if they are in the lower half of the income distribution. Only those in the upper half retain positive option values slightly beyond the age of 65. Looking at men retiring through the other pre-retirement plan (KOP), similar results emerge, as the latter face a negative option values exactly at age 62 which corresponds to their statutory retirement age.

Analysis of the option value thus offers a more complete picture of the incentive structure of the Austrian pension system. On the one hand, it is an economically more interesting statistic because it is utility based and incorporates future utility from labour income and leisure (see chapter 4). On the other hand, it shows that the incentive effects are not as discouraging as seemed to be the case when looking at the SSW alone, at least when considering only regular retirement plans. Nevertheless, even accounting for utility from labour income does not alter the general conclusion that the Austrian pension system delivers only very limited incentives to continue work beyond statutory (pre-)retirement ages (cf. appendix XX for the complee set of tables).

Chapter 6

IREA: Econometric Model

6.1 Data

Although, in principle, we compute the incentive measures for every individual in every planning year, we reduce our dataset for the econometric analysis mainly due to computational tractability. First, we are interested in exit probabilities, so we only include observations from the beginning of the planning period, 2002, up to the actual retirement date, i.e. 2009 at the latest. Second, we do not want to include observations which are too far removed from observed retirement, thus restricting the individual observations to only 5 years prior to the actual retirement date. The resulting left-censored dataset thus contains between 1 and 6 observations per individual, depending on the actual retirement date. Third, we randomly draw 5,000 individuals from the full dataset, thus resulting in an estimation sample of 14,301 person-years.

6.2 Specifications

In order to model retirement behaviour within the option value framework we estimate several cross-sectional probit models with retirement in the planning year as dependent and SSW plus an additional incentive measure as the main independent variables. As discussed in section 4.1, the introduction of forward-looking variables like the option value in a cross-sectional model allows us to capture most of the intertemporal variation within a comparatively simple framework[1]. To capture the effects of aging on retirement we let age enter the model in two different ways, either linearly (LA) or through a full set of indicators (AD). In addition, we differentiate between females and males, thus resulting in a total of 12 model specifications. The estimation results for the option value (OV) specifications are shown in tables 6.1 and 6.2, while the results from the accrual rate and peak value specifications (ACCRA, PEAK) are shown in the appendix C.

While we are abstracting from equilibrium effects on interest rate and discount factor[2] by assuming a constant $\delta = 0.97$, we implement a grid search mechanism in order to find the optimal values for α and γ. Table

[1]In order to better deal with unobserved heterogeneity among individuals we have additionally estimated several random-effects specifications, however, none of these offered significant improvements over the original option value specification.

[2]Based on a corresponding discount rate of $r = 0.03$.

Table 6.1: Option Value Specification with Linear Age (OV-LA-MEN)

#	MALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	3.10e-06	3.42e-07	9.06	0.000
2	**option value**	-0.000788	0.0000441	-17.86	0.000
3	age	0.0490289	0.0088135	5.56	0.000
4	migration	0.1464948	0.0365513	4.01	0.000
5	sick leave	0.0006478	0.0001536	4.22	0.000
6	regular employment	0.0000237	0.0000173	1.37	0.171
7	self-employment	0.0000273	0.0000174	1.57	0.117
8	fragmented employment	-9.50e-06	0.0000850	-0.11	0.911
9	unemployment	-0.0000712	0.0000245	-2.91	0.004
10	avg. monthly income	-0.0004606	0.0000466	-9.89	0.000
11	NACE A	0.2309181	0.1848995	1.25	0.212
12	NACE B	-0.3338738	0.2823768	-1.18	0.237
13	NACE C	0.0820796	0.1001994	0.82	0.413
14	NACE D	-0.0739154	0.1474779	-0.50	0.616
15	NACE E	0.6126561	0.4596404	1.33	0.183
16	NACE F	0.3319055	0.1034424	3.21	0.001
17	NACE G	0.0238435	0.1001503	0.24	0.812
18	NACE H	-0.0386803	0.1137415	-0.34	0.734
19	NACE I	0.2267986	0.1405453	1.61	0.107
20	NACE J	-0.1725319	0.1603280	-1.08	0.282
21	NACE K	-0.1830038	0.1206741	-1.52	0.129
22	NACE L	-0.0016103	0.2115430	-0.01	0.994
23	NACE M	-0.0918498	0.1271987	-0.72	0.470
24	NACE N	0.1998773	0.1451288	1.38	0.168
25	NACE O	0.0751489	0.1120666	0.67	0..502
26	NACE P	-0.2915570	0.2974188	-0.98	0.327
27	NACE Q	-0.1512520	0.1752370	-0.86	0.388
28	NACE R	-0.1189379	0.2224540	-0.53	0.593
29	NACE S	-0.0695682	0.1760470	-0.40	0.693
30	NACE T	-0.2590911	0.5140223	-0.50	0.614
31	NACE U	(referrence)			
32	YEAR 2002	-1.0713500	0.0701397	-15.27	0.000
33	YEAR 2003	-1.0352270	0.0681197	-15.20	0.000
34	YEAR 2004	-1.3838770	0.0703666	-19.67	0.000
35	YEAR 2005	-1.0934620	0.0653927	-16.72	0.000
36	YEAR 2006	-0.8323986	0.0641612	-12.97	0.000
37	YEAR 2007	-0.9224212	0.0680696	-13.55	0.000
38	YEAR 2008	(referrence)			
39	YEAR 2009	(referrence)			
38	Constant	-2.5604260	0.5772210	-4.44	0.000

Summary Statistics:		
	number of observations	8867
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3632.4976
	likelihood ratio index ρ^2	0.2580

Source: IREA, 2012

6.3 summarizes the favoured approach as well as the actual values used by the various country groups in Gruber and Wise (2002). The most general approach to determine optimal values for α and γ would be to develop a full structural model that delivers estimates of the two utility parameters along with other parameters. This approach is described in more detail in the original contribution of Stock and Wise (1990). Though they succeed in determining structural utility parameters on the basis of the retirement behaviour of workers from one large firm, none of the authors in Gruber and Wise (2002) (or elsewhere) implement this approach on the basis of a

Table 6.2: Option Value Specification with Linear Age (OV-LA-WOMEN)

#	FEMALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	8.47e-06	3.92e-07	21.63	0.000
2	**option value**	-0.0003609	0.0000332	-10.86	0.000
3	age	0.1999934	0.0081175	24.64	0.000
4	migration	0.1543268	0.0333787	4.62	0.000
5	sick leave	0.0006876	0.0001425	4.83	0.000
6	regular employment	-2.86e-06	0.0000113	-0.25	0.801
7	self-employment	-1.46e-06	0.0000124	-0.12	0.906
8	fragmented employment	-0.0000848	0.0000390	-2.17	0.030
9	unemployment	-0.0000622	0.0000243	-2.56	0.010
10	avg. monthly income	-0.0014097	0.0000765	-18.44	0.000
11	NACE A	-0.071935	0.2168824	-0.33	0.740
12	NACE B	(reference)			
13	NACE C	-0.0721004	0.8871410	-0.81	0.416
14	NACE D	0.2461368	0.3155584	0.78	0.435
15	NACE E	-0.2019777	0.3638039	-0.56	0.579
16	NACE F	-0.1577642	0.1237474	-1.27	0.202
17	NACE G	-0.1950140	0.0836146	-2.33	0.020
18	NACE H	-0.1883729	0.1248225	-1.51	0.131
19	NACE I	-0.1010081	0.0969629	-1.04	0.298
20	NACE J	-0.0737845	0.1826955	-0.40	0.686
21	NACE K	-0.1327506	0.1203130	-1.10	0.270
22	NACE L	-0.2696328	0.1213721	-2.22	0.026
23	NACE M	-0.2294154	0.1140781	-2.01	0.044
24	NACE N	-0.0138500	0.1079309	-0.13	0.898
25	NACE O	-0.1510573	0.0907597	-1.66	0.096
26	NACE P	-0.1903601	0.1707463	-1.11	0.265
27	NACE Q	-0.2639135	0.1022324	-2.58	0.010
28	NACE R	0.3685364	0.3759394	0.98	0.327
29	NACE S	-0.0843404	0.1102427	-0.77	0.444
30	NACE T	0.1979234	0.1910086	1.04	0.300
31	NACE U	(reference)			
32	YEAR 2002	-0.8845741	0.0648686	-13.64	0.000
33	YEAR 2003	-0.7891009	0.0624716	-12.63	0.000
34	YEAR 2004	-1.3395620	0.0674459	-19.86	0.000
35	YEAR 2005	-1.1091810	0.0601959	-18.43	0.000
36	YEAR 2006	-0.9180255	0.0586510	-15.65	0.000
37	YEAR 2007	-0.9559141	0.0613606	-15.58	0.000
38	YEAR 2008	(reference)			
39	YEAR 2009	(reference)			
40	Constant	-11.1362100	0.4995615	-22.29	0.000

Summary Statistics:		
	number of observations	10405
	log-likelihood $\mathscr{L}(\hat{\beta})$	-3877.4475
	likelihood ratio index ρ^2	0.3152

Source: IREA, 2012

more differentiated dataset.

In chosing the utility parameters for their models, the majority of the research teams thus simply refers to the results of Stock and Wise (1990), that is to say they assume $\alpha = 1.36$ and $\gamma = 0.75$. The results from the grid search, however, suggest that in our case the likelihood of the econometric model increases as α increases and/or γ decreases. While the magnitude of the effect of the incentive measures increases along with the likelihood, the age-effect on retirement probabilities decreases until it eventually turns insignificant[3] (only for very low values of γ, see appendix D). To avoid this, we chose a boundary solution, $\alpha = 1.92$ and $\gamma = 0.56$, such that the significance of all variables is preserved while the likelihood of the model is maximised.

Table 6.3: Utility Parameters: Methods and Values

		BE	CA	DEN	FRA	GER	IT	JPN	NED	ESP	SWE	UK	US	**AUT**
exog.	α	1.36	1.36	1.36	-	-	1.25	1.36	1.36	1.25	-	1.36	1.36	-
	γ	0.75	0.75	0.75	-	1	1	0.75	0.75	1	0.75	0.75	0.75	-
	δ	0.97	0.97	0.97	0.97	0.97	0.985	0.97	0.97	0.97	0.97	0.97	0.97	**0.97**
grid search	α	-	-	-	1.12	2.8	-	-	-	-	3.19 (m) 1.18 (f)	-	-	**1.92**
	γ	-	-	-	0.25	-	-	-	-	-	-	-	-	**0.56**

Note: Countries taking $\alpha = 1.36$ and $\gamma = 0.75$ are referring to the structural model developed by Stock and Wise (1990).
Source: All country groups refer to Gruber and Wise (2002)

6.3 Estimation Results

As shown in the estimation tables 6.1 and 6.2, the parameter estimates of the incentive measures have the expected sign and are highly significant throughout the 12 specifications[4] (see appendix C for the complete set of estimates). In general, the stock of social security wealth (SSW_S) increases, while additional incentive measures ($ACCRA_S$, $PEAK_S$ or OV_S) decrease the probability to retire at planning age S. Though the magnitude of the effects varies, this pattern is found in all specifications (including the grid search) thus pointing to a robust relationship between the incentive structure and retirement behaviour.

With regard to the control variables the estimation results are also as expected. All other things held constant, an additional year of age increases the probability to retire, where the age indicators show that men and women are most likely to retire at ages 65 and 60 respectively. Additional peaks in the age indicators are observed at 50, 60 and 62 for men and at 57 for women, however, year and industry indicators display no particular pattern. Migrational background as well as days in sick leave (per year) both have a positive effect on retirement at planning age.

However, as no educational information is included in either of our data sources, we include averages of monthly income over the entire employment record to approximate educational attainments. As expected, a higher income potential corresponds to a lower probability of leaving the labour market. Regarding employment we include four different variables that are all measured on a days per year basis: regular employment, self-employment, fragmented employment and unemployment. While regular employment has a positive effect on retirement for males, the parameter turns insignificant in the female models, which fits well with the fact that

[3]As depicted in the two tables in appendix D our results suggest that, although it keeps on increasing, the likelihood function does not reach a maximum within reasonably defined boundaries. In a first round the grid search includes values of $\alpha \in [1,10]$ and $\gamma \in [0.25,1]$ in order to check for an eventual maximum. However, based on the results from the first round, the grid has been narrowed to $\alpha \in [1.88,2.07]$ and $\gamma \in [0.53,0.57]$.

[4]Only the accrual rate parameter in the age indicator specification shows a somewhat lower level of significance.

a considerable part of the female entitlements in the observed age cohorts are due to childcare periods. Self-employment turns out to be insignificant in most specifications, however, time spent in fragmented employment or unemployment has a significantly negative effect on retirement probabilities.

Although these results are qualitatively the same for different values of the two utility parameters, α and γ, the quantitative effects of the respective incentive measure increase as α increases and/or γ decreases. In general, the incentive effects are stronger in the specifications with age indicators, where the option value models reach the highest log-likelihood values thus resulting in likelihood ratio indices ρ^2 of 0.46 and 0.34 for females and males, respectively.

6.4 Discussion

Table 6.4 summarises signs and significance of the incentive measures in various model specifications[5], thus comparing parameter estimates among the countries collected in Gruber and Wise (2004). It suggests that the Austrian model compares quite favourably to the others, as incentives are significant and behave as expected throughout all specifications. We thus interpret our results as robust evidence of the effect of the incentive structure on retirement behaviour in Austria.

Table 6.4: International Comparison of Parameter Estimates

	ACCUAL RATE		PEAK VALUE		OPTION VALUE	
	LA	AD	LA	AD	LA	AD
BE	ACC -* SSW -*	ACC -* SSW -*	PEAK -* SSW -*	PEAK -* SSW -	OV -* SSW -*	OV -* SSW -*
CAN	ACC -* SSW +*	ACC -* SSW +*	PEAK -* SSW +*	PEAK -* SSW +*	OV -* SSW +*	OV -* SSW +*
DEN	ACC +* SSW +*	ACC -* SSW +*	PEAK -* SSW +*	PEAK -* SSW +*	OV -* SSW +*	OV -* SSW +*
FRA	ACC -* SSW-*	ACC -* SSW -*	PEAK -* SSW -*	PEAK -* SSW -	OV -* SSW -*	OV -* SSW -*
GER	ACC -* SSW -	ACC -* SSW -	PEAK -* SSW -	PEAK -* SSW -	OV -* SSW -	OV -* SSW -*
IT	ACC -* SSW-*	ACC -* SSW -	PEAK + SSW +	PEAK - SSW -	OV + SSW +	OV - SSW +
JPN	ACC -* SSW +	ACC -* SSW-	PEAK -* SSW -	PEAK -* SSW -	OV -* SSW +	OV + SSW -
NED	ACC +* SSW +*	ACC +* SSW +	PEAK -* SSW +*	PEAK -* SSW +*	OV -* SSW +*	OV -* SSW +*
ESP	ACC -* SSW +	ACC + SSW +*	PEAK -* SSW -	PEAK + SSW +	OV - SSW +	OV + SSW +
SWE	ACC -* SSW +*	ACC - SSW +*	PEAK -* SSW +*	PEAK -* SSW +*	OV -* SSW +*	OV -* SSW +*
UK	ACC -* SSW +*	ACC - SSW +*	PEAK - SSW +*	PEAK - SSW +*	OV -* SSW +*	OV -* SSW +*
US	ACC +* SSW +*	ACC + SSW +	PEAK -* SSW +*	PEAK -* SSW +*	OV -* SSW +*	OV -* SSW -*
AUT	ACC -* SSW +*	ACC -* SSW +*	PEAK -* SSW +*	PEAK -* SSW +*	OV -* SSW +*	OV -* SSW +*

Notes: This table summarises information from Gruber and Wise (2004), where +/- indicate the sign of the corresponding parameter and * indicates singnificance at 5% level. Although the Austrian model distinguishes between the genders, we summarise both specifications in one line since results are qualitatively similar.

Since the effect of a given change in the pension system is determined by changes in the wealth level as well as in the forward-looking incentive measure, the quantitative relevance of our estimation results is best judged through simulations. While the latter will be discussed in depth in chapter 7, the following section evaluates the performance of our estimates with regard to several (internal) dimensions. First, we calculate expected

[5]Note that most authors did not estimate seperate models for females and males.

Table 6.5: Retirement Ages: Simulated and Empirical

	males			females		
retirement plan	empirical	OV-LA	OV-AD	empirical	OV-LA	OV-AD
AP	65.08	64.03	63.86	60.08	59.31	59.45
VAPL	60.67	60.01	60.08	56.27	56.02	56.05
KOP	62	60.15	60.23	-	-	-
BU	56.70	56.96	56.85	54.33	54.81	54.66
EU	57.17	57.13	57.02	56.38	56.35	56.41
IP	56.58	56.75	56.61	54.86	55.26	55.16

Note: OV-LA and OV-AD refer to the option value specification with linear age and age indicators, respectively.
Source: IREA, 2012

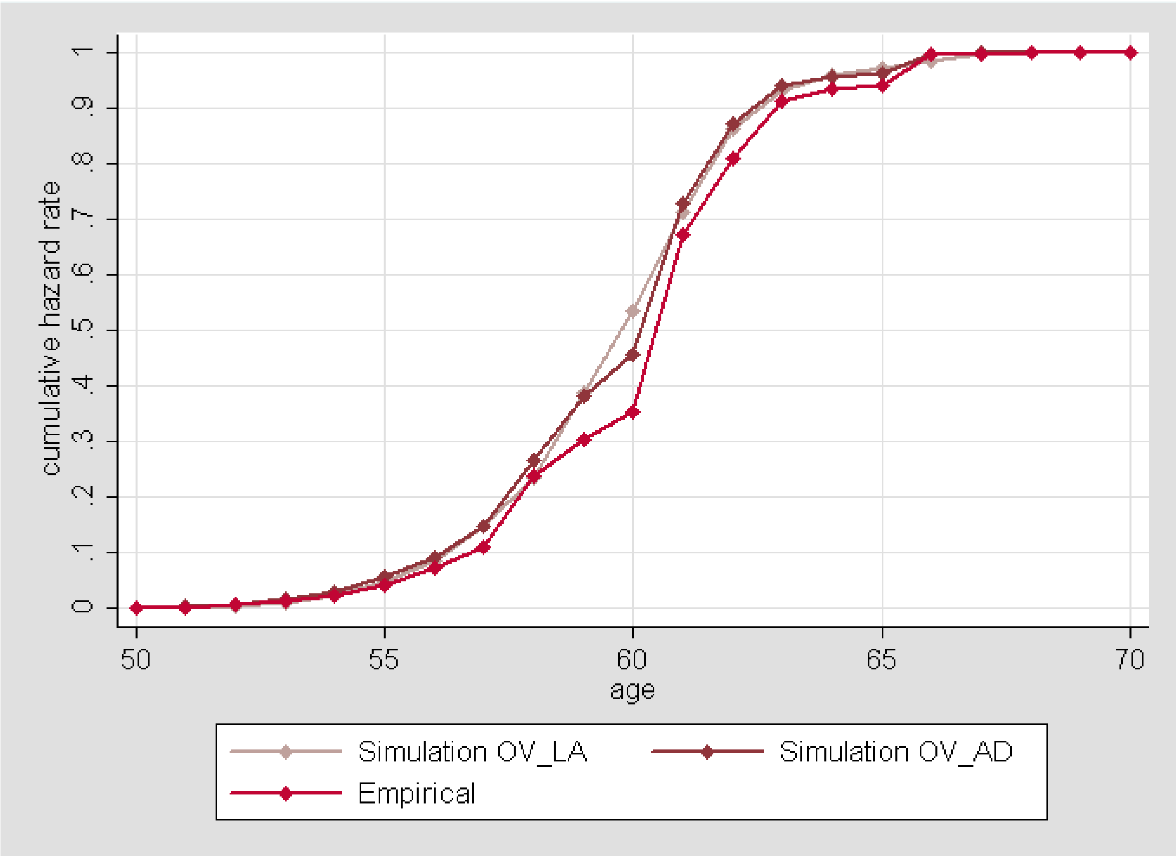
retirement ages by retirement plan and gender as simulated by the option value model and compare these to the average retirement ages in our data. The results are summarised in table 6.5, where we distinguish between option value specifications with linear age (OV-LA) and age indicators (OV-AD).

The table shows that the simulations typically underestimate retirement ages for regular retirement plans (AP, VAPL, KOP) while slightly overestimating them for the disability options (BU, EU, IP). In case of the old-age retirement plan (AP) male estimates are about one year below the observed average, though female estimates are closer. Simulated retirement ages in the pre-retirement plan due to long insurance history (VAPL), which is by far the most common pathway to retirement (cf. table 3.3), are generally very close to the observed values. The characteristics of the other pre-retirement plan (KOP), however, are harder to account for, thereby resulting in comparatively large differences. Our approach with regard to the disability options, on the other hand, appears to capture observed behaviour quite well, as the results for all three options (BU, EU, IP) are very close to empirical averages.

In addition, we compute empirical cumulative hazard rates and plot them against the simulation results in figures 6.1 and 6.2. For both genders, it is apparent that the simulations fit the observed retirement data very well. Though the specifications with linear age are not capable of reproducing the observed kinks at 60 (for males and females) and 65 (males only), the inclusion of age indicators yields almost exactly the same structure.

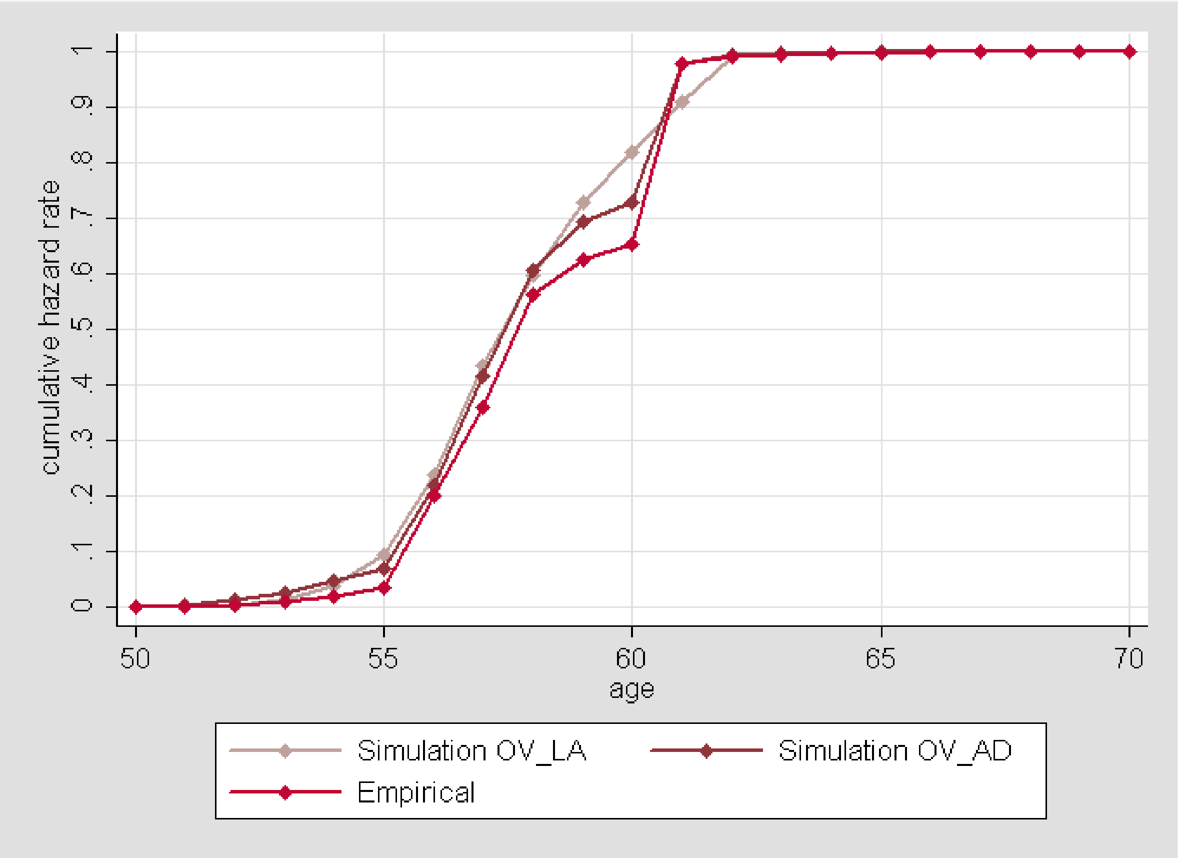
A range of further empirical results emerge from these two figures. Both show that until the age of 55 only less than 10% of the individuals in our dataset have already left the labour market. Starting at that age, however, females begin to drop out very rapidly, so that female retirees account for around 35% at age 57 and 60% at ages 58 and 59. At statutory retirement age, 60, 65% of the female work force in our dataset is already retired. After a further shift into retirement at 60, almost none of the females remains employed. For males, the picture shifts somewhat to the right. Although 90% are still working at age 57, a considerable amount drops out in the next 3 years, resulting in 35% already being retired at age 60. As for the females, many leave the labour market at this age so that only 10% of the male labour force remains at ages 61-63. Only a fraction of these workers continues to be employed until the statutory retirement age, 65, is reached. After that age the amount of individuals who are still in the labour market is negligible.

Figure 6.1: Male Cumulative Hazard Rates: Simulated and Empirical



Notes: OV-LA and OV-AD refer to the option value specification with linear age and age indicators respectively. Empirical hazard rates are computed on the basis of the estimation subsample, see section 6.1.
Source: IREA, 2012

Figure 6.2: Female Cumulative Hazard Rates: Simulated and Empirical



Notes: OV-LA and OV-AD refer to the option value specification with linear age and age indicators respectively. Empirical hazard rates are computed on the basis of the estimation subsample, see section 6.1.
Source: IREA, 2012

Chapter 7

IREA: Simulations

7.1 General Setting

This section presents a range of simulations that have been run on the basis of the estimation results as discussed in the previous chapter (cf. 6.3). The simulations serve two main purposes. First, we want to apply the estimated parameters from the full set of specifications so as to check external validity and make sure that no unexpected results arise. Second, having discussed signs and significance of the estimated parameters, we need to consider simulations in order to assess the full quantitative effects of a given change in the incentive structure on retirement behaviour.

To this end we implement two standard reforms as laid out in Gruber and Wise (2004). The first reform evaluates the effect of an increase in the statutory retirement age by three years (3Y), while the second common reform scenario pronounces financial incentives through additional bonuses and deductions (CR). As a more policy relevant application, we also shortly discuss the abolition of the hard-worker-rule, which is a specific pathway into retirement that was originally aimed at blue-collar workers (see 5.3).

For the simulations we make use of an extended dataset which includes every individual not only until observed retirement date, but until the end of the observational period in 2009[1]. We chose the option value model[2] as the basis for the simulations because, on the one hand, its representation of individual behaviour is more in line with economic theory and, on the other hand, due to its advantage in terms of explanatory power (cf. 6.3). However, to abstract from idiosyncratic temporal effects we use estimation results from the linear age specification (OV-LA). Though, in this section, results will be discussed on the basis of only one model, simulation results are reported for every model specification in appendix C.

The baseline scenario is defined such that it represents the Austrian pension system exactly as it has been faced by the individual decision makers in the corresponding year of the observational period 2002-2009[3]. To evaluate counterfactuals against this baseline we implement each of the reform scenarios on the basis of exactly the same time period. However, since amendments of the retirement legislation are typically implemented over a

[1]Note that we exclude individuals who are either below 50 at the beginning, or above 70 at the end of the observational period.
[2]As discussed earlier, the option values are calculated on the basis of a 5-year planning horizon.
[3]Note that there existed considerable diversity with regard to retirement regulations within this time period, see 5.3.

medium to long term horizon, a comprehensive prediction of future retirement behaviour would entail a careful representation of the implementation process, depending not only on the reform scenarios but also on expected changes in future regulations as formulated by current law. Although such predictions of future scenarios are perfectly feasible on the basis of our model, the simulations we present in this section serve to evaluate what would have been the case if reforms were enacted within the baseline period.

7.2 Scenario Description

7.2.1 Postponement of Statutory Retirement Ages (3Y)

The first reform scenario postpones statutory retirement ages for all regular retirement plans by three years, thus implying the following structure compared to the status quo described in 5.3:

- AP: old-age retirement at 68 and 63 for men and women respectively
- VAPL: pre-retirement due to long insurance record is generally depending on the cohort, 63-68 for men and 58-63 for women
- KOP: pre-retirement through the corridor option is possible at 65
- Hard-worker-rule remains in effect now allowing for retirement at 63 for men and 58 for women
- Disability options (BU, EU, IP) remain unchanged as eligibility depends on the health status

Since the availability of disability options mainly depends on the individual health status, eligibility regulations for these retirement plans remain as described in 5.4. This, however, does not imply that the reform fails to affect the incentive structure at earlier ages. Since expected incentive measures, as defined in equation 5.1, depend also on future eligibility for regular retirement plans, changes in the statutory retirement ages will affect incentives also through this channel.

7.2.2 Strengthening Financial Incentives (CR)

The second scenario aims at an unification of various retirement plans and a stronger pronounciation of the financial incentives delivered by the pension system. It is based on the common reform proposed by Gruber and Wise (2004), p.30-35.

- Unique statutory retirement at 65 (for men and women)
- Pre-retirement is possible beginning at age 60 for both genders
- Retirement benefits at statutory retirement age comprise 60% of labour income at age 59 (with a minimum of 300 euros/month)
- Benefits are reduced by 6% p.a. for each year before age 65
- Benefits are increased by 6% p.a. for each year after age 65

Again, in this case we model the disability options as before. However, as the pre-retirement character of the disability options is in conflict with the spirit of this reform scenario, it is necessary to make some further specifications. Although we keep access to the disability options open in this scenario, we apply the same deductions as for regular pre-retirement ages, that is 6% p.a. for each year prior to 65.

7.3 Discussion

To discuss simulation results we aggregate individual retirement probabilities by age and gender and compare aggregate results between base and reform scenarios. Specifically, we compute mean hazard rates as well as cumulative hazards for all age groups between 50 and 68 for females and 69 for males. In addition, we compute expected retirement ages at the beginning of the observational period, i.e. in 2002, and look at the proportion of individuals aged 56 to 65 that is out of the labour force (OLF).

Figure 7.1 shows female hazard rates in the baseline simulation with linear age (OV-LA) as well as in the reform scenarios 3Y (+3 years) and CR (common reform). Figure 7.3 has corresponding results from the model with age indicators (OV-AD). While in the former model hazard rates are smoothly increasing with age, the latter allows for fixed age effects which contribute to the observed peaks at 57, 60 and 65. Though the peak at age 60 is due to eligibility age effects alone, the increase in mean hazards in the age group 55-57 is likely to be related to the increased probability of obtaining disability pension. The peak at 65, however, might either correspond to interrelations with male eligibility or else be due to some social norm about the accepted (female) retirement age. Both specifications show that the reform scenarios reduce the average exit probability, though in the female case the decrease in the hazard rates due to the common reform is stronger throughout all age groups. As discussed in Gruber and Wise (2004), this is due to the fact that the common reform represents a rather harsh regime as compared to the current Austrian regulations (especially for women). The main driving forces are: (i) the common reform introduces a unique statutory retirement age of 65 for both genders, which is higher than the female retirement age in the base (60) as well as in the 3Y scenario (63); (ii) pre-retirement begins at age 60, which is again higher than in the other two scenarios (55-60 in the base and 58-63 in the 3Y scenario); and (iii) access to disability options is allowed only under considerable deductions and without the imposition of a maximum loss.

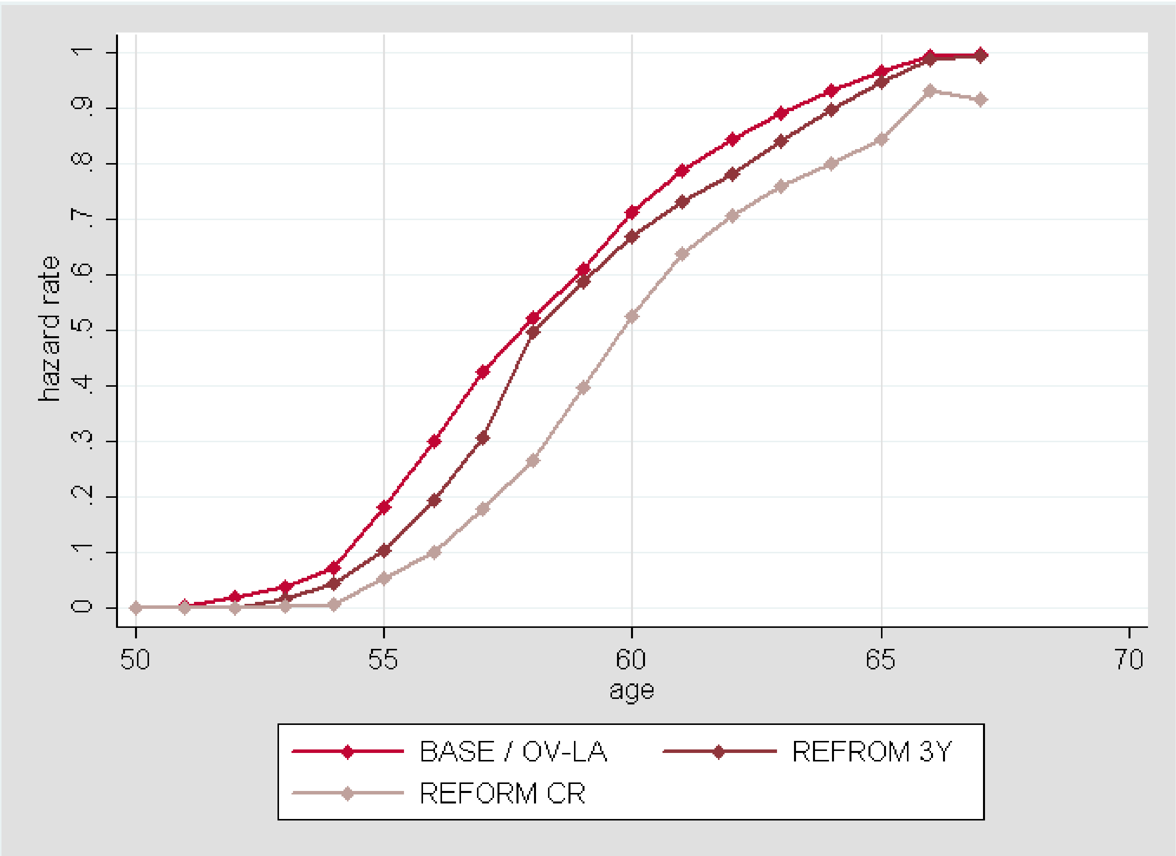
Table 7.1: Out of Labour Force Proportions

	BASE	3Y	CR
females	0.724	0.677	0.606
males	0.538	0.461	0.466

Source: IREA, 2012

The cumulative hazards in figure 7.5 confirm these results. While, in the baseline scenario about 18% of females are already out of the labour force at age 56, reform 3Y decreases this number to 10%, and the common reform reduces it even further, i.e. to 4%. Although the gap between the reform scenarios and the baseline increases with age for women in their 50s, it begins to narrow again at 60, so that (even in the common reform scenario) only very few females remain in the labour market after that age. Table 7.1 shows that these effects correspond to a reduction of the OLF proportion of females between 56 and 65 from 72.4% in the base to 67.7% and 60.6% in the 3Y and CR scenarios. Comparing these results to those in Gruber and Wise (2004) indicates that Austrian women in this age group have the second highest OLF proportion among all countries included in this volume. Although the abovementioned summary argues that dutch workers display a similar OLF proportion, it is shown that the common reform is likely to reduce it to less than 30%. However, our results imply that, although retirement behaviour of Austrian women is driven by incentives, the reduction due to an implementation of the common reform would be much lower (thus placing them closer to the Italian case).

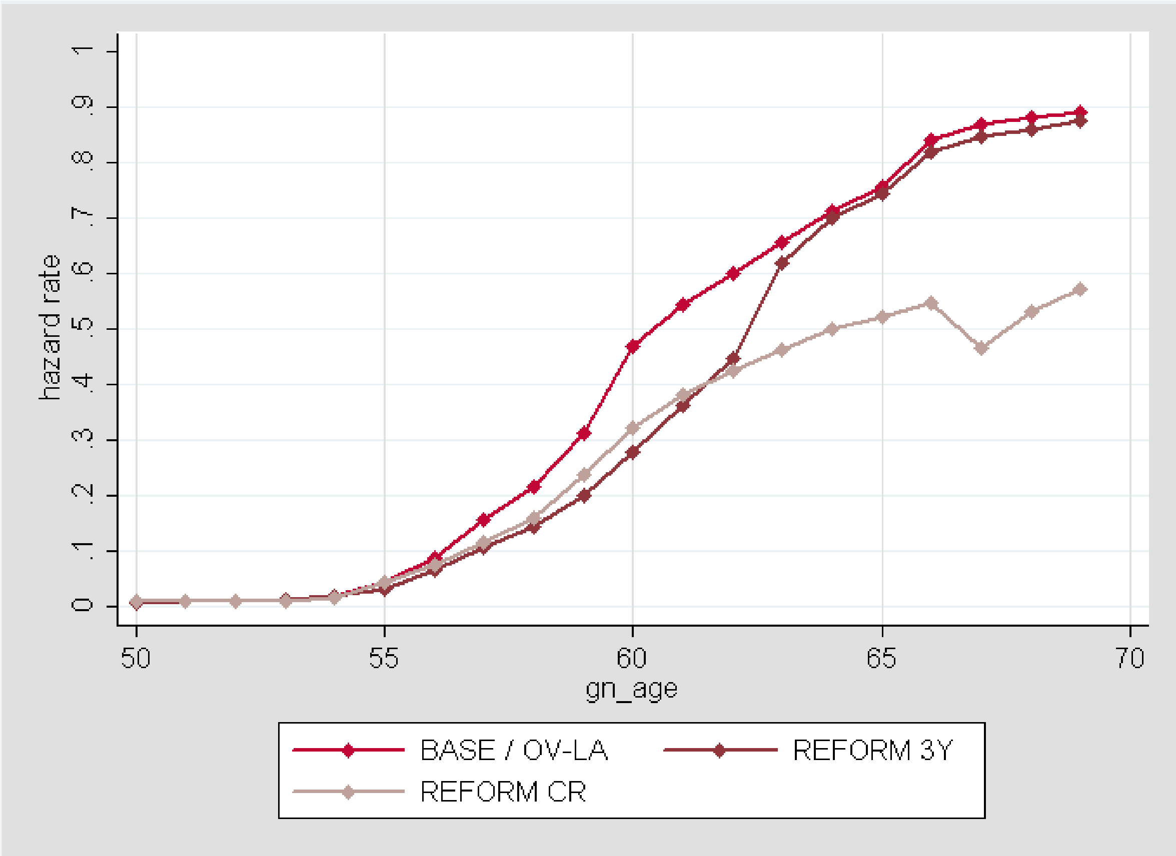
Figure 7.1: Female Hazard Rates by Age



Notes: This figure shows mean individual hazard rates by age in three different scenarios. OV-LA refers to the option value specification with linear age; 3Y refers to scenario 7.2.1 and CR to scenario 7.2.2.
Source: IREA, 2012

Although both reform scenarios decrease the hazard rates considerably, the two reform scenarios have more distinguished effects in the male case, see 7.2 and 7.4 for the model with linear age and age indicators, respectively. Results from the model with age indicators shows similar, though somewhat less pronounced, peaks at ages 57, 62 and 65. While the first of these is again related to the disability options, the second peak relates to pre-retirement eligibility (either through VAPL or KOP retirement plans) and the third to old-age eligibility.

Figure 7.2: Male Hazard Rates by Age

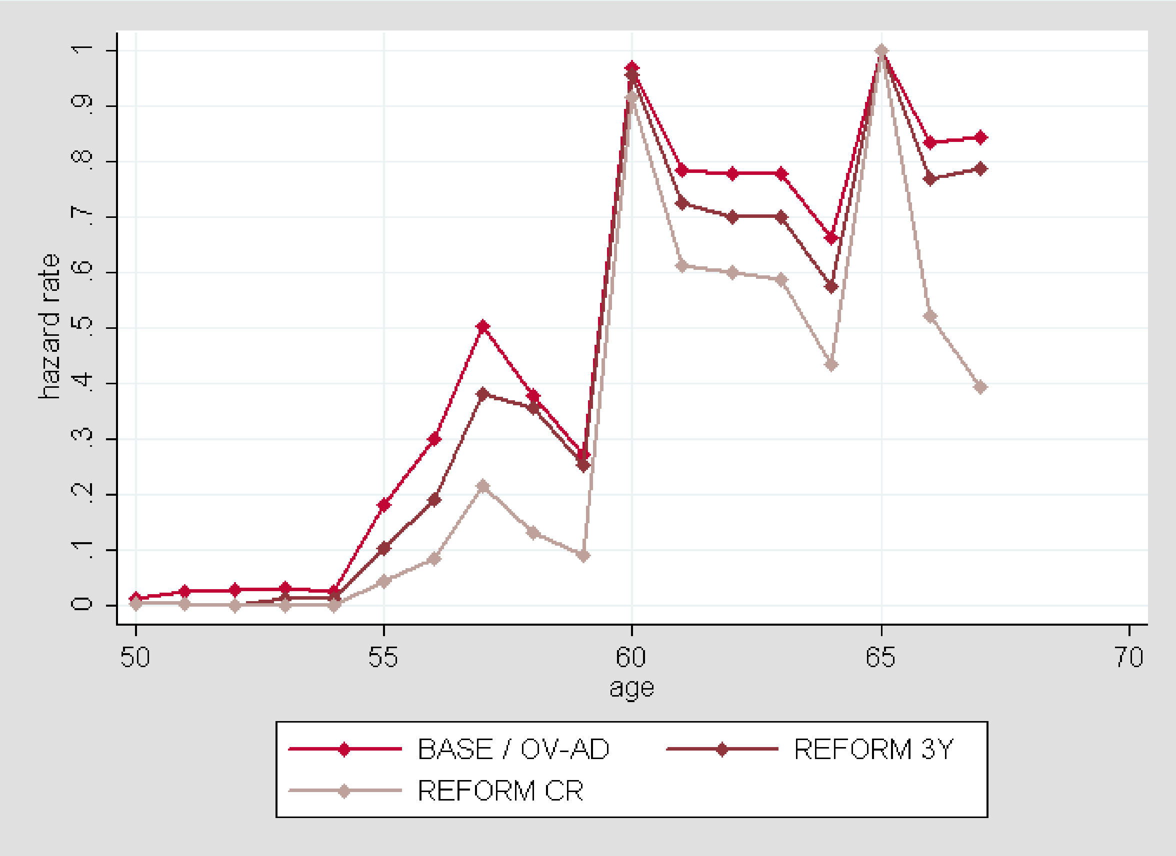


Notes: This figure shows mean individual hazard rates by age in three different scenarios. OV-LA refers to the option value specification with linear age; 3Y refers to scenario 7.2.1 and CR to scenario 7.2.2.
Source: IREA, 2012

Comparing the relative impact of the two reforms, however, indicates that the 3Y scenario implies lower hazard rates only for males between 55 and 61. This picture changes drastically as the hazard rates for males older than 61 show only a marginal decrease in the 3Y scenario relative to the base scenario. Since every retirement plan is adjusted by 3 years and the disability options are not subjected to increased deductions, the impact of the 3Y scenario peters out as soon as pre-retirement again becomes accessible starting at age 63. The common reform, on the other hand, has stronger effects for males in the age group 60-69. This result is in line with the fact that men, relative to women, show a much stronger response to incentive measures as indicated by the estimated parameters. Although the statutory retirement age is the same for men in the base scenario as compared to the common reform, the incentives introduced by the latter appear to yield strong impacts on male retirement behaviour well beyond pre-retirement ages.

These results are again reflected in the cumulative hazards in figure 7.6. In the baseline scenario 47% are out of the labour force at age 60, a number that is decreased to 38% and 34% in the common reform and

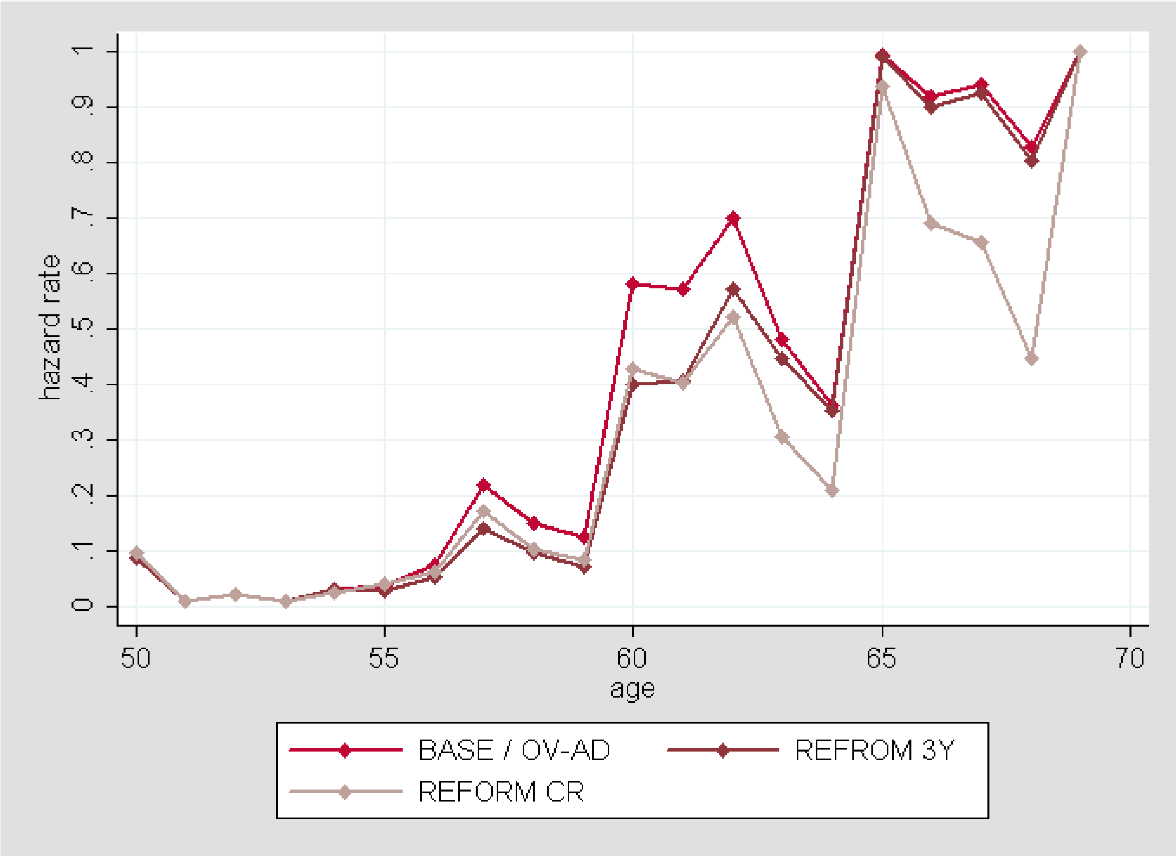
Figure 7.3: Female Hazard Rates by Age



Notes: This figure shows mean individual hazard rates by age in three different scenarios. OV-LA refers to the option value specification with linear age; 3Y refers to scenario 7.2.1 and CR to scenario 7.2.2.
Source: IREA, 2012

3Y scenarios respectively. While some positive difference between base and reform remains until age 65 in the 3Y scenario, the common reform scenario succeeds in extending male employment careers up until age 68. A comparison of these results with discussions in the previous paragraphs demonstrates large differences between Austrian men and women. On the one hand, males have a lower OLF proportion due to the current difference in statutory retirement ages, as depicted in table 7.1. On the other hand, they also show a stronger response to financial incentives, what gives rise to an increased scope for policy makers to influence male retirement behaviour. Although the common reform basically introduces the same incentive structure for both genders, it does therefore not fully succeed in bringing the female OLF proportion to about the same range as the male. As for international comparisons, Austrian men are in the middle ranges with regard to their OLF proportions. Although they are more responsive than their female counterparts, the impact of the reform scenarios is still not as high as for countries like Germany or the Netherlands. The same picture emerges from the consideration of expected retirement ages, see 7.2. While the general performance of our simulations in

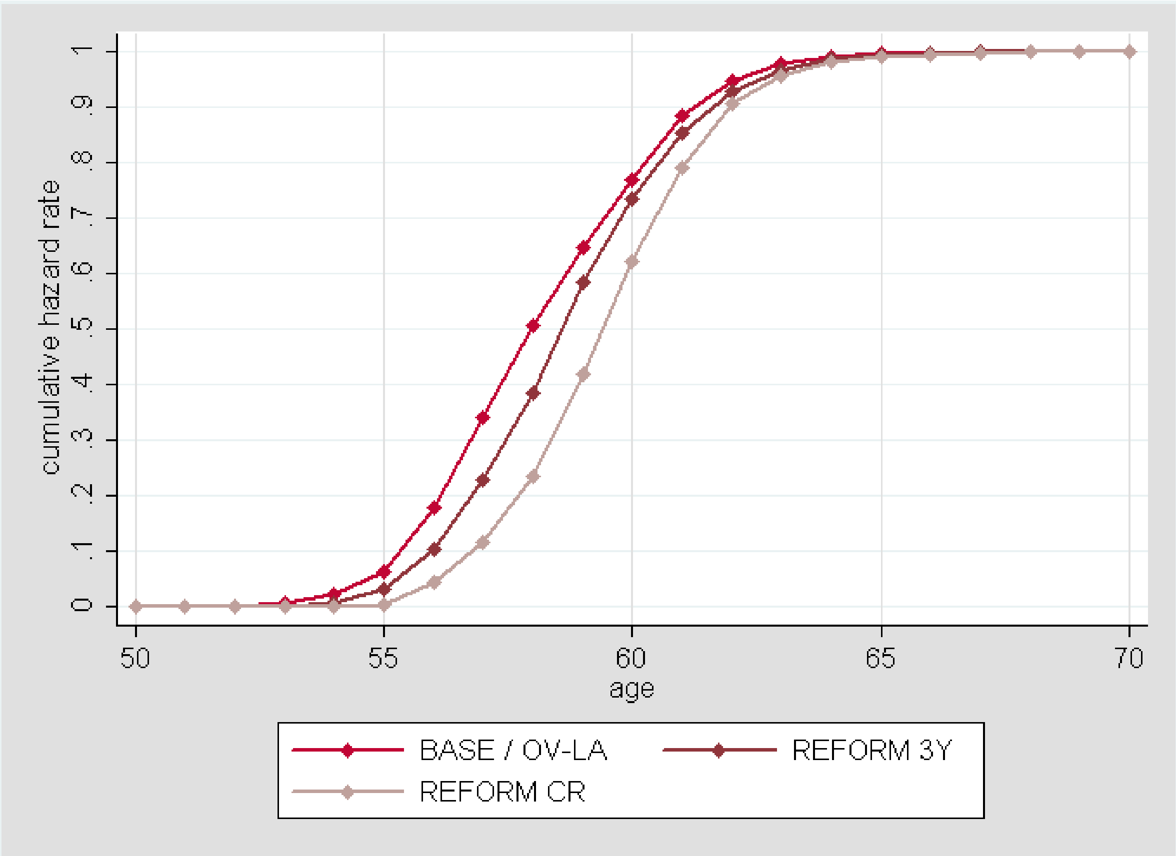
Figure 7.4: Male Hazard Rates by Age



Notes: This figure shows mean individual hazard rates by age in three different scenarios. OV-LA refers to the option value specification with linear age; 3Y refers to scenario 7.2.1 and CR to scenario 7.2.2.
Source: IREA, 2012

terms of this number has been discussed in section 6.4, evaluation of the reform scenarios indicates that both have the potential to increase male expected retirement ages by approximately 0.8-0.9 years on average. For females the corresponding increase in the 3Y scenario would be around 0.5 years, while reaching 1.4 years in the common reform scenario. In addition to these more general issues, we also evaluate another reform measure that is often brought up in Austrian policy debates, that is the abolition of the hard-worker rule. This rule basically represents a further pathway into retirement that allows for pre-retirement without any reductions at age 60 and 55 for males and females respectively, provided a certain amount of insurance contributions was accumulated over the entire employment career. This specific retirement pathway offers strong negative incentives with regard to a continuation of work, as no further increases in retirement benefits can be achieved once an individual is eligible. The last row in table 7.2 shows that, although only a fraction of the individuals is potentially eligible, the abolition of this rule alone yields an increase in the mean expected retirement ages of 0.2 and 0.1 years for males and females, respectively.

Figure 7.5: Female Cumulative Hazard Rates by Age



Notes: This figure shows mean cumulative hazard rates by age in three different scenarios. OV-LA refers to the option value specification with linear age; 3Y refers to scenario 7.2.1 and CR to scenario 7.2.2.

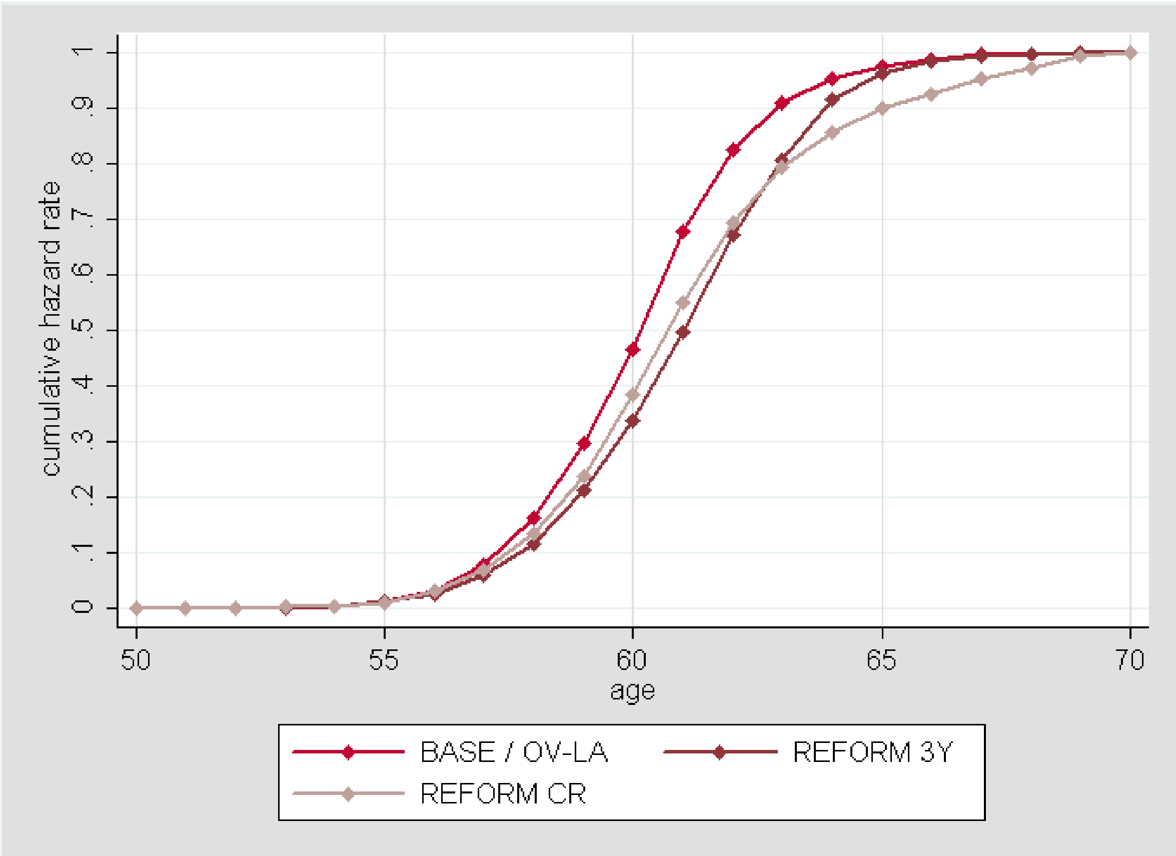
Table 7.2: Expected Retirement Ages

	exp. retirement		**difference**	
	females	males	females	males
BASE	**57.6**	**59.7**	-	-
3Y: plus 3 years	58.1	60.4	+ 0.5	+ 0.8
CR: common reform	59.0	60.6	+ 1.4	+ 0.9
hard-worker rule	57.7	59.9	+ 0.1	+ 0.2

Source: IREA, 2012

Although international comparison on the basis of the results in Gruber and Wise (2004) is hindered by the fact that current legislation differs substantially among countries, it is apparent from the results discussed in this section that the Austrian case is characterised by several features. Although the estimation results show a robust

Figure 7.6: Male Cumulative Hazard Rates by Age



Notes: This figure shows mean cumulative hazard rates by age in three different scenarios. OV-LA refers to the option value specification with linear age; 3Y refers to scenario 7.2.1 and CR to scenario 7.2.2.
Source: IREA, 2012

relationship between incentive measures and retirement behaviour, the overall quantitative impact appears to be somewhat lower than in other countries, especially when combined with the fact that actual retirement ages are among the lowest. This feature is highlighted through a comparison e.g. with the danish case, where the common reform yields an increase of 1.4 years for women and men alike. Germany, which is typically assumed to share some similarities in the institutional setting with Austria, also reports a stronger impact related to both reform scenarios, thus ranging up to 2.3 years for both genders. Another characteristic feature, which is of course related to the low actual retirement ages, is the existence of several disability options. Although we believe that our approach captures this feature quite well, a more comprehensive approach might be warranted, especially with regard to the transition from these forms of early retirement to regular retirement. A third relevant aspect might be hidden in the fact that the Austrian retirement regulations are characterised by a considerable degree of diversity, especially for individuals retiring within the time frame of our dataset. Due to this complexity (as well as the uncertainty related to potential future reforms), it is not entirely clear to what extend Austrian individuals are in fact capable of forming rational expectations about their future entitlements. However, as this situation will give way to more transparent regulations in the near future, it is to be expected that the observed incentive effects are strengthened along with this development.

Appendix

Appendix A

Variable Description

A.1 VVP Database - Verdichtung von Versicherungszeiten und Pensionsberechnung

Variables	Description	
id	ID made up from penr and lf_n	ID Nummer
penr	Personal Number	Personennummer
lf_ n	Sequential Number	Laufnummer
dn_male	Sex	Geschlech
dn_Gebjahr	Birth Year	Geburtsjahr
sdate	Pension Valuation Date (date variable)	Stichdatum
sjahr	Pension Valuation Year (date variable)	Stichjahr
smonat	Pension Valuation Month (date variable)	Stichmonat
bdate	Pension Notification Date (date variable)	Bescheiddatum
bjahr	Pension Notification Year (date variable)	Bescheidjahr
bmonat	Pension Notification Month (date variable)	Bescheidmonat
dn_age	Age at Pension Valuation Day	Alter zu Stichtag
dn_vstr	Insurance Carrier	Versicherungstraeger
dn_id_rla	Legal Situation	Rechtslage
dn_Waehrung	Currency	Waehrung
dn_PensArt	Pension Type	Pensionsart
dm_btr_anr	Pension Benefit	Pensionshoehe
dm_btr_stb	Pension Benefit without Child-Leave Periods and Additional Benefits	Pensionshoehe ohne Kinderersatzzeiten und Zusatzleistungen
dn_GKiez	Total Child-Leave Period	Gesamte Kinderersatzzeiten
dm_BPens	Gross Pension Income	Bruttopensionseinkommen
dn_summ_kiez_ges	Insurance Months of Child-Leave Period	Versicherungsmonate der Kinderersatzzeiten
dn_summ_fkiez	Uncapped Insurance Months of Child-Leave Period	Ungedeckelte Versicherungsmonate der Kinderersatzzeiten
dn_summ_ukiez_leistw	Capped Insurance Months of Child-Leave Period	Gedeckelte Versicherungsmonate der Kinderersatzzeiten
dn_VM_Leist	Sum of Insurance Months for Pension Benefit Calculation	Summe der Versicherungsmonate zur Berechnung der Leistungshoehe
dn_VM_Wart	Sum of Insurance Months for Fulfilling the Waiting Period	Summe der Versicherungsmonate zur Erfuellung der Wartezeit

dm_btr_bes_stb	Special Accrual Rate	Erhoehter Steigerunsbetrag
dn_proz_stb	Accrual Rate	Steigerungsbetrag
dm_BMG_ER	Assessment Base due to Employment	Bemessungsgrundlage aus Erwerbsarbeit
dm_BMG_GES	Assessment Base	Gesamtbemessungsgrundlage
dm_BMG_KIEZ	Assessment Base of Child-Leave Periods	Bemessungsgrundlage der Kinderersatzzeiten
dm_btr_leizu	Productivity Bonus	Leistungsbonus
dm_btr_boni	Bonus for Long Insurance	Bonifikation
dn_kz_au	Type of Labour Accident	Unfall, Krankheit, Dienstbeschaedigung
dn_kz_zwst	Inter-Country Pension Calculation	Zwischenstaatliche Pension
dn_datum_unfall	Date of Accident (date variable)	Unfallsdatum
dn_VstPenr	ID of dead Person	ID des Verstorbenen

A.2 ASSD (Austrian Social Security) Database - Arbeitsmarktdatenbank

redate	Labour Market Exit Date (date variable)	Beginn der ersten Renten Episode
rejahr	Labour Market Exit Year (date variable)	Erstes Rentenjahr
remonat	Labour Market Exit Month (date variable)	Erstes Rentenmonat
dn_amdb_stbg	Nationality	Staatsbuergerschaft
dn_migb	Migration Background	Migrationshintergrund
dn_edu	Educational Attainment	Bildungsstand
amdb_kst_#v	Sick Days per Year	Krankentage
	of the years 1995 until 2008	pro Jahr von 1995 bis 2008
amdb_as_1_#v	Main Occupation	Arbeitsmarktstatus im Jahr
	in the years 1978 until 2008	von 1978 bis 2008
	Seven categories (summarized from 30 categories):	7 Kategorien
	1 civil servants, employees	Beamte, Arbeiter, Angestellte
	2 farmers, self-employees	Landwirte, Selbststaendige
	3 trainees, marginally employed,	Lehre, geringfuegig beschaeftigt,
	freelancer	freier Dienstvertrag
	4 unemployed (with and without benefits)	Arbeitslos (mit und ohne Leistungsbezug)
	5 maternity benefits, child-care allowances	Wochengeld, Kinderbetreuungsgeldbezug
	6 pensioners, civil servants	Erwerbspension, Zivildienst,
		sonstige Versicherungszeiten
	7 no data	keine Daten, generierte Nullzeiten
amdb_nace_#v	NACE Industry Indicator	NACE Industrieindikator
	of the Years 1978 until 2008	im Jahr von 1978 bis 2008
	A Agriculture,Forestry,Fishing	
	B Mining,Quarrying	
	C Manufacturing	
	D Electricity,Gas, etc.	
	E Watersupply,WasteManagement	
	F Construction	
	G Wholesale and Retail Trade	
	H Transporting,Storage	
	I Accomodation,FoodService	
	J Information,Communication	
	K Financial,InsuranceActivities	
	L Real Estate Activities	
	M Professional,Scientific, TechnicalActivities	
	N Admin.,Support Service	
	O PublicAdministration, Defence, Social Security	
	P Education	
	Q HumanHealth,SocialAffairs	
	R Arts,Entertainment,Recreation	
	S Other service activities	
	T Activities of Households as Employers	
	U Activities of Extraterritorial Organisations	

Appendix B

Empirical Incentive Measures

Table B.1: Option Value by Age

	Women							Men						
Age	p10	p25	p50	p75	p90	mean	sd	p10	p25	p50	p75	p90	mean	sd
47	-213	223	683	965	1,212	577	550	414	963	1,353	1,627	1,848	1,255	550
48	362	822	1,098	1,363	1,623	1,041	484	543	1,102	1,483	1,766	1,979	1,395	564
49	591	970	1,218	1,476	1,719	1,177	441	608	1,179	1,573	1,865	2,112	1,493	586
50	645	1,031	1,342	1,741	2,146	1,364	565	697	1,229	1,617	1,911	2,178	1,547	580
51	641	1,044	1,366	1,739	2,078	1,365	546	700	1,282	1,649	1,949	2,224	1,582	591
52	481	977	1,287	1,616	1,889	1,255	529	613	1,228	1,605	1,898	2,155	1,523	595
53	205	801	1,114	1,399	1,667	1,064	512	591	1,189	1,532	1,796	1,978	1,436	547
54	85	610	917	1,179	1,448	878	478	486	1,017	1,396	1,660	1,864	1,293	529
55	-83	94	646	1,040	1,349	632	578	303	767	1,239	1,561	1,804	1,142	552
56	-170	1	346	873	1,279	479	618	132	493	1,057	1,349	1,555	934	535
57	-197	-113	188	747	1,241	387	663	-3	396	907	1,145	1,297	786	514
58	-217	-130	129	644	1,176	334	673	-38	449	736	915	1,248	690	490
59	-219	-91	147	574	1,125	337	713	-49	301	484	717	1,069	521	470
60	-139	-33	77	374	909	279	706	-183	-119	-28	477	860	208	550
61	-135	-47	29	265	751	225	698	-241	-144	-90	199	586	83	542
62	-203	-93	-20	158	594	157	740	-350	-186	-128	8	317	-23	529
63	-189	-108	-44	101	481	130	816	-381	-212	-147	-67	227	-64	520
64	-216	-144	-83	17	332	72	845	-390	-223	-159	-78	241	-74	509
65	-264	-196	-131	-74	178	1	967	-418	-232	-134	-28	65	-87	550
66	-334	-233	-155	-107	78	-29	1,353	-449	-274	-225	-98	26	-145	621
67	-384	-303	-194	-135	-22	-64	1,819	-477	-275	-241	-125	5	-162	661
68								-316	-260	-201	-99	63	-113	546
69								-336	-243	-180	-121	25	-129	409
70								-390	-270	-240	-151	15	-161	419
71								-413	-289	-250	-174	-33	-179	443
72								-432	-311	-259	-194	-57	-181	532
Total	-165	-23	324	1,023	1,459	540	761	-223	-117	378	1,061	1,561	518	755

Source: IREA, 2012

Table B.2: Peak Value by Age

	Women							Men						
Age	p10	p25	p50	p75	p90	mean	sd	p10	p25	p50	p75	p90	mean	sd
47	-16,585	-9,321	-4,538	-2,572	-1,411	-6,861	6,785	-611	1,918	4,293	9,714	20,042	7,299	10,189
48	-3,940	-973	-476	-266	544	-883	3,760	2,512	4,691	8,310	14,895	25,259	11,799	11,573
49	222	370	853	2,045	4,121	1,824	3,402	4,056	7,155	12,147	19,561	30,523	15,395	12,762
50	764	1,446	4,015	15,800	28,662	9,891	11,850	4,767	7,878	13,304	21,337	31,991	16,536	13,119
51	1,216	2,659	8,228	23,764	36,864	14,457	14,317	5,603	9,333	14,643	22,315	32,780	17,613	13,130
52	-1,978	1,490	9,066	28,235	42,797	15,813	17,288	5,296	8,765	13,432	20,160	30,054	16,230	12,516
53	-1,703	771	5,415	28,638	45,609	15,401	18,686	3,970	6,399	10,012	15,243	23,775	12,511	10,697
54	-362	781	4,858	28,258	46,539	15,395	19,548	2,614	4,525	6,975	10,809	17,459	9,075	8,756
55	-13,158	-1,940	3,177	12,040	30,153	6,608	18,116	-4,870	-3,355	1,517	4,767	9,909	2,108	7,883
56	-18,828	-3,877	3,372	9,712	19,619	2,772	19,321	-5,384	-4,056	-1,224	1,000	4,110	-812	5,569
57	-20,958	-11,980	2,375	11,134	18,996	1,267	27,739	-6,290	-4,865	-2,821	-338	1,608	-2,439	4,800
58	-22,094	-14,628	874	12,970	22,527	1,040	23,829	-6,778	-4,969	-2,273	1,963	5,470	-1,370	7,232
59	-21,754	-14,036	1,517	18,541	28,389	3,933	33,266	-6,788	-4,731	-1,252	6,820	10,647	897	14,423
60	-11,270	-6,033	3,726	16,102	25,445	7,401	42,052	-24,462	-20,294	-6,380	-1,462	5,346	-9,172	26,749
61	-11,269	-6,560	2,539	12,754	20,742	5,714	33,272	-25,347	-22,491	-14,594	-2,562	4,429	-11,697	27,097
62	-17,260	-9,610	741	9,748	16,168	2,392	40,623	-26,396	-24,330	-18,446	-7,910	3,403	-14,342	28,354
63	-16,454	-7,665	1,210	8,123	12,480	2,121	66,486	-27,437	-25,560	-19,837	-10,662	-11	-15,974	27,767
64	-18,029	-10,630	-1,162	4,439	8,172	-764	59,417	-28,310	-26,378	-20,434	-11,605	2,339	-16,246	22,809
65	-21,518	-14,111	-3,693	1,074	4,720	-3,940	100,206	-28,778	-23,514	-16,432	-10,462	-1,003	-14,987	31,714
66	-21,638	-14,742	-7,500	-797	1,696	-3,843	206,823	-36,218	-32,281	-23,839	-13,923	-1,302	-20,485	48,203
67	-21,308	-15,167	-10,022	-4,007	-61	-2,640	321,071	-37,187	-34,000	-24,893	-14,389	-1,930	-21,479	63,975
68								-35,987	-32,401	-19,512	-5,693	157	-18,058	29,478
69								-32,600	-28,942	-18,441	-6,083	-983	-17,458	14,536
70								-36,239	-34,523	-20,393	-6,690	-1,943	-19,833	13,673
71								-36,540	-34,866	-20,002	-7,972	-2,984	-20,333	13,437
72								-36,576	-35,758	-20,534	-10,108	-4,004	-21,081	13,456
Total	-15,872	-3,719	2,897	13,881	28,252	6,069	43,522	-25,004	-15,861	-3,559	3,576	10,552	-4,844	24,296

Source: IREA, 2012

Table B.3: Accrual Rate by Age

	Women							Men						
Age	p10	p25	p50	p75	p90	mean	sd	p10	p25	p50	p75	p90	mean	sd
47	-0.60	-0.57	-0.52	-0.45	-0.38	-0.50	0.10	-0.15	-0.08	-0.05	0.01	0.13	-0.01	0.18
48	-0.49	-0.47	-0.42	-0.35	-0.29	-0.39	0.13	-0.07	0.08	0.12	0.17	0.32	0.14	0.20
49	-0.28	-0.26	-0.23	-0.18	-0.14	-0.20	0.14	0.01	0.18	0.27	0.33	0.47	0.28	0.24
50	-0.05	-0.03	-0.01	0.02	0.07	0.02	0.15	0.08	0.26	0.39	0.46	0.57	0.38	0.25
51	-0.01	-0.01	0.11	0.20	0.26	0.13	0.20	0.12	0.27	0.45	0.53	0.62	0.43	0.26
52	-0.01	-0.01	-0.01	0.18	0.32	0.08	0.19	0.13	0.24	0.44	0.52	0.62	0.42	0.25
53	-0.01	-0.01	-0.01	0.13	0.33	0.08	0.18	0.12	0.24	0.42	0.54	0.60	0.41	0.22
54	-0.01	-0.01	0.00	0.18	0.26	0.09	0.14	0.09	0.19	0.36	0.43	0.48	0.33	0.18
55	-0.04	-0.02	-0.01	0.00	0.05	0.00	0.05	-0.02	-0.01	0.05	0.25	0.33	0.13	0.17
56	-0.06	-0.02	-0.01	0.00	0.02	-0.01	0.04	-0.02	-0.02	-0.01	0.04	0.18	0.04	0.10
57	-0.06	-0.04	-0.01	0.00	0.02	-0.01	0.03	-0.09	-0.03	-0.02	-0.01	0.00	-0.02	0.06
58	-0.06	-0.05	-0.01	0.00	0.01	-0.02	0.03	-0.09	-0.02	-0.02	-0.01	-0.01	-0.03	0.05
59	-0.06	-0.05	-0.01	0.04	0.08	0.00	0.06	-0.03	-0.02	-0.01	0.02	0.03	-0.02	0.08
60	-0.04	-0.02	0.01	0.04	0.07	0.01	0.04	-0.06	-0.06	-0.03	-0.01	0.00	-0.03	0.03
61	-0.04	-0.02	0.01	0.04	0.06	0.01	0.04	-0.07	-0.06	-0.05	-0.02	0.00	-0.04	0.03
62	-0.05	-0.03	0.00	0.03	0.05	0.00	0.04	-0.07	-0.06	-0.06	-0.03	-0.01	-0.05	0.03
63	-0.05	-0.03	0.00	0.03	0.04	0.00	0.04	-0.07	-0.07	-0.06	-0.04	-0.02	-0.05	0.02
64	-0.06	-0.04	-0.01	0.02	0.03	-0.01	0.04	-0.08	-0.07	-0.07	-0.04	0.00	-0.05	0.04
65	-0.07	-0.06	-0.02	0.00	0.01	-0.03	0.04	-0.08	-0.07	-0.05	-0.04	-0.01	-0.05	0.03
66	-0.07	-0.07	-0.04	-0.01	0.01	-0.04	0.03	-0.09	-0.09	-0.08	-0.05	-0.01	-0.06	0.04
67	-0.07	-0.07	-0.06	-0.03	0.00	-0.05	0.03	-0.09	-0.09	-0.09	-0.06	-0.01	-0.07	0.04
68								-0.10	-0.09	-0.07	-0.03	0.00	-0.06	0.04
69								-0.09	-0.09	-0.08	-0.04	-0.01	-0.06	0.03
70								-0.10	-0.10	-0.09	-0.04	-0.02	-0.07	0.03
71								-0.11	-0.10	-0.10	-0.05	-0.03	-0.08	0.03
72								-0.11	-0.11	-0.10	-0.07	-0.04	-0.09	0.03
Total	-0.05	-0.02	-0.01	0.02	0.11	0.01	0.11	-0.07	-0.06	-0.02	0.01	0.31	0.03	0.18

Source: IREA, 2012

Appendix C

Estimation Results

Table C.1: Disability

#	MALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	age	-8.9229960	2.8170100	-3.17	0.002
2	age^2	0.1757204	0.0508968	3.45	0.001
3	age^3	-0.0011420	0.0003059	-3.73	0.000
4	migration	0.1208689	0.0371022	3.26	0.001
5	avg. monthly income	-0.0000846	0.0000248	-3.41	0.001
6	sick leave	0.0015879	0.0001532	10.36	0.000
7	regular employment	0.0000979	0.0000311	3.15	0.002
8	self-employment	0.0002069	0.0000178	11.65	0.000
9	fragmented employment	0.0001773	0.0001056	1.68	0.093
10	unemployment	0.0002806	0.0000261	10.77	0.000
11	NACE A	0.0432546	0.0154226	2.80	0.005
12	NACE B	-0.0042950	0.0267653	-0.16	0.873
13	NACE C	0.0317609	0.0106440	2.98	0.003
14	NACE D	0.0176789	0.0140274	1.26	0.208
15	NACE E	0.0357124	0.0195022	1.83	0.067
16	NACE F	0.045759	0.0102780	4.45	0.000
17	NACE G	0.0241075	0.0107396	2.24	0.025
18	NACE H	0.0321721	0.0112446	2.86	0.004
19	NACE I	0.0451574	0.0112343	4.02	0.000
20	NACE J	0.0134792	0.0153328	0.88	0.379
21	NACE K	0.0137407	0.0123669	1.11	0.267
22	NACE L	0.0412128	0.0135569	3.04	0.002
23	NACE M	0.0186414	0.0128761	1.45	0.148
24	NACE N	0.0470014	0.0126390	3.72	0.000
25	NACE O	0.0216844	0.0110532	1.96	0.050
26	NACE P	0.0360243	0.0198986	1.81	0.070
27	NACE Q	0.0391706	0.0138466	2.83	0.005
28	NACE R	0.0454607	0.0155593	2.92	0.003
29	NACE S	0.0158934	0.0142941	1.11	0.266
30	NACE T	0.1537665	0.0661521	2.32	0.020
31	NACE U	0.0085322	0.0392446	0.22	0.828
32	YEAR 2002	-1.0211470	0.1378691	-7.41	0.000
33	YEAR 2003	-1.1390660	0.1352163	-8.42	0.000
34	YEAR 2004	-1.4999060	0.1436022	-10.44	0.000
35	YEAR 2005	-1.7224880	0.1341509	-12.84	0.000
36	YEAR 2006	-1.8357530	0.1336559	-13.73	0.000
37	YEAR 2007	-2.0029500	0.1367518	-14.65	0.000
38	YEAR 2008	-2.0487630	0.1347887	-15.20	0.000
39	YEAR 2009	-2.2701420	0.1364330	-16.64	0.000
40	Constant	148.2981000	51.8631800	2.86	0.004

Summary Statistics:		
	number of observations	13616
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3127.9204
	likelihood ratio index ρ^2	1290.19
	likelihood ratio index ρ^2	0.1710

Source: IREA, 2012

Table C.2: Disability

#	FEMALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	age	-40.3380400	5.3817150	-7.50	0.000
2	age^2	0.7615687	0.1003164	7.59	0.000
3	age^3	-0.0047784	0.0006221	-7.68	0.000
4	migration	0.1802927	0.0458683	3.93	0.000
5	avg. monthly income	-0.0002371	0.0000617	-3.85	0.000
6	sick leave	0.0009780	0.0001613	6.06	0.000
7	regular employment	-0.0000702	0.0000407	-1.72	0.085
8	self-employment	0.0001089	0.0000138	7.89	0.000
9	fragmented employment	0.0000213	0.0000604	0.35	0.724
10	unemployment	0.0001217	0.0000323	3.77	0.000
11	NACE A	0.0274589	0.0285609	0.96	0.336
12	NACE B	(reference)			
13	NACE C	0.0412519	0.0150957	2.73	0.006
14	NACE D	(reference)			
15	NACE E	0.0933529	0.0619484	1.51	0.132
16	NACE F	0.0357456	0.0183218	1.95	0.051
17	NACE G	0.0238352	0.0151875	1.57	0.117
18	NACE H	0.0324083	0.0171512	1.89	0.059
19	NACE I	0.0437480	0.0144386	3.03	0.002
20	NACE J	-0.0774121	0.0930992	-0.83	0.406
21	NACE K	0.0210659	0.0175852	1.20	0.231
22	NACE L	0.0269948	0.0181060	1.49	0.136
23	NACE M	0.0135092	0.0183571	0.74	0.462
24	NACE N	0.0554348	0.0165710	3.35	0.001
25	NACE O	0.0357680	0.0151686	2.36	0.018
26	NACE P	0.0200142	0.0244480	0.82	0.413
27	NACE Q	0.0402572	0.0163325	2.46	0.014
28	NACE R	0.0210766	0.0254283	0.83	0.407
29	NACE S	0.0422131	0.0168633	2.50	0.012
30	NACE T	-0.1612355	0.1274692	-1.26	0.206
31	NACE U	(reference)			
32	YEAR 2002	-1.245375	0.1870122	-6.66	0.000
33	YEAR 2003	-1.541068	0.1830589	-8.42	0.000
34	YEAR 2004	-1.705531	0.1885476	-9.05	0.000
35	YEAR 2005	-1.984252	0.1831530	-10.83	0.000
36	YEAR 2006	-2.181083	0.1820537	-11.98	0.000
37	YEAR 2007	-2.188116	0.1847223	-11.85	0.000
38	YEAR 2008	-2.371205	0.1827918	-12.97	0.000
39	YEAR 2009	-2.458082	0.1841069	-13.35	0.000
40	Constant	709.991003	96.0413000	7.39	0.000

Summary Statistics:		
	number of observations	14408
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-1748.6792
	likelihood ratio index ρ^2	0.1822

Source: IREA, 2012

Table C.3: Accrual Rate Specification with Linear Age (AR-LA-men)

#	MALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	3.34e-06	3.28e-07	10.18	0.000
2	**accrual rate**	-19.9033000	0.7910281	-25.16	0.000
3	age	0.1058270	0.0076338	13.86	0.000
4	migration	0.1248117	0.0373336	3.34	0.001
5	sick leave	0.0008281	0.0001569	5.28	0.000
6	regular employment	-0.0000413	0.0000177	-2.34	0.019
7	self-employment	-0.0000422	0.0000179	-2.36	0.018
8	fragmented employment	-0.0000496	0.0000864	-0.57	0.566
9	unemployment	-0.0000234	0.0000247	-0.95	0.343
10	avg. monthly income	-0.0005541	0.0000441	-12.56	0.000
11	NACE A	0.1485128	0.1888419	0.79	0.432
12	NACE B	-0.2729872	0.2983834	-0.91	0.360
13	NACE C	0.1118624	0.1030764	1.09	0.278
14	NACE D	0.0118273	0.1512027	0.08	0.938
15	NACE E	0.5095662	0.4602660	1.11	0.268
16	NACE F	0.2502772	0.1061367	2.36	0.018
17	NACE G	0.0458669	0.1031453	0.44	0.657
18	NACE H	-0.0408009	0.1173716	-0.35	0.728
19	NACE I	0.3104447	0.1425199	2.18	0.029
20	NACE J	-0.1633913	0.1646107	-0.99	0.321
21	NACE K	-0.0736134	0.1239465	-0.59	0.553
22	NACE L	-0.0140272	0.2128898	-0.07	0.947
23	NACE M	-0.0836321	0.1300495	-0.64	0.520
24	NACE N	0.1821623	0.1494553	1.22	0.223
25	NACE O	0.1194860	0.1147898	1.04	0.298
26	NACE P	-0.3566768	0.3072205	1.16	0.246
27	NACE Q	-0.2301686	0.1807474	-1.27	0.203
28	NACE R	-0.0156282	0.2253605	-0.07	0.945
29	NACE S	-0.1448025	0.1787073	-0.81	0.418
30	NACE T	-0.0017010	0.5335450	-0.00	0.997
31	NACE U	(reference)			
32	YEAR 2002	-1.2194010	0.0731589	-16.67	0.000
33	YEAR 2003	-1.1701030	0.0705422	-16.59	0.000
34	YEAR 2004	-1.5423030	0.0734932	-20.99	0.000
35	YEAR 2005	-1.2109020	0.0681595	-17.77	0.000
36	YEAR 2006	-0.9487656	0.0672413	-14.11	0.000
37	YEAR 2007	-0.9867182	0.0716572	-13.77	0.000
38	YEAR 2008	(reference)			
39	YEAR 2009	(reference)			
40	Constant	-6.0756990	0.5053160	-12.02	0.000

Summary Statistics:		
	number of observations	8867
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3436.5942
	likelihood ratio index ρ^2	0.2980

Source: IREA, 2012

Table C.4: Accrual Rate Specification with Linear Age (AR-LA-women)

#	**FEMALE ESTIMATES**	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	0.0000101	3.64e-07	27.87	0.000
2	**accrual rate**	-0.5118065	0.3836233	-1.33	-0.182
3	age	0.2208522	0.0080014	27.60	0.000
4	migration	0.1514679	0.0331419	4.57	0.000
5	sick leave	0.0008077	0.0001427	5.66	0.000
6	regular employment	-0.0000205	0.0000112	-1.82	0.068
7	self-employment	-0.0000247	0.0000124	-1.99	0.046
8	fragmented employment	-0.0000776	0.0000391	-1.99	0.047
9	unemployment	-0.0000414	0.0000242	-1.71	0.087
10	avg. monthly income	-0.0017107	0.0000714	-23.97	0.000
11	NACE A	-0.1173780	0.2169442	-0.54	0.588
12	NACE B	(reference)			
13	NACE C	-0.0090465	0.0886788	-0.10	0.919
14	NACE D	0.3248266	0.3124909	1.04	0.299
15	NACE E	-0.2419323	0.3631863	-0.67	0.505
16	NACE F	-0.1037603	0.1229458	-0.84	0.399
17	NACE G	-0.1444719	0.0837470	-1.73	0.085
18	NACE H	-0.12876840	0.1241727	-1.04	0.300
19	NACE I	-0.6118520	0.0972477	-0.63	0.529
20	NACE J	-0.6111450	0.1820282	-0.34	0.737
21	NACE K	-0.08933700	0.1190246	-0.75	0.453
22	NACE L	-0.2053401	0.1213428	-1.69	0.091
23	NACE M	-0.1935775	0.1138394	-1.70	0.089
24	NACE N	0.0136430	0.1080548	0.13	0.900
25	NACE O	-0.1400971	0.0908069	-1.54	0.123
26	NACE P	-0.1831886	0.1695926	-1.08	0.280
27	NACE Q	-0.2493340	0.1019669	-2.45	0.014
28	NACE R	0.3352619	0.3751787	0.89	0.372
29	NACE S	-0.7754510	0.1099819	-0.71	0.481
30	NACE T	0.2279633	0.1905147	1.20	0.231
31	NACE U	(reference)			
32	YEAR 2002	-0.9434001	0.0642762	-14.68	0.000
33	YEAR 2003	-0.8455410	0.0619457	-13.65	0.000
34	YEAR 2004	-1.3766180	0.0669895	-20.55	0.000
35	YEAR 2005	-1.1697870	0.0596589	-19.61	0.000
36	YEAR 2006	-0.9769148	0.0581422	-16.80	0.000
37	YEAR 2007	-0.9918780	0.0610470	-16.25	0.000
38	YEAR 2008	(reference)			
39	YEAR 2009	(reference)			
40	Constant	-12.4494600	0.4899790	-25.41	0.000

Summary Statistics:		
	number of observations	10403
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3935.951
	likelihood ratio index ρ^2	0.3048

Source: IREA, 2012

Table C.5: Peak Value Specification with Linear Age (PV-LA-men)

#	MALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	1.77e-06	3.44e-07	5.16	0.000
2	**peak value**	-0.0000586	2.22e-06	-26.36	0.000
3	age	0.1054297	0.0074990	14.06	0.000
4	migration	0.1256002	0.0375073	3.35	0.001
5	sick leave	0.0008910	0.0001542	5.78	0.000
6	regular employment	-0.0000252	0.0000177	-1.42	0.155
7	self-employment	-0.0000228	0.0000179	-1.27	0.203
8	fragmented employment	-0.0000343	0.0000862	-0.40	0.691
9	unemployment	-6.65e-06	0.0000246	-0.27	0.787
10	avg. monthly income	-0.0004501	0.0000446	-10.10	0.000
11	NACE A	0.2000435	0.1862964	1.07	0.283
12	NACE B	-0.2370126	0.2978230	-0.80	0.426
13	NACE C	0.1317716	0.1025074	1.29	0.199
14	NACE D	-0.0096981	0.1524652	-0.06	0.949
15	NACE E	0.5472541	0.4523126	1.21	0.226
16	NACE F	0.2577029	0.1054238	2.44	0.015
17	NACE G	0.0717719	0.1026133	0.70	0.484
18	NACE H	-0.0130358	0.1167715	-0.11	0.911
19	NACE I	0.3189145	0.1415793	2.25	0.024
20	NACE J	-0.1345914	0.1664748	-0.81	0.419
21	NACE K	-0.0604640	0.1244124	-0.49	0.627
22	NACE L	0.0179694	0.2125391	0.08	0.933
23	NACE M	-0.0881733	0.1301149	-0.68	0.498
24	NACE N	0.2098642	0.1477652	1.42	0.156
25	NACE O	0.1394149	0.1144427	1.22	0.223
26	NACE P	-0.3213199	0.3063927	-1.05	0.294
27	NACE Q	-0.2162886	0.1801759	-1.20	0.230
28	NACE R	-0.0552001	0.2285551	-0.24	0.809
29	NACE S	-0.1550605	0.1793716	-0.86	0.387
30	NACE T	-0.1755909	0.5236753	-0.34	0.737
31	NACE U	(reference)			
32	YEAR 2002	-1.1222970	0.0728842	-15.40	0.000
33	YEAR 2003	-1.0462550	0.0702838	-14.89	0.000
34	YEAR 2004	-1.4279840	0.0731941	-19.51	0.000
35	YEAR 2005	-1.1266400	0.0680990	-16.54	0.000
36	YEAR 2006	-0.8656873	0.0673878	-12.85	0.000
37	YEAR 2007	-0.9174968	0.0719555	-12.75	0.000
38	YEAR 2008	(reference)			
39	YEAR 2009	(reference)			
40	Constant	-5.9149170	0.4984206	-11.87	0.000

Summary Statistics:		
	number of observations	8867
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3400.2443
	likelihood ratio index ρ^2	0.3054

Source: IREA, 2012

Table C.6: Peak Value Specification with Linear Age (PV-LA-women)

#	FEMALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	9.37e-06	3.74e-07	25.10	0.000
2	**peak value**	-7.78e-06	1.05e-06	-7.41	0.000
3	age	0.2193333	0.0079164	27.71	0.000
4	migration	0.1499353	0.0332625	4.51	0.000
5	sick leave	0.0007799	0.0001422	5.48	0.000
6	regular employment	-0.0000221	0.0000112	-1.97	0.049
7	self-employment	-0.0000279	0.0000124	-2.26	0.024
8	fragmented employment	-0.0000737	0.0000389	-1.89	0.058
9	unemployment	-0.0000419	0.0000241	-1.74	0.083
10	avg. monthly income	-0.0015713	0.0000732	-21.45	0.000
11	NACE A	-0.1108304	0.2154715	-0.51	0.607
12	NACE B	(reference)			
13	NACE C	-0.0133708	0.0884514	-0.15	0.880
14	NACE D	0.3373536	0.3192495	1.06	0.291
15	NACE E	-0.2561777	0.3585772	-0.71	0.475
16	NACE F	-0.0914330	0.1236625	-0.74	0.460
17	NACE G	-0.1495704	0.0834678	-1.79	0.073
18	NACE H	-0.1371849	0.1244905	-1.10	0.270
19	NACE I	-0.0739690	0.0969366	-0.76	0.445
20	NACE J	-0.0809736	0.1830310	-0.44	0.658
21	NACE K	-0.0712981	0.1202462	-0.59	0.553
22	NACE L	-0.2258500	0.1210681	-1.87	0.062
23	NACE M	-0.1936790	0.1138495	-1.70	0.089
24	NACE N	-0.0043599	0.1075506	-0.04	0.968
25	NACE O	-0.1525240	0.0906946	-1.68	0.093
26	NACE P	-0.1835155	0.1698432	-1.08	0.280
27	NACE Q	-0.2525846	0.1020178	-2.48	0.013
28	NACE R	0.3555232	0.3787934	0.94	0.348
29	NACE S	-0.0761444	0.1099663	-0.69	0.489
30	NACE T	0.2114158	0.1899168	1.11	0.266
31	NACE U	(reference)			
32	YEAR 2002	-0.9234194	0.0644301	-14.33	0.000
33	YEAR 2003	-0.8258191	0.0620171	-13.32	0.000
34	YEAR 2004	-1.3740460	0.0671667	-20.46	0.000
35	YEAR 2005	-1.1499780	0.0598797	-19.20	0.000
36	YEAR 2006	-0.9506571	0.0584822	-16.26	0.000
37	YEAR 2007	-0.9741880	0.0613776	-15.87	0.000
38	YEAR 2008	(reference)			
39	YEAR 2009	(reference)			
40	Constant	-12.2781100	0.486061	-25.26	0.000

Summary Statistics:	number of observations	10405
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3908.6886
	likelihood ratio index ρ^2	0.3097

Source: IREA, 2012

Table C.7: Option Value Specification with Linear Age (OV-LA-men)

#	MALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	3.10e-06	3.42e-07	9.06	0.000
2	**option value**	-0.000788	0.0000441	-17.86	0.000
3	age	0.0490289	0.0088135	5.56	0.000
4	migration	0.1464948	0.0365513	4.01	0.000
5	sick leave	0.0006478	0.0001536	4.22	0.000
6	regular employment	0.0000237	0.0000173	1.37	0.171
7	self-employment	0.0000273	0.0000174	1.57	0.117
8	fragmented employment	-9.50e-06	0.0000850	-0.11	0.911
9	unemployment	-0.0000712	0.0000245	-2.91	0.004
10	avg. monthly income	-0.0004606	0.0000466	-9.89	0.000
11	NACE A	0.2309181	0.1848995	1.25	0.212
12	NACE B	-0.3338738	0.2823768	-1.18	0.237
13	NACE C	0.0820796	0.1001994	0.82	0.413
14	NACE D	-0.0739154	0.1474779	-0.50	0.616
15	NACE E	0.6126561	0.4596404	1.33	0.183
16	NACE F	0.3319055	0.1034424	3.21	0.001
17	NACE G	0.0238435	0.1001503	0.24	0.812
18	NACE H	-0.0386803	0.1137415	-0.34	0.734
19	NACE I	0.2267986	0.1405453	1.61	0.107
20	NACE J	-0.1725319	0.1603280	-1.08	0.282
21	NACE K	-0.1830038	0.1206741	-1.52	0.129
22	NACE L	-0.0016103	0.2115430	-0.01	0.994
23	NACE M	-0.0918498	0.1271987	-0.72	0.470
24	NACE N	0.1998773	0.1451288	1.38	0.168
25	NACE O	0.0751489	0.1120666	0.67	0..502
26	NACE P	-0.2915570	0.2974188	-0.98	0.327
27	NACE Q	-0.1512520	0.1752370	-0.86	0.388
28	NACE R	-0.1189379	0.2224540	-0.53	0.593
29	NACE S	-0.0695682	0.1760470	-0.40	0.693
30	NACE T	-0.2590911	0.5140223	-0.50	0.614
31	NACE U	(reference)			
32	YEAR 2002	-1.0713500	0.0701397	-15.27	0.000
33	YEAR 2003	-1.0352270	0.0681197	-15.20	0.000
34	YEAR 2004	-1.3838770	0.0703666	-19.67	0.000
35	YEAR 2005	-1.0934620	0.0653927	-16.72	0.000
36	YEAR 2006	-0.8323986	0.0641612	-12.97	0.000
37	YEAR 2007	-0.9224212	0.0680696	-13.55	0.000
38	YEAR 2008	(reference)			
39	YEAR 2009	(reference)			
40	Constant	-2.5604260	0.5772210	-4.44	0.000

Summary Statistics:		
	number of observations	8867
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3632.4976
	likelihood ratio index ρ^2	0.2580

Source: IREA, 2012

Table C.8: Option Value Specification with Linear Age (OV-LA-women)

#	FEMALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	8.47e-06	3.92e-07	21.63	0.000
2	**option value**	-0.0003609	0.0000332	-10.86	0.000
3	age	0.1999934	0.0081175	24.64	0.000
4	migration	0.1543268	0.0333787	4.62	0.000
5	sick leave	0.0006876	0.0001425	4.83	0.000
6	regular employment	-2.86e-06	0.0000113	-0.25	0.801
7	self-employment	-1.46e-06	0.0000124	-0.12	0.906
8	fragmented employment	-0.0000848	0.0000390	-2.17	0.030
9	unemployment	-0.0000622	0.0000243	-2.56	0.010
10	avg. monthly income	-0.0014097	0.0000765	-18.44	0.000
11	NACE A	-0.071935	0.2168824	-0.33	0.740
12	NACE B	(reference)			
13	NACE C	-0.0721004	0.8871410	-0.81	0.416
14	NACE D	0.2461368	0.3155584	0.78	0.435
15	NACE E	-0.2019777	0.3638039	-0.56	0.579
16	NACE F	-0.1577642	0.1237474	-1.27	0.202
17	NACE G	-0.1950140	0.0836146	-2.33	0.020
18	NACE H	-0.1883729	0.1248225	-1.51	0.131
19	NACE I	-0.1010081	0.0969629	-1.04	0.298
20	NACE J	-0.0737845	0.1826955	-0.40	0.686
21	NACE K	-0.1327506	0.1203130	-1.10	0.270
22	NACE L	-0.2696328	0.1213721	-2.22	0.026
23	NACE M	-0.2294154	0.1140781	-2.01	0.044
24	NACE N	-0.0138500	0.1079309	-0.13	0.898
25	NACE O	-0.1510573	0.0907597	-1.66	0.096
26	NACE P	-0.1903601	0.1707463	-1.11	0.265
27	NACE Q	-0.2639135	0.1022324	-2.58	0.010
28	NACE R	0.3685364	0.3759394	0.98	0.327
29	NACE S	-0.0843404	0.1102427	-0.77	0.444
30	NACE T	0.1979234	0.1910086	1.04	0.300
31	NACE U	(reference)			
32	YEAR 2002	-0.8845741	0.0648686	-13.64	0.000
33	YEAR 2003	-0.7891009	0.0624716	-12.63	0.000
34	YEAR 2004	-1.3395620	0.0674459	-19.86	0.000
35	YEAR 2005	-1.1091810	0.0601959	-18.43	0.000
36	YEAR 2006	-0.9180255	0.0586510	-15.65	0.000
37	YEAR 2007	-0.9559141	0.0613606	-15.58	0.000
38	YEAR 2008	(reference)			
39	YEAR 2009	(reference)			
40	Constant	-11.1362100	0.4995615	-22.29	0.000

Summary Statistics:	number of observations	10405
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3877.4475
	likelihood ratio index ρ^2	0.3152

Source: IREA, 2012

Table C.9: Accrual Rate Specification with Age Dummies (AR-AD-men)

#	MALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	3.20e-06	3.57e-07	8.97	0.000
2	**accrual rate**	-19.4543	0.9301995	-20.91	0.000
3	age 47	(reference)			
4	age 48	0.4610335	1.0281950	0.45	0.654
5	age 49	-0.0319285	0.9756989	-0.03	0.974
6	age 50	0.7822930	0.8702564	0.90	0.369
7	age 51	-0.2182889	0.8824695	-0.25	0.805
8	age 52	0.1695939	0.8292300	0.20	0.838
9	age 53	-0.2474626	0.8282776	-0.30	0.765
10	age 54	0.1406295	0.8210449	0.17	0.864
11	age 55	-0.2540174	0.8197537	-0.31	0.757
12	age 56	-0.2311523	0.8183140	-0.28	0.778
13	age 57	0.2831200	0.8167729	0.35	0.729
14	age 58	-0.1600856	0.8173046	-0.20	0.845
15	age 59	-0.1728679	0.8182753	-0.21	0.833
16	age 60	0.7315296	0.8165068	0.90	0.370
17	age 61	0.4928659	0.8173351	0.60	0.546
18	age 62	0.8707856	0.8184144	1.06	0.287
19	age 63	-0.1630871	0.8238920	-0.20	0.843
20	age 64	-0.4130914	0.8299043	-0.50	0.619
21	age 65	3.7684410	0.8631891	4.37	0.000
22	age 66	1.3603720	1.0824120	1.26	0.209
23	age 67	1.2198110	1.0776440	1.13	0.258
24	age 68	(reference)			
25	age 69	(reference)			
26	migration	0.1109934	0.0391102	2.84	0.005
27	sick leave	0.0008607	0.0001591	5.41	0.000
28	regular employment	3.25e-06	0.0000205	0.16	0.874
29	self-employment	5.86e-06	0.0000212	0.28	0.782
30	fragmented employment	9.58e-06	0.0000931	0.10	0.918
31	unemployment	0.0000251	0.0000276	0.91	0.362
32	avg. monthly income	-0.0005342	0.0000471	-11.33	0.000
33	NACE A	0.1320498	0.1965780	0.67	0.502
34	NACE B	-0.3095726	0.3171468	-0.98	0.329
35	NACE C	0.1355733	0.1099794	1.23	0.218
36	NACE D	0.0162395	0.1627099	0.10	0.920
37	NACE E	0.6775572	0.4565290	1.48	0.138
38	NACE F	0.2906430	0.1129202	2.57	0.010
39	NACE G	0.0492296	0.1097345	0.45	0.654
40	NACE H	-0.0074192	0.1244330	-0.06	0.952
41	NACE I	0.3608424	0.1507769	2.39	0.017
42	NACE J	-0.1900320	0.1757196	-1.08	0.279
43	NACE K	-0.0802152	0.1316942	-0.61	0.542
44	NACE L	-0.0540982	0.2291155	-0.24	0.813
45	NACE M	-0.0663440	0.1396375	-0.48	0.635
46	NACE N	0.1553118	0.1560815	1.00	0.320
47	NACE O	0.1031696	0.1228009	0.84	0.401
48	NACE P	-0.4203668	0.3230669	-1.30	0.193
49	NACE Q	-0.2386400	0.1979304	-1.21	0.228
50	NACE R	-0.2300381	0.2736025	-0.84	0.400
51	NACE S	-0.0715699	0.1861861	-0.38	0.701
52	NACE T	-0.3063634	0.6730280	-0.46	0.649
53	NACE U	(reference)			
54	YEAR 2002	-1.1726590	0.0785054	-14.94	0.000
55	YEAR 2003	-1.1182870	0.0756777	-14.78	0.000
56	YEAR 2004	-1.5015990	0.0784182	-19.15	0.000
57	YEAR 2005	-1.1386410	0.0732615	-15.54	0.000
58	YEAR 2006	-0.9283772	0.0723969	-12.82	0.000
59	YEAR 2007	-0.9483637	0.0771407	-12.29	0.000
60	YEAR 2008	(reference)			
61	YEAR 2009	(reference)			
62	Constant	-0.5064851	0.8298923	-0.61	0.542

Summary Statistics:		
	number of observations	8866
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3102.0239
	likelihood ratio index ρ^2	0.3662

Source: IREA, 2012

Table C.10: Accrual Rate Specification with Age Dummies (AR-AD-women)

#	FEMALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	0.0000115	4.19e-07	27.40	0.000
2	**accrual rate**	-1.196973	0.4732189	-2.53	0.011
3	age 47	(reference)			
4	age 48	-0.6226681	0.5743543	-1.08	0.278
5	age 49	-0.1756338	0.5198530	-0.34	0.735
6	age 50	-0.7129236	0.5105878	-1.40	0.163
7	age 51	-0.8252187	0.4973576	-1.66	0.097
8	age 52	-1.2081990	0.4942277	-2.44	0.015
9	age 53	-1.2492640	0.4907634	-2.55	0.011
10	age 54	-1.5453120	0.4905498	-3.15	0.002
11	age 55	-0.7196141	0.4860213	-1.48	0.139
12	age 56	-0.5355116	0.4857381	-1.10	0.270
13	age 57	-0.0441126	0.4855711	-0.09	0.928
14	age 58	-0.6759305	0.4874850	-1.39	0.166
15	age 59	-1.1909750	0.4891365	-2.43	0.015
16	age 60	2.3340650	0.4913506	4.75	0.000
17	age 61	0.6599950	0.5244800	1.26	0.208
18	age 62	0.5699490	0.5377772	1.06	0.289
19	age 63	0.5484695	0.5656410	0.97	0.332
20	age 64	(reference)			
21	age 65	(reference)			
22	age 66	(reference)			
23	age 67	(reference)			
24	age 68	(reference)			
25	age 69	(reference)			
26	migration	0.1915289	0.0371573	5.15	0.000
27	sick leave	0.0007738	0.0001449	5.34	0.000
28	regular employment	0.0000343	0.0000138	2.48	0.013
29	self-employment	0.0000244	0.0000151	1.62	0.106
30	fragmented employment	-0.0000623	0.0000513	-1.21	0.224
31	unemployment	0.0000159	0.0000273	0.58	0.559
32	avg. monthly income	-0.0020345	0.0000832	-24.45	0.000
33	NACE A	-0.0976894	0.2419147	-0.40	0.686
34	NACE B	(reference)			
35	NACE C	-0.0309622	0.1050522	-0.29	0.768
36	NACE D	0.4767988	0.3117359	1.53	0.126
37	NACE E	-0.3171485	0.4059124	-0.78	0.435
38	NACE F	-0.1283288	0.1380344	-0.93	0.353
39	NACE G	-0.1428865	0.0999278	-1.43	0.153
40	NACE H	-0.1884233	0.1461304	-1.29	0.197
41	NACE I	-0.0704217	0.1132365	-0.62	0.534
42	NACE J	-0.1762835	0.2036373	-0.87	0.387
43	NACE K	-0.0974823	0.1350389	-0.72	0.470
44	NACE L	-0.2495986	0.1421590	-1.76	0.079
45	NACE M	-0.2584718	0.1346499	-1.92	0.055
46	NACE N	-0.0421547	0.1265248	-0.33	0.739
47	NACE O	-0.1728954	0.1071412	-1.61	0.107
48	NACE P	-0.2237468	0.1904617	-1.17	0.240
49	NACE Q	-0.2956885	0.1194684	-2.48	0.013
50	NACE R	0.2971463	0.4198947	0.71	0.479
51	NACE S	-0.1508765	0.1278739	-1.18	0.238
52	NACE T	0.1202312	0.2316714	0.52	0.604
53	NACE U	(reference)			
54	YEAR 2002	-1.0259670	0.0737886	-13.90	0.000
55	YEAR 2003	-0.9439487	0.0705044	-13.39	0.000
56	YEAR 2004	-1.440515	0.0757347	-19.02	0.000
57	YEAR 2005	-1.2243960	0.0678663	-18.04	0.000
58	YEAR 2006	-1.0275260	0.0670552	-15.32	0.000
59	YEAR 2007	-0.9679794	0.0709364	-13.65	0.000
60	YEAR 2008	(reference)			
61	YEAR 2009	(reference)			
62	Constant	0.1540329	0.4915417	0.31	0.754

Summary Statistics:	number of observations	10393
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3096.3644
	likelihood ratio index ρ^2	0.4524

Source: IREA, 2012

Table C.11: Peak Value Specification with Age Dummies (PV-AD-men)

#	**MALE ESTIMATES**	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	1.85e-06	3.74e-07	4.95	0.000
2	**peak value**	-0.0000526	2.53e-06	-20.76	0.000
3	age 47	(reference)			
4	age 48	-0.0947451	1.0433700	-0.09	0.928
5	age 49	-0.5772154	0.9938722	-0.58	0.561
6	age 50	0.2288573	0.8893338	0.26	0.797
7	age 51	-0.7801184	0.9027698	-0.86	0.388
8	age 52	-0.3975827	0.8500295	-0.47	0.640
9	age 53	-0.8032418	0.8491593	-0.95	0.344
10	age 54	-0.3744482	0.8423181	-0.44	0.657
11	age 55	-0.7516418	0.8411564	-0.89	0.372
12	age 56	-0.6953793	0.8398971	-0.83	0.408
13	age 57	-0.1185759	0.8384852	-0.14	0.888
14	age 58	-0.4370513	0.8392093	-0.52	0.603
15	age 59	-0.5845869	0.8397218	-0.70	0.486
16	age 60	0.3206460	0.8384959	0.38	0.702
17	age 61	0.1153944	0.8393861	0.14	0.891
18	age 62	0.4730476	0.8403306	0.56	0.573
19	age 63	-0.5036726	0.8462528	-0.60	0.552
20	age 64	-0.9087684	0.8509780	-1.07	0.286
21	age 65	2.8341530	0.8779177	3.23	0.001
22	age 66	0.8005134	1.0932800	0.73	0.464
23	age 67	0.8519922	1.1082280	0.77	0.442
24	age 68	(reference)			
25	age 69	(reference)			
26	migration	0.1185175	0.0390941	3.03	0.002
27	sick leave	0.0009260	0.0001567	5.91	0.000
28	regular employment	5.73e-06	0.0000204	0.28	0.779
29	self-employment	0.0000122	0.0000211	0.58	0.563
30	fragmented employment	7.28e-06	0.0000924	0.08	0.937
31	unemployment	0.0000261	0.0000273	0.95	0.340
32	avg. monthly income	-0.0004462	0.0000476	-9.37	0.000
33	NACE A	0.1695549	0.1934404	0.88	0.381
34	NACE B	-0.3009627	0.3133562	-0.96	0.337
35	NACE C	0.1365589	0.1090821	1.25	0.211
36	NACE D	-0.0101891	0.1628646	-0.06	0.950
37	NACE E	0.6784872	0.4511671	1.50	0.133
38	NACE F	0.2869315	0.1119614	2.56	0.010
39	NACE G	0.0626395	0.1088039	0.58	0.565
40	NACE H	0.0044283	0.1233720	0.04	0.971
41	NACE I	0.3544155	0.1496951	2.37	0.018
42	NACE J	-0.1804177	0.1758559	-1.03	0.305
43	NACE K	-0.0955230	0.1313313	-0.73	0.467
44	NACE L	-0.0454490	0.2284844	-0.20	0.842
45	NACE M	-0.0951464	0.1388350	-0.69	0.493
46	NACE N	0.1752971	0.1543571	1.14	0.256
47	NACE O	0.1136129	0.1220871	0.93	0.352
48	NACE P	-0.4263840	0.3261959	-1.31	0.191
49	NACE Q	-0.2324073	0.1956076	-1.19	0.235
50	NACE R	-0.2226518	0.2716757	-0.82	0.412
51	NACE S	-0.1031157	0.1860548	-0.55	0.579
52	NACE T	-0.3103727	0.6460805	-0.48	0.631
53	NACE U	(reference)			
54	YEAR 2002	-1.1123080	0.0780100	-14.26	0.000
55	YEAR 2003	-1.0283960	0.0751819	-13.68	0.000
56	YEAR 2004	-1.4328340	0.0779311	-18.39	0.000
57	YEAR 2005	-1.1005570	0.0729548	-15.09	0.000
58	YEAR 2006	-0.8943319	0.0722231	-12.38	0.000
59	YEAR 2007	-0.9277640	0.0769893	-12.05	0.000
60	YEAR 2008	(reference)			
61	YEAR 2009	(reference)			
62	Constant	0.1890547	0.8509386	0.22	0.824

Summary Statistics:		
	number of observations	8866
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3117.4187
	likelihood ratio index ρ^2	0.3630

Source: IREA, 2012

Table C.12: Peak Value Specification with Age Dummies (PV-AD-women)

#	FEMALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	0.0000109	4.29e-07	25.38	0.000
2	**peak value**	-7.71e-06	1.19e-06	-6.47	0.000
3	age 47	(reference)			
4	age 48	-0.6227960	0.5727614	-1.09	0.277
5	age 49	-0.1839160	0.5187594	-0.35	0.723
6	age 50	-0.6560766	0.5100205	-1.29	0.198
7	age 51	-0.7160459	0.4969180	-1.44	0.150
8	age 52	-1.1000280	0.4937079	-2.23	0.026
9	age 53	-1.1193500	0.4903025	-2.28	0.022
10	age 54	-1.4255660	0.4898483	-2.91	0.004
11	age 55	-0.6563252	0.4851110	-1.35	0.176
12	age 56	-0.4782780	0.4848194	-0.99	0.324
13	age 57	0.0188245	0.4846826	0.04	0.969
14	age 58	-0.5998214	0.4866920	-1.23	0.218
15	age 59	-1.1242350	0.4881503	-2.30	0.021
16	age 60	2.4064290	0.4900222	4.91	0.000
17	age 61	0.7242980	0.5232523	1.38	0.166
18	age 62	0.5767714	0.5368037	1.07	0.283
19	age 63	0.5535455	0.5643843	0.98	0.327
20	age 64	(reference)			
21	age 65	(reference)			
22	age 66	(reference)			
23	age 67	(reference)			
24	age 68	(reference)			
25	age 69	(reference)			
26	migration	0.1903671	0.0372624	5.11	0.000
27	sick leave	0.0007509	0.0001445	5.20	0.000
28	regular employment	0.0000339	0.0000138	2.46	0.014
29	self-employment	0.0000223	0.0000151	1.48	0.139
30	fragmented employment	-0.0000598	0.0000512	-1.17	0.244
31	unemployment	0.0000148	0.0000272	0.55	0.585
32	avg. monthly income	-0.0019209	0.0000850	-22.60	0.000
33	NACE A	-0.0949878	0.2402827	-0.40	0.693
34	NACE B	(reference)			
35	NACE C	-0.0410994	0.1047717	-0.39	0.695
36	NACE D	0.4723271	0.3165860	1.49	0.136
37	NACE E	-0.3334775	0.4021136	-0.83	0.407
38	NACE F	-0.1229898	0.1385596	-0.89	0.375
39	NACE G	-0.1546841	0.0996414	-1.55	0.121
40	NACE H	-0.2014687	0.1463807	-1.38	0.169
41	NACE I	-0.0829684	0.1128684	-0.74	0.462
42	NACE J	-0.2054944	0.2045451	-1.00	0.315
43	NACE K	-0.0923278	0.1359093	-0.68	0.497
44	NACE L	-0.2734692	0.1420211	-1.93	0.054
45	NACE M	-0.2709758	0.1347375	-2.01	0.044
46	NACE N	-0.0625412	0.1260202	-0.50	0.620
47	NACE O	-0.1899326	0.1070142	-1.77	0.076
48	NACE P	-0.2204208	0.1909186	-1.15	0.248
49	NACE Q	-0.3037608	0.1194577	-2.54	0.011
50	NACE R	0.3013068	0.4239375	0.71	0.477
51	NACE S	-0.1556579	0.1278161	-1.22	0.223
52	NACE T	0.0916485	0.2313449	0.40	0.692
53	NACE U	(reference)			
54	YEAR 2002	-0.9992719	0.0739184	-13.52	0.000
55	YEAR 2003	-0.9178607	0.0706280	-13.00	0.000
56	YEAR 2004	-1.4279200	0.0759434	-18.80	0.000
57	YEAR 2005	-1.1971000	0.0681102	-17.58	0.000
58	YEAR 2006	-0.9973045	0.0674526	-14.79	0.000
59	YEAR 2007	-0.9484017	0.0712696	-13.31	0.000
60	YEAR 2008	(reference)			
61	YEAR 2009	(reference)			
62	Constant	0.1466698	0.4904259	0.30	0.765

Summary Statistics:	number of observations	10395
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3078.2135
	likelihood ratio index ρ^2	0.4557

Source: IREA, 2012

Table C.13: Option Value Specification with Age Dummies (OV-AD-men)

#	MALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	3.40e-06	3.66e-07	9.27	0.000
2	**option value**	-0.0006797	0.0000477	-14.24	0.000
3	age 47	(reference)			
4	age 48	0.3493745	1.0699050	0.33	0.744
5	age 49	-0.1634392	1.0244270	-0.16	0.873
6	age 50	0.6354458	0.9216824	0.69	0.491
7	age 51	-0.5200380	0.9429322	-0.55	0.581
8	age 52	-0.1689937	0.8830532	-0.19	0.848
9	age 53	-0.5811168	0.8816188	-0.66	0.510
10	age 54	-0.2020537	0.8748502	-0.23	0.817
11	age 55	-0.4907403	0.8739535	-0.56	0.574
12	age 56	-0.5100510	0.8723646	-0.58	0.559
13	age 57	-0.0683418	0.8706990	-0.08	0.937
14	age 58	-0.6125232	0.8707720	-0.70	0.482
15	age 59	-1.0417410	0.8706008	-1.20	0.231
16	age 60	0.1709683	0.8698009	0.20	0.844
17	age 61	-0.0456789	0.8705845	-0.05	0.958
18	age 62	0.2721984	0.8715526	0.31	0.755
19	age 63	-0.5604065	0.8767954	-0.64	0.523
20	age 64	-1.0565770	0.8807264	-1.20	0.230
21	age 65	2.3731420	0.9066768	2.62	0.009
22	age 66	0.6408800	1.0987780	0.58	0.560
23	age 67	0.7514354	1.1410690	0.66	0.510
24	age 68	(reference)			
25	age 69	(reference)			
26	migration	0.1486828	0.0383607	3.88	0.000
27	sick leave	0.0006961	0.0001569	4.44	0.000
28	regular employment	0.0000506	0.0000197	2.56	0.010
29	self-employment	0.0000509	0.0000203	2.51	0.012
30	fragmented employment	0.0000387	0.0000921	0.42	0.675
31	unemployment	-0.0000350	0.0000271	-1.29	0.196
32	avg. monthly income	-0.0005004	0.0000490	-10.22	0.000
33	NACE A	0.1982962	0.1923177	1.03	0.303
34	NACE B	-0.3716127	0.3041229	-1.22	0.222
35	NACE C	0.0849084	0.1070929	0.79	0.428
36	NACE D	-0.1043618	0.1589706	-0.66	0.512
37	NACE E	0.8048549	0.4503234	1.79	0.074
38	NACE F	0.3404505	0.1101851	3.09	0.002
39	NACE G	0.0072348	0.1068358	0.07	0.946
40	NACE H	-0.0268777	0.1209082	-0.22	0.824
41	NACE I	0.2660644	0.1490570	1.78	0.074
42	NACE J	-0.2422998	0.1725637	-1.40	0.160
43	NACE K	-0.2229041	0.1287746	-1.73	0.083
44	NACE L	-0.1085948	0.2281506	-0.48	0.634
45	NACE M	-0.1410540	0.1371220	-1.03	0.304
46	NACE N	0.1446860	0.1524454	0.95	0.343
47	NACE O	0.0521578	0.1201430	0.43	0.664
48	NACE P	-0.5234005	0.3263457	-1.60	0.109
49	NACE Q	-0.2101477	0.1917160	-1.10	0.273
50	NACE R	-0.2889043	0.2620510	-1.10	0.270
51	NACE S	-0.0675382	0.1849632	-0.37	0.715
52	NACE T	-0.4170782	0.6321464	-0.66	0.509
53	NACE U	(reference)			
54	YEAR 2002	-1.1324950	0.0761338	-14.88	0.000
55	YEAR 2003	-1.0647400	0.0736369	-14.46	0.000
56	YEAR 2004	-1.4604740	0.0759893	-19.22	0.000
57	YEAR 2005	-1.1218660	0.0709615	-15.81	0.000
58	YEAR 2006	-0.8816342	0.0699324	-12.61	0.000
59	YEAR 2007	-0.9378585	0.0743050	-12.62	0.000
60	YEAR 2008	(reference)			
61	YEAR 2009	(reference)			
62	Constant	0.3572207	0.8808609	0.41	0.685

Summary Statistics:		
	number of observations	8866
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3247.0959
	likelihood ratio index ρ^2	0.3365

Source: IREA, 2012

Table C.14: Option Value Specification with Age Dummies (OV-AD-women)

#	FEMALE ESTIMATES	coeff. estimate	std. error	t-stat	p-value
1	**social security wealth**	0.0000102	4.45e-07	22.88	0.000
2	**option value**	-0.0003289	0.000037	-8.89	0.000
3	age 47	(reference)			
4	age 48	-0.4171772	0.5784596	-0.72	0.471
5	age 49	0.0470165	0.5205453	0.09	0.928
6	age 50	-0.4296968	0.5123806	-0.84	0.402
7	age 51	-0.5001995	0.4994071	-1.00	0.317
8	age 52	-0.9280039	0.4958848	-1.87	0.061
9	age 53	-0.9911418	0.4922012	-2.01	0.044
10	age 54	-1.3662590	0.4913208	-2.78	0.005
11	age 55	-0.5957094	0.4867238	-1.22	0.221
12	age 56	-0.4207979	0.4864178	-0.87	0.387
13	age 57	0.0853045	0.4863310	0.18	0.861
14	age 58	-0.5462422	0.4882281	-1.12	0.263
15	age 59	-1.0985700	0.4895143	-2.24	0.025
16	age 60	2.3439410	0.4911527	4.77	0.000
17	age 61	0.6935248	0.5247212	1.32	0.186
18	age 62	0.5838658	0.5378552	1.09	0.278
19	age 63	0.5433209	0.5657915	0.96	0.337
20	age 64	(reference)			
21	age 65	(reference)			
22	age 66	(reference)			
23	age 67	(reference)			
24	age 68	(reference)			
25	age 69	(reference)			
26	migration	0.1942240	0.0373296	5.20	0.000
27	sick leave	0.0006541	0.0001447	4.52	0.000
28	regular employment	0.0000434	0.0000138	3.15	0.002
29	self-employment	0.0000358	0.0000149	2.40	0.016
30	fragmented employment	-0.0000814	0.0000512	-1.59	0.112
31	unemployment	-9.05e-06	0.0000274	-0.33	0.741
32	avg. monthly income	-0.0017830	0.0000883	-20.19	0.000
33	NACE A	-0.0690803	0.2412054	-0.29	0.775
34	NACE B	(reference)			
35	NACE C	-0.1103169	0.1050542	-1.05	0.294
36	NACE D	0.3869225	0.3137560	1.23	0.218
37	NACE E	-0.3665158	0.4065475	-0.90	0.367
38	NACE F	-0.1972951	0.1385738	-1.42	0.155
39	NACE G	-0.2162901	0.0998111	-2.17	0.030
40	NACE H	-0.2643943	0.1462921	-1.81	0.071
41	NACE I	-0.1280479	0.1129401	-1.13	0.257
42	NACE J	-0.2145885	0.2040033	-1.05	0.293
43	NACE K	-0.1618925	0.1359528	-1.19	0.234
44	NACE L	-0.3370820	0.1422832	-2.37	0.018
45	NACE M	-0.3219330	0.1347547	-2.39	0.017
46	NACE N	-0.0956354	0.1263734	-0.76	0.449
47	NACE O	-0.2124708	0.1070363	-1.99	0.047
48	NACE P	-0.2641558	0.1916239	-1.38	0.168
49	NACE Q	-0.3297094	0.1195102	-2.76	0.006
50	NACE R	0.2892472	0.4208550	0.69	0.492
51	NACE S	-0.1871383	0.1280671	-1.46	0.144
52	NACE T	0.0709803	0.2306211	0.31	0.758
53	NACE U	(reference)			
54	YEAR 2002	-0.9716169	0.0743029	-13.08	0.000
55	YEAR 2003	-0.8931463	0.0710609	-12.57	0.000
56	YEAR 2004	-1.4001520	0.0762411	-18.36	0.000
57	YEAR 2005	-1.1627520	0.0684233	-16.99	0.000
58	YEAR 2006	-0.9686167	0.0675948	-14.33	0.000
59	YEAR 2007	-0.9326999	0.0712018	-13.10	0.000
60	YEAR 2008	(reference)			
61	YEAR 2009	(reference)			
62	Constant	0.1916812	0.4919604	0.39	0.697

Summary Statistics:	number of observations	10395
	log-likelihood $\mathscr{L}(\widehat{\beta})$	-3060.0365
	likelihood ratio index ρ^2	0.4589

Source: IREA, 2012

Appendix D

Grid Search

Table D.1: Grid Search: OV-LA-WOMEN

α	γ	LL	SSW	OV	age	migration	sick days	regular employm.	self-employm.	fragmented employm.	un-employm.	avg. monthly income
1.89	0.55	-3877.47	0.00000850	-0.0003994	0.2005424	0.151024	0.000679	-0.000002	-0.000004	-0.000082	-0.000059	-0.001413
1.96	0.56	-3877.44	0.00000851	-0.0003531	0.2008262	0.150920	0.000681	-0.000002	-0.000005	-0.000082	-0.000059	-0.001413
2.04	0.57	-3877.32	0.00000851	-0.0003118	0.2010698	0.150812	0.000683	-0.000003	-0.000005	-0.000081	-0.000059	-0.001413
1.90	0.55	-3877.20	0.00000850	-0.0003998	0.2004110	0.151025	0.000679	-0.000002	-0.000004	-0.000082	-0.000059	-0.001413
1.97	0.56	-3877.19	0.00000850	-0.0003534	0.2007061	0.150922	0.000681	-0.000002	-0.000005	-0.000082	-0.000059	-0.001412
2.05	0.57	-3877.10	0.00000851	-0.0003119	0.2009627	0.150811	0.000683	-0.000003	-0.000005	-0.000081	-0.000059	-0.001412
1.98	0.56	-3876.94	0.00000850	-0.0003536	0.2005867	0.150923	0.000680	-0.000002	-0.000005	-0.000082	-0.000059	-0.001412
1.91	0.55	-3876.94	0.00000849	-0.0004002	0.2002801	0.151026	0.000678	-0.000002	-0.000004	-0.000082	-0.000059	-0.001412
2.06	0.57	-3876.87	0.00000850	-0.0003120	0.2008562	0.150812	0.000682	-0.000003	-0.000005	-0.000081	-0.000059	-0.001411
1.99	0.56	-3876.70	0.00000849	-0.0003538	0.2004683	0.150925	0.000680	-0.000002	-0.000005	-0.000082	-0.000059	-0.001411
1.92	0.55	-3876.67	0.00000848	-0.0004005	0.2001500	0.151027	0.000678	-0.000002	-0.000004	-0.000082	-0.000059	-0.001411
2.07	0.57	-3876.65	0.00000850	-0.0003122	0.2007508	0.150815	0.000682	-0.000003	-0.000005	-0.000081	-0.000059	-0.001411
2.00	0.56	-3876.46	0.00000849	-0.0003540	0.2003514	0.150928	0.000680	-0.000002	-0.000005	-0.000082	-0.000059	-0.001410
1.93	0.55	-3876.41	0.00000848	-0.0004008	0.2000207	0.151030	0.000678	-0.000002	-0.000004	-0.000082	-0.000059	-0.001410
2.01	0.56	-3876.22	0.00000848	-0.0003542	0.2002360	0.150930	0.000680	-0.000002	-0.000005	-0.000082	-0.000059	-0.001409
1.94	0.55	-3876.14	0.00000847	-0.0004012	0.1998916	0.151033	0.000678	-0.000002	-0.000004	-0.000082	-0.000060	-0.001409
2.02	0.56	-3875.99	0.00000848	-0.0003544	0.2001210	0.150929	0.000680	-0.000002	-0.000005	-0.000082	-0.000059	-0.001408
1.88	0.54	-3875.93	0.00000846	-0.0004540	0.1994831	0.151139	0.000675	-0.000001	-0.000004	-0.000082	-0.000060	-0.001408
1.95	0.55	-3875.88	0.00000847	-0.0004015	0.1997632	0.151034	0.000677	-0.000002	-0.000004	-0.000082	-0.000060	-0.001408
2.03	0.56	-3875.75	0.00000847	-0.0003546	0.2000066	0.150931	0.000679	-0.000002	-0.000005	-0.000082	-0.000059	-0.001408
1.89	0.54	-3875.65	0.00000846	-0.0004544	0.1993432	0.151141	0.000675	-0.000001	-0.000004	-0.000082	-0.000060	-0.001407
1.96	0.55	-3875.62	0.00000846	-0.0004018	0.1996358	0.151037	0.000677	-0.000002	-0.000004	-0.000082	-0.000060	-0.001407
2.04	0.56	-3875.51	0.00000847	-0.0003547	0.1998932	0.150935	0.000679	-0.000002	-0.000005	-0.000082	-0.000059	-0.001407
1.90	0.54	-3875.37	0.00000845	-0.0004549	0.1992045	0.151144	0.000675	-0.000001	-0.000004	-0.000082	-0.000060	-0.001406
1.97	0.55	-3875.36	0.00000846	-0.0004021	0.1995100	0.151040	0.000677	-0.000002	-0.000004	-0.000082	-0.000060	-0.001406
2.05	0.56	-3875.28	0.00000846	-0.0003549	0.1997809	0.150940	0.000679	-0.000002	-0.000005	-0.000081	-0.000059	-0.001406
1.98	0.55	-3875.11	0.00000845	-0.0004023	0.1993861	0.151042	0.000677	-0.000002	-0.000004	-0.000082	-0.000060	-0.001405
1.91	0.54	-3875.09	0.00000844	-0.0004553	0.1990660	0.151147	0.000675	-0.000002	-0.000004	-0.000082	-0.000060	-0.001405
2.06	0.56	-3875.04	0.00000846	-0.0003551	0.1996690	0.150943	0.000679	-0.000002	-0.000005	-0.000081	-0.000059	-0.001405
1.99	0.55	-3874.86	0.00000845	-0.0004026	0.1992625	0.151042	0.000677	-0.000002	-0.000004	-0.000082	-0.000060	-0.001405
1.92	0.54	-3874.81	0.00000844	-0.0004558	0.1989280	0.151149	0.000674	-0.000002	-0.000004	-0.000082	-0.000060	-0.001405
2.07	0.56	-3874.79	0.00000845	-0.0003552	0.1995571	0.150947	0.000679	-0.000002	-0.000005	-0.000081	-0.000059	-0.001404
2.00	0.55	-3874.61	0.00000844	-0.0004028	0.1991396	0.151045	0.000676	-0.000002	-0.000004	-0.000082	-0.000060	-0.001404
1.93	0.54	-3874.53	0.00000843	-0.0004562	0.1987908	0.151152	0.000674	-0.000002	-0.000004	-0.000082	-0.000060	-0.001404
2.01	0.55	-3874.36	0.00000844	-0.0004031	0.1990179	0.151049	0.000676	-0.000002	-0.000005	-0.000082	-0.000060	-0.001403
1.94	0.54	-3874.26	0.00000843	-0.0004565	0.1986556	0.151156	0.000674	-0.000002	-0.000004	-0.000082	-0.000060	-0.001403
2.02	0.55	-3874.11	0.00000843	-0.0004033	0.1988973	0.151054	0.000676	-0.000002	-0.000005	-0.000082	-0.000060	-0.001402
1.88	0.53	-3874.05	0.00000842	-0.0005166	0.1982301	0.151271	0.000672	-0.000001	-0.000003	-0.000083	-0.000060	-0.001402
1.95	0.54	-3874.00	0.00000842	-0.0004569	0.1985224	0.151158	0.000674	-0.000002	-0.000004	-0.000082	-0.000060	-0.001402
2.03	0.55	-3873.86	0.00000843	-0.0004035	0.1987769	0.151059	0.000676	-0.000002	-0.000005	-0.000082	-0.000060	-0.001401
1.89	0.53	-3873.75	0.00000841	-0.0005172	0.1980818	0.151274	0.000671	-0.000001	-0.000004	-0.000083	-0.000060	-0.001401
1.96	0.54	-3873.74	0.00000842	-0.0004572	0.1983897	0.151159	0.000673	-0.000002	-0.000004	-0.000082	-0.000060	-0.001401
2.04	0.55	-3873.60	0.00000842	-0.0004038	0.1986563	0.151063	0.000675	-0.000002	-0.000005	-0.000082	-0.000060	-0.001401
1.97	0.54	-3873.47	0.00000841	-0.0004576	0.1982576	0.151162	0.000673	-0.000002	-0.000004	-0.000082	-0.000060	-0.001400
1.90	0.53	-3873.46	0.00000840	-0.0005177	0.1979345	0.151276	0.000671	-0.000001	-0.000004	-0.000083	-0.000060	-0.001400
2.05	0.55	-3873.33	0.00000842	-0.0004041	0.1985359	0.151067	0.000675	-0.000002	-0.000005	-0.000082	-0.000060	-0.001400
1.98	0.54	-3873.20	0.00000841	-0.0004579	0.1981269	0.151167	0.000673	-0.000002	-0.000004	-0.000082	-0.000060	-0.001399
1.91	0.53	-3873.17	0.00000840	-0.0005182	0.1977890	0.151281	0.000671	-0.000001	-0.000004	-0.000083	-0.000060	-0.001399
2.06	0.55	-3873.07	0.00000841	-0.0004043	0.1984160	0.151070	0.000675	-0.000002	-0.000005	-0.000082	-0.000060	-0.001399
1.99	0.54	-3872.94	0.00000840	-0.0004582	0.1979975	0.151172	0.000673	-0.000002	-0.000004	-0.000082	-0.000060	-0.001398
1.92	0.53	-3872.89	0.00000839	-0.0005187	0.1976457	0.151284	0.000670	-0.000001	-0.000004	-0.000083	-0.000060	-0.001398
2.07	0.55	-3872.80	0.00000840	-0.0004046	0.1982964	0.151074	0.000675	-0.000002	-0.000005	-0.000082	-0.000060	-0.001398
2.00	0.54	-3872.67	0.00000839	-0.0004585	0.1978680	0.151178	0.000672	-0.000002	-0.000004	-0.000082	-0.000060	-0.001398
1.93	0.53	-3872.61	0.00000839	-0.0005192	0.1975032	0.151286	0.000670	-0.000001	-0.000004	-0.000083	-0.000060	-0.001397
2.01	0.54	-3872.39	0.00000839	-0.0004589	0.1977381	0.151183	0.000672	-0.000002	-0.000004	-0.000082	-0.000060	-0.001397
1.94	0.53	-3872.32	0.00000838	-0.0005196	0.1973614	0.151289	0.000670	-0.000001	-0.000004	-0.000083	-0.000060	-0.001396
2.02	0.54	-3872.11	0.00000838	-0.0004593	0.1976085	0.151188	0.000672	-0.000002	-0.000004	-0.000082	-0.000060	-0.001396
1.95	0.53	-3872.04	0.00000837	-0.0005201	0.1972210	0.151295	0.000670	-0.000001	-0.000004	-0.000082	-0.000060	-0.001396
2.03	0.54	-3871.83	0.00000838	-0.0004596	0.1974792	0.151192	0.000672	-0.000002	-0.000004	-0.000082	-0.000060	-0.001395
1.96	0.53	-3871.76	0.00000837	-0.0005205	0.1970821	0.151301	0.000669	-0.000002	-0.000004	-0.000082	-0.000060	-0.001395
2.04	0.54	-3871.54	0.00000837	-0.0004600	0.1973505	0.151197	0.000671	-0.000002	-0.000004	-0.000082	-0.000060	-0.001394
1.97	0.53	-3871.47	0.00000836	-0.0005209	0.1969428	0.151308	0.000669	-0.000002	-0.000004	-0.000082	-0.000061	-0.001394
2.05	0.54	-3871.26	0.00000837	-0.0004603	0.1972233	0.151203	0.000671	-0.000002	-0.000004	-0.000082	-0.000060	-0.001393
1.98	0.53	-3871.18	0.00000836	-0.0005214	0.1968030	0.151313	0.000669	-0.000002	-0.000004	-0.000082	-0.000061	-0.001393
2.06	0.54	-3870.98	0.00000836	-0.0004607	0.1970968	0.151209	0.000671	-0.000002	-0.000004	-0.000082	-0.000060	-0.001392
1.99	0.53	-3870.88	0.00000835	-0.0005219	0.1966635	0.151320	0.000668	-0.000002	-0.000004	-0.000082	-0.000061	-0.001392
2.07	0.54	-3870.70	0.00000836	-0.0004610	0.1969706	0.151217	0.000670	-0.000002	-0.000004	-0.000082	-0.000060	-0.001392
2.00	0.53	-3870.58	0.00000835	-0.0005224	0.1965245	0.151324	0.000668	-0.000002	-0.000004	-0.000082	-0.000061	-0.001391
2.01	0.53	-3870.28	0.00000834	-0.0005229	0.1963862	0.151331	0.000668	-0.000002	-0.000004	-0.000082	-0.000061	-0.001390
2.02	0.53	-3869.98	0.00000833	-0.0005233	0.1962497	0.151338	0.000668	-0.000002	-0.000004	-0.000082	-0.000061	-0.001389
2.03	0.53	-3869.69	0.00000833	-0.0005238	0.1961135	0.151346	0.000667	-0.000002	-0.000004	-0.000082	-0.000061	-0.001388
2.04	0.53	-3869.39	0.00000832	-0.0005242	0.1959775	0.151356	0.000667	-0.000002	-0.000004	-0.000082	-0.000061	-0.001387
2.05	0.53	-3869.08	0.00000832	-0.0005247	0.1958425	0.151366	0.000667	-0.000002	-0.000004	-0.000082	-0.000061	-0.001387
2.06	0.53	-3868.79	0.00000831	-0.0005251	0.1957083	0.151377	0.000666	-0.000002	-0.000004	-0.000082	-0.000061	-0.001386
2.07	0.53	-3868.49	0.00000831	-0.0005255	0.1955748	0.151389	0.000666	-0.000002	-0.000004	-0.000082	-0.000061	-0.001385

Source: IREA, 2012

Table D.2: Grid Search: OV-LA-MEN

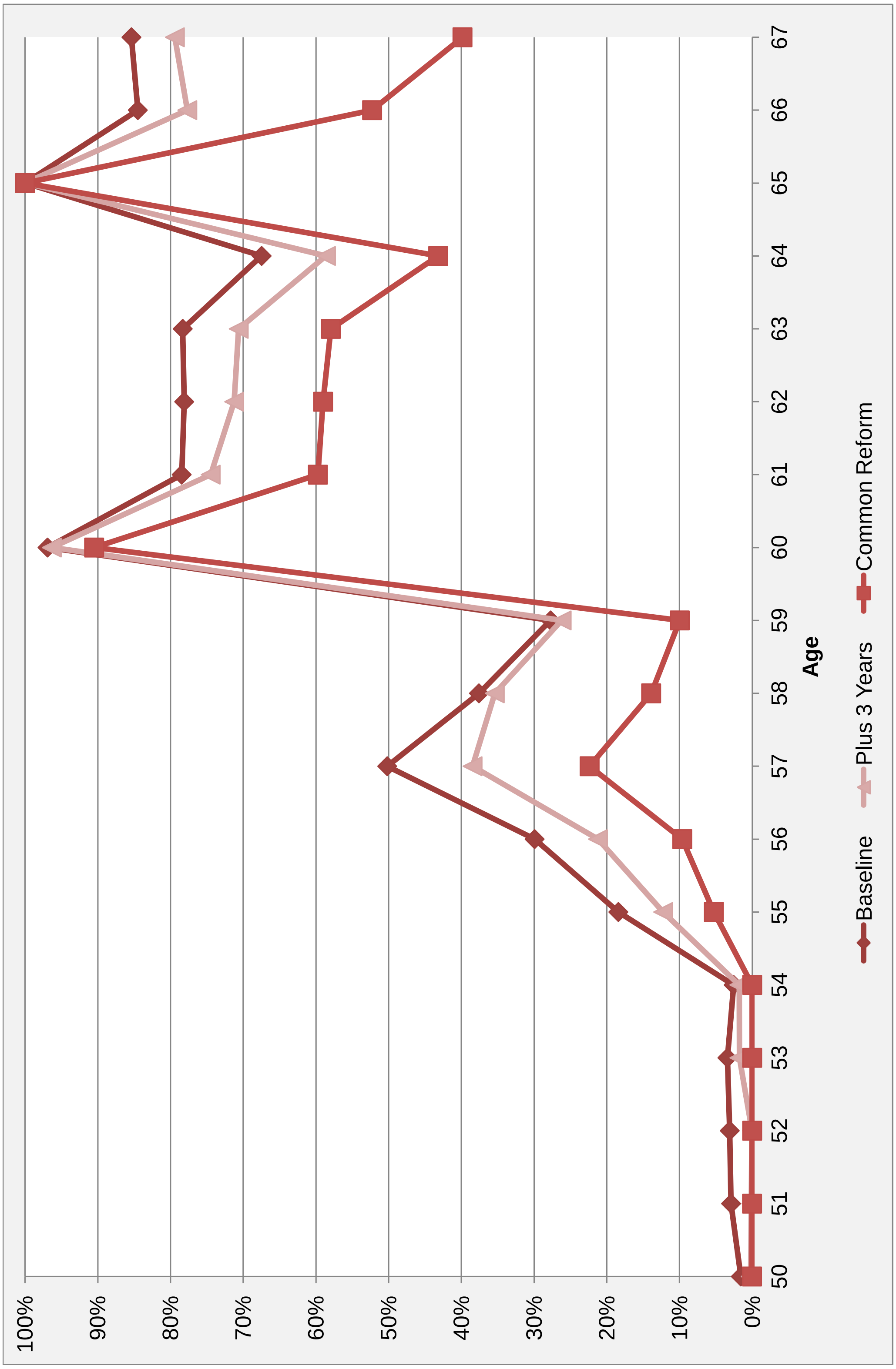
α	γ	LL	SSW	OV	age	migration	sick leave	regular employm.	self-employm.	fragmented employm.	un-employm.	avg. monthly income
1.91	0.54	-3641.88	0.00000302	-0.0009643	0.0483234	0.152404	0.000715	0.000023	0.000028	-0.000021	-0.000073	-0.000452
1.96	0.57	-3641.77	0.00000307	-0.0006921	0.0511981	0.152073	0.000724	0.000023	0.000028	-0.000021	-0.000072	-0.000454
1.93	0.55	-3641.31	0.00000303	-0.0008647	0.0491064	0.152291	0.000717	0.000023	0.000028	-0.000021	-0.000073	-0.000452
1.90	0.53	-3641.00	0.00000300	-0.0010795	0.0470511	0.152516	0.000709	0.000023	0.000029	-0.000021	-0.000074	-0.000450
1.95	0.56	-3640.80	0.00000304	-0.0007752	0.0499130	0.152176	0.000719	0.000023	0.000028	-0.000021	-0.000073	-0.000452
1.92	0.54	-3640.39	0.00000301	-0.0009682	0.0478243	0.152402	0.000712	0.000023	0.000028	-0.000022	-0.000074	-0.000450
1.97	0.57	-3640.36	0.00000306	-0.0006947	0.0507414	0.152063	0.000722	0.000023	0.000027	-0.000022	-0.000072	-0.000453
1.94	0.55	-3639.84	0.00000302	-0.0008681	0.0486227	0.152286	0.000714	0.000023	0.000028	-0.000022	-0.000073	-0.000451
1.91	0.53	-3639.49	0.00000299	-0.0010839	0.0465424	0.152515	0.000706	0.000023	0.000028	-0.000022	-0.000074	-0.000449
1.96	0.56	-3639.37	0.00000303	-0.0007781	0.0494442	0.152171	0.000716	0.000023	0.000028	-0.000022	-0.000073	-0.000451
1.98	0.57	-3638.95	0.00000305	-0.0006973	0.0502871	0.152055	0.000719	0.000022	0.000027	-0.000022	-0.000073	-0.000451
1.93	0.54	-3638.90	0.00000300	-0.0009721	0.0473284	0.152401	0.000709	0.000023	0.000028	-0.000022	-0.000074	-0.000449
1.95	0.55	-3638.37	0.00000301	-0.0008715	0.0481401	0.152283	0.000711	0.000023	0.000028	-0.000022	-0.000074	-0.000449
1.92	0.53	-3637.99	0.00000298	-0.0010883	0.0460373	0.152514	0.000703	0.000023	0.000028	-0.000022	-0.000075	-0.000447
1.97	0.56	-3637.92	0.00000302	-0.0007811	0.0489764	0.152165	0.000713	0.000022	0.000027	-0.000022	-0.000073	-0.000449
1.99	0.57	-3637.53	0.00000303	-0.0006999	0.0498340	0.152048	0.000716	0.000022	0.000027	-0.000022	-0.000073	-0.000450
1.94	0.54	-3637.41	0.00000299	-0.0009759	0.0468367	0.152399	0.000706	0.000023	0.000028	-0.000022	-0.000074	-0.000448
1.96	0.55	-3636.90	0.00000300	-0.0008749	0.0476608	0.152281	0.000708	0.000023	0.000028	-0.000023	-0.000074	-0.000448
1.93	0.53	-3636.48	0.00000296	-0.0010927	0.0455349	0.152514	0.000700	0.000023	0.000028	-0.000023	-0.000075	-0.000446
1.98	0.56	-3636.47	0.00000301	-0.0007841	0.0485102	0.152161	0.000711	0.000022	0.000027	-0.000023	-0.000074	-0.000448
2.00	0.57	-3636.11	0.00000302	-0.0007025	0.0493820	0.152041	0.000713	0.000022	0.000027	-0.000023	-0.000073	-0.000449
1.95	0.54	-3635.92	0.00000298	-0.0009797	0.0463484	0.152396	0.000703	0.000023	0.000028	-0.000023	-0.000075	-0.000446
1.97	0.55	-3635.44	0.00000299	-0.0008782	0.0471858	0.152278	0.000705	0.000022	0.000027	-0.000023	-0.000075	-0.000446
1.99	0.56	-3635.02	0.00000300	-0.0007870	0.0480472	0.152158	0.000708	0.000022	0.000027	-0.000023	-0.000074	-0.000447
1.94	0.53	-3634.97	0.00000295	-0.0010970	0.0450357	0.152513	0.000697	0.000023	0.000028	-0.000023	-0.000075	-0.000445
2.01	0.57	-3634.68	0.00000301	-0.0007050	0.0489311	0.152035	0.000711	0.000022	0.000027	-0.000023	-0.000074	-0.000447
1.96	0.54	-3634.43	0.00000297	-0.0009835	0.0458624	0.152395	0.000700	0.000022	0.000028	-0.000023	-0.000075	-0.000445
1.98	0.55	-3633.97	0.00000298	-0.0008815	0.0467139	0.152274	0.000702	0.000022	0.000027	-0.000024	-0.000075	-0.000445
2.00	0.56	-3633.58	0.00000299	-0.0007899	0.0475881	0.152153	0.000705	0.000022	0.000027	-0.000024	-0.000075	-0.000445
1.95	0.53	-3633.46	0.00000294	-0.0011012	0.0445398	0.152511	0.000695	0.000022	0.000028	-0.000024	-0.000076	-0.000443
2.02	0.57	-3633.25	0.00000300	-0.0007076	0.0484835	0.152030	0.000708	0.000022	0.000027	-0.000024	-0.000074	-0.000446
1.97	0.54	-3632.94	0.00000295	-0.0009873	0.0453797	0.152393	0.000697	0.000022	0.000027	-0.000024	-0.000076	-0.000443
1.99	0.55	-3632.50	0.00000297	-0.0008848	0.0462442	0.152271	0.000700	0.000022	0.000027	-0.000024	-0.000075	-0.000444
2.01	0.56	-3632.13	0.00000298	-0.0007928	0.0471318	0.152148	0.000702	0.000022	0.000027	-0.000024	-0.000075	-0.000444
1.96	0.53	-3631.94	0.00000293	-0.0011055	0.0440459	0.152508	0.000692	0.000022	0.000028	-0.000024	-0.000076	-0.000442
2.03	0.57	-3631.83	0.00000299	-0.0007101	0.0480399	0.152023	0.000705	0.000022	0.000026	-0.000024	-0.000075	-0.000445
1.98	0.54	-3631.46	0.00000294	-0.0009910	0.0449005	0.152389	0.000694	0.000022	0.000027	-0.000024	-0.000076	-0.000442
2.00	0.55	-3631.03	0.00000296	-0.0008881	0.0457776	0.152267	0.000697	0.000022	0.000027	-0.000025	-0.000076	-0.000442
2.02	0.56	-3630.68	0.00000297	-0.0007956	0.0466775	0.152143	0.000700	0.000022	0.000027	-0.000025	-0.000075	-0.000443
1.97	0.53	-3630.42	0.00000292	-0.0011097	0.0435548	0.152504	0.000689	0.000022	0.000027	-0.000025	-0.000077	-0.000440
2.04	0.57	-3630.41	0.00000298	-0.0007126	0.0475996	0.152016	0.000703	0.000022	0.000026	-0.000025	-0.000075	-0.000443
1.99	0.54	-3629.96	0.00000293	-0.0009947	0.0444231	0.152384	0.000691	0.000022	0.000027	-0.000025	-0.000076	-0.000441
2.01	0.55	-3629.57	0.00000295	-0.0008913	0.0453139	0.152262	0.000694	0.000022	0.000027	-0.000025	-0.000076	-0.000441
2.03	0.56	-3629.24	0.00000296	-0.0007984	0.0462268	0.152137	0.000697	0.000022	0.000026	-0.000025	-0.000076	-0.000442
2.05	0.57	-3628.98	0.00000297	-0.0007151	0.0471610	0.152009	0.000700	0.000022	0.000026	-0.000025	-0.000075	-0.000442
1.98	0.53	-3628.90	0.00000291	-0.0011139	0.0430664	0.152497	0.000686	0.000022	0.000027	-0.000025	-0.000077	-0.000439
2.00	0.54	-3628.46	0.00000292	-0.0009983	0.0439479	0.152380	0.000688	0.000022	0.000027	-0.000025	-0.000077	-0.000439
2.02	0.55	-3628.09	0.00000294	-0.0008945	0.0448522	0.152256	0.000691	0.000022	0.000027	-0.000026	-0.000077	-0.000440
2.04	0.56	-3627.79	0.00000295	-0.0008012	0.0457792	0.152130	0.000694	0.000022	0.000026	-0.000026	-0.000076	-0.000440
2.06	0.57	-3627.56	0.00000296	-0.0007175	0.0467258	0.152002	0.000697	0.000022	0.000026	-0.000026	-0.000076	-0.000441
1.99	0.53	-3627.37	0.00000290	-0.0011181	0.0425809	0.152489	0.000683	0.000022	0.000027	-0.000026	-0.000078	-0.000438
2.01	0.54	-3626.96	0.00000291	-0.0010020	0.0434756	0.152372	0.000685	0.000022	0.000027	-0.000026	-0.000077	-0.000438
2.03	0.55	-3626.61	0.00000292	-0.0008977	0.0443930	0.152251	0.000688	0.000022	0.000026	-0.000026	-0.000077	-0.000438
2.05	0.56	-3626.34	0.00000294	-0.0008040	0.0453334	0.152123	0.000691	0.000022	0.000026	-0.000026	-0.000077	-0.000439
2.07	0.57	-3626.14	0.00000295	-0.0007199	0.0462932	0.151994	0.000694	0.000022	0.000026	-0.000026	-0.000076	-0.000440
2.00	0.53	-3625.84	0.00000289	-0.0011222	0.0420998	0.152481	0.000680	0.000022	0.000027	-0.000026	-0.000078	-0.000436
2.02	0.54	-3625.45	0.00000290	-0.0010056	0.0430061	0.152362	0.000683	0.000022	0.000027	-0.000026	-0.000078	-0.000437
2.04	0.55	-3625.13	0.00000291	-0.0009009	0.0439365	0.152242	0.000685	0.000022	0.000026	-0.000027	-0.000077	-0.000437
2.06	0.56	-3624.89	0.00000293	-0.0008068	0.0448898	0.152115	0.000689	0.000022	0.000026	-0.000027	-0.000077	-0.000438
2.01	0.53	-3624.31	0.00000288	-0.0011263	0.0416207	0.152470	0.000677	0.000022	0.000027	-0.000027	-0.000078	-0.000435
2.03	0.54	-3623.95	0.00000289	-0.0010092	0.0425416	0.152352	0.000680	0.000022	0.000026	-0.000027	-0.000078	-0.000435
2.05	0.55	-3623.65	0.00000290	-0.0009040	0.0434831	0.152231	0.000683	0.000022	0.000026	-0.000027	-0.000078	-0.000436
2.07	0.56	-3623.43	0.00000292	-0.0008095	0.0444488	0.152106	0.000686	0.000022	0.000026	-0.000027	-0.000077	-0.000436
2.02	0.53	-3622.78	0.00000287	-0.0011303	0.0411440	0.152459	0.000674	0.000022	0.000027	-0.000027	-0.000079	-0.000434
2.04	0.54	-3622.45	0.00000288	-0.0010127	0.0420786	0.152341	0.000677	0.000022	0.000026	-0.000027	-0.000078	-0.000434
2.06	0.55	-3622.18	0.00000289	-0.0009071	0.0430348	0.152218	0.000680	0.000022	0.000026	-0.000028	-0.000078	-0.000435
2.03	0.53	-3621.24	0.00000285	-0.0011344	0.0406695	0.152446	0.000671	0.000022	0.000026	-0.000028	-0.000079	-0.000432
2.05	0.54	-3620.94	0.00000287	-0.0010162	0.0416182	0.152329	0.000674	0.000022	0.000026	-0.000028	-0.000079	-0.000433
2.07	0.55	-3620.70	0.00000288	-0.0009101	0.0425881	0.152206	0.000677	0.000022	0.000026	-0.000028	-0.000078	-0.000433
2.04	0.53	-3619.70	0.00000284	-0.0011384	0.0401985	0.152428	0.000668	0.000022	0.000026	-0.000028	-0.000080	-0.000431
2.06	0.54	-3619.42	0.00000286	-0.0010197	0.0411592	0.152315	0.000671	0.000022	0.000026	-0.000028	-0.000079	-0.000431
2.05	0.53	-3618.16	0.00000283	-0.0011424	0.0397305	0.152410	0.000665	0.000022	0.000026	-0.000029	-0.000080	-0.000430
2.07	0.54	-3617.90	0.00000285	-0.0010232	0.0407037	0.152297	0.000668	0.000022	0.000026	-0.000029	-0.000080	-0.000430
2.06	0.53	-3616.61	0.00000282	-0.0011463	0.0392670	0.152389	0.000662	0.000022	0.000026	-0.000029	-0.000080	-0.000428
2.07	0.53	-3615.07	0.00000281	-0.0011502	0.0388067	0.152366	0.000659	0.000022	0.000026	-0.000030	-0.000081	-0.000427

Source: IREA, 2012

Appendix E

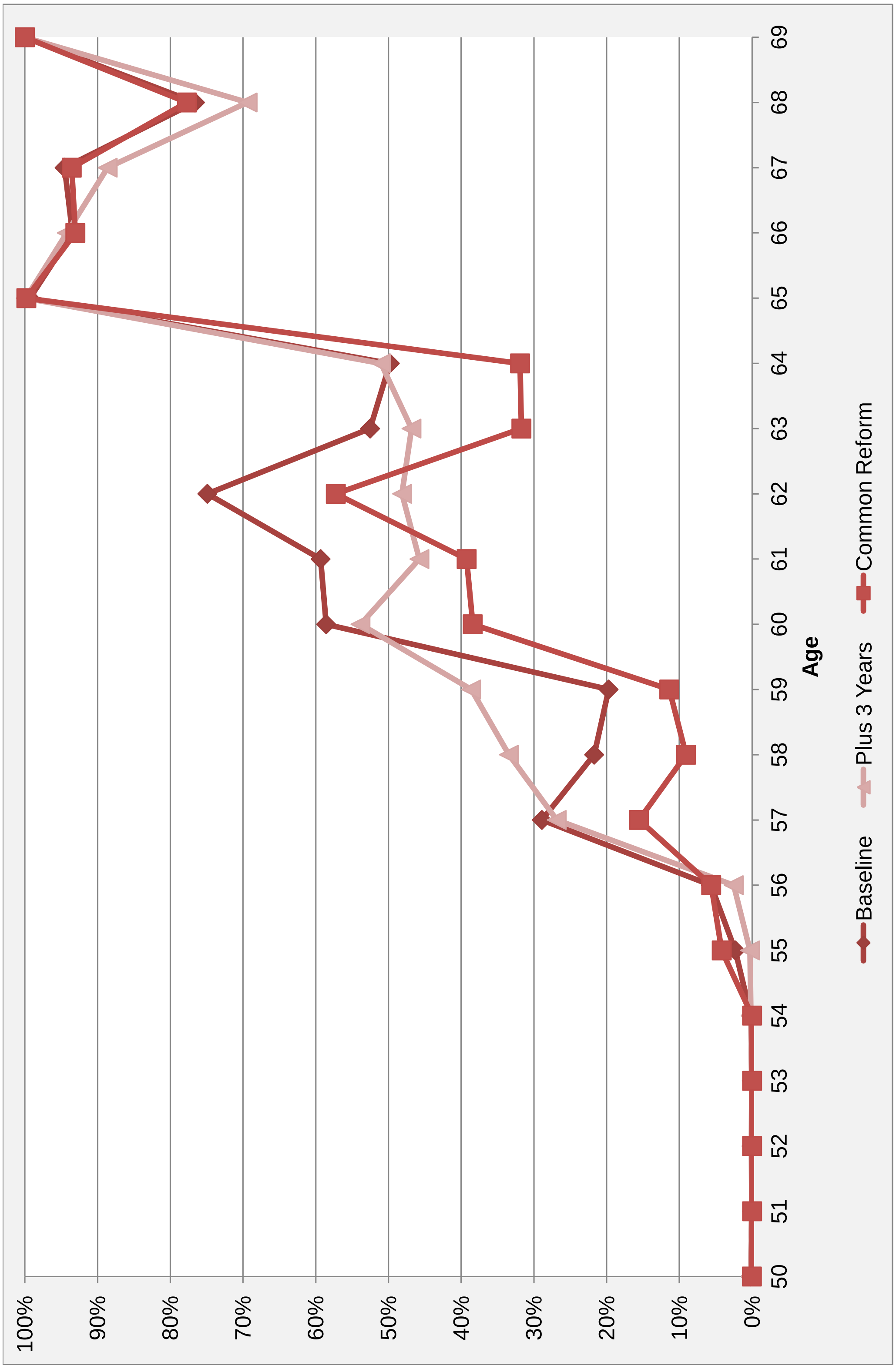
Hazard Rate Figures

Figure E.1: Female Hazard Rate: Accrual Rate/AD



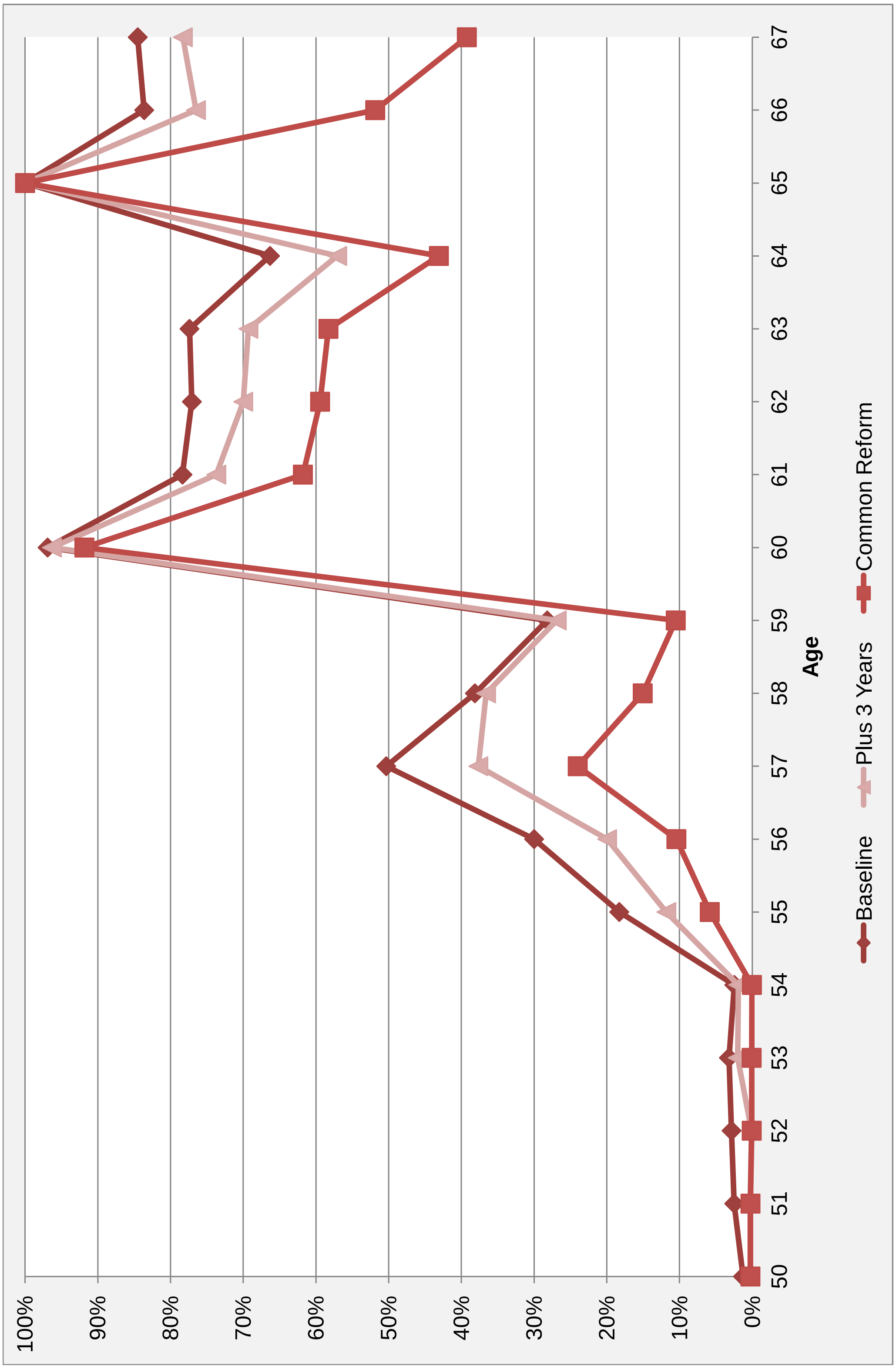
Source: IREA, 2012

Figure E.2: Male Hazard Rate: Accrual Rate/AD



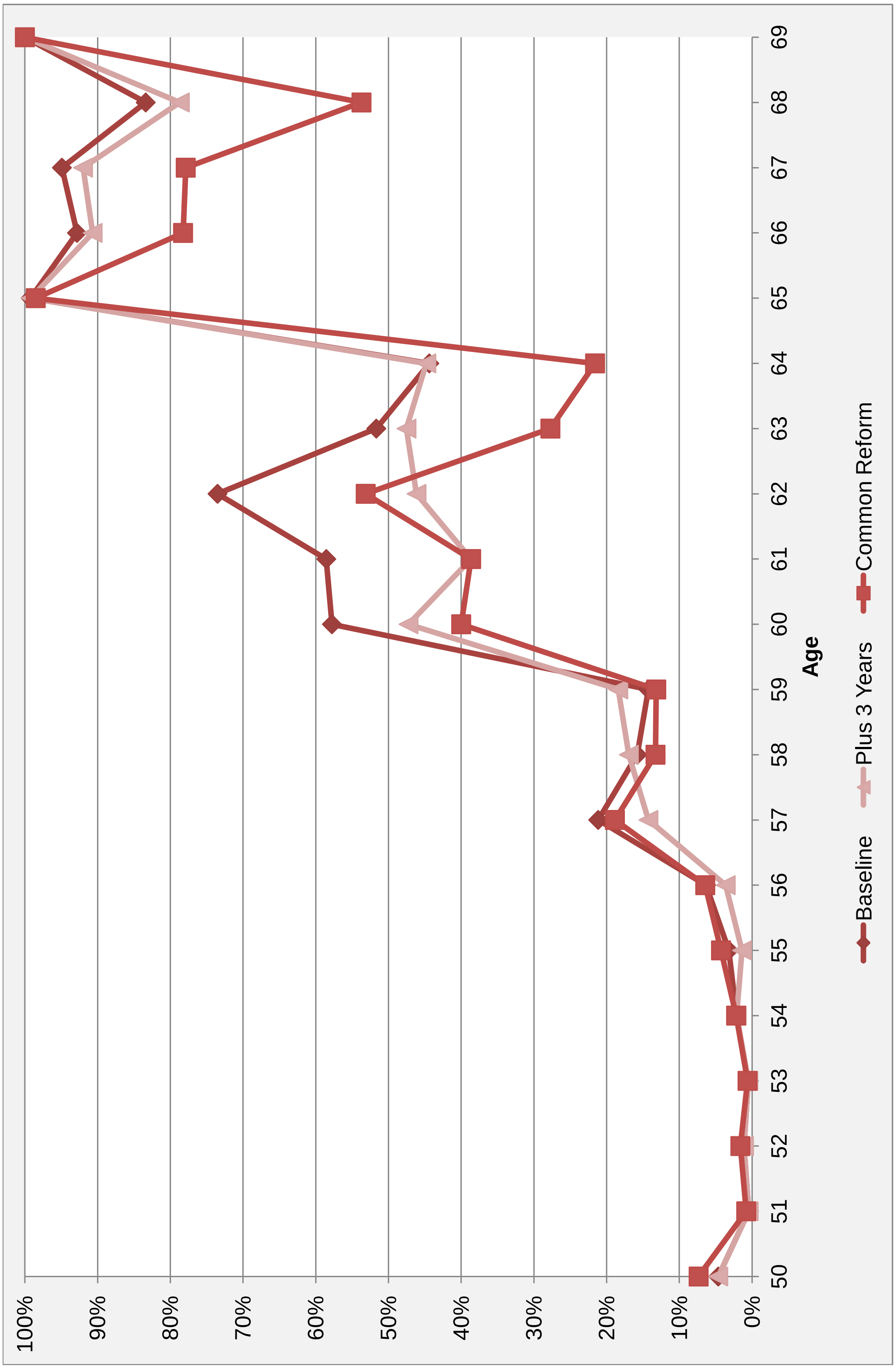
Source: IREA, 2012

Figure E.3: Female Hazard Rate: Peak Value/AD



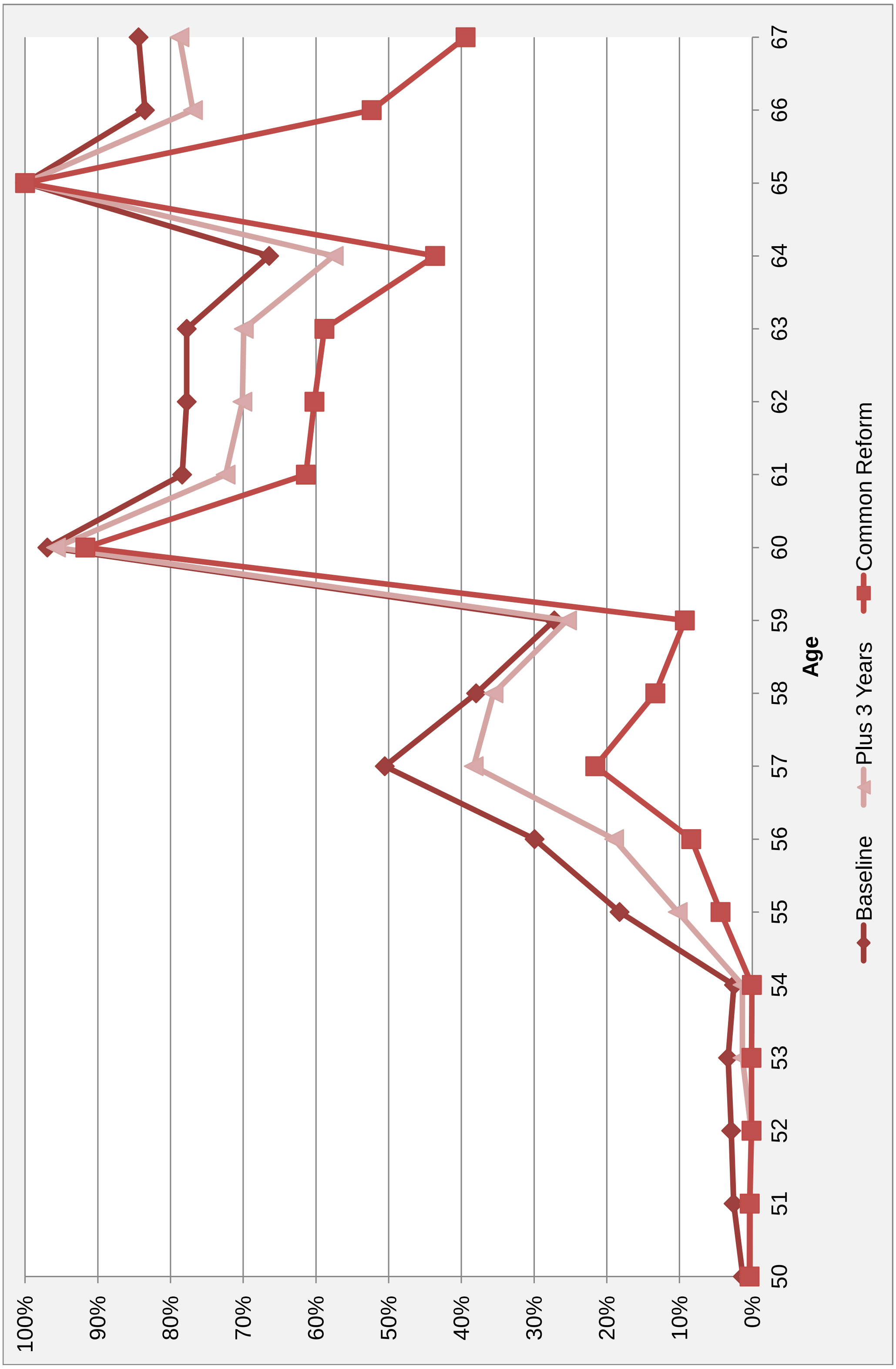
Source: IREA, 2012

Figure E.4: Male Hazard Rate: Peak Value/AD



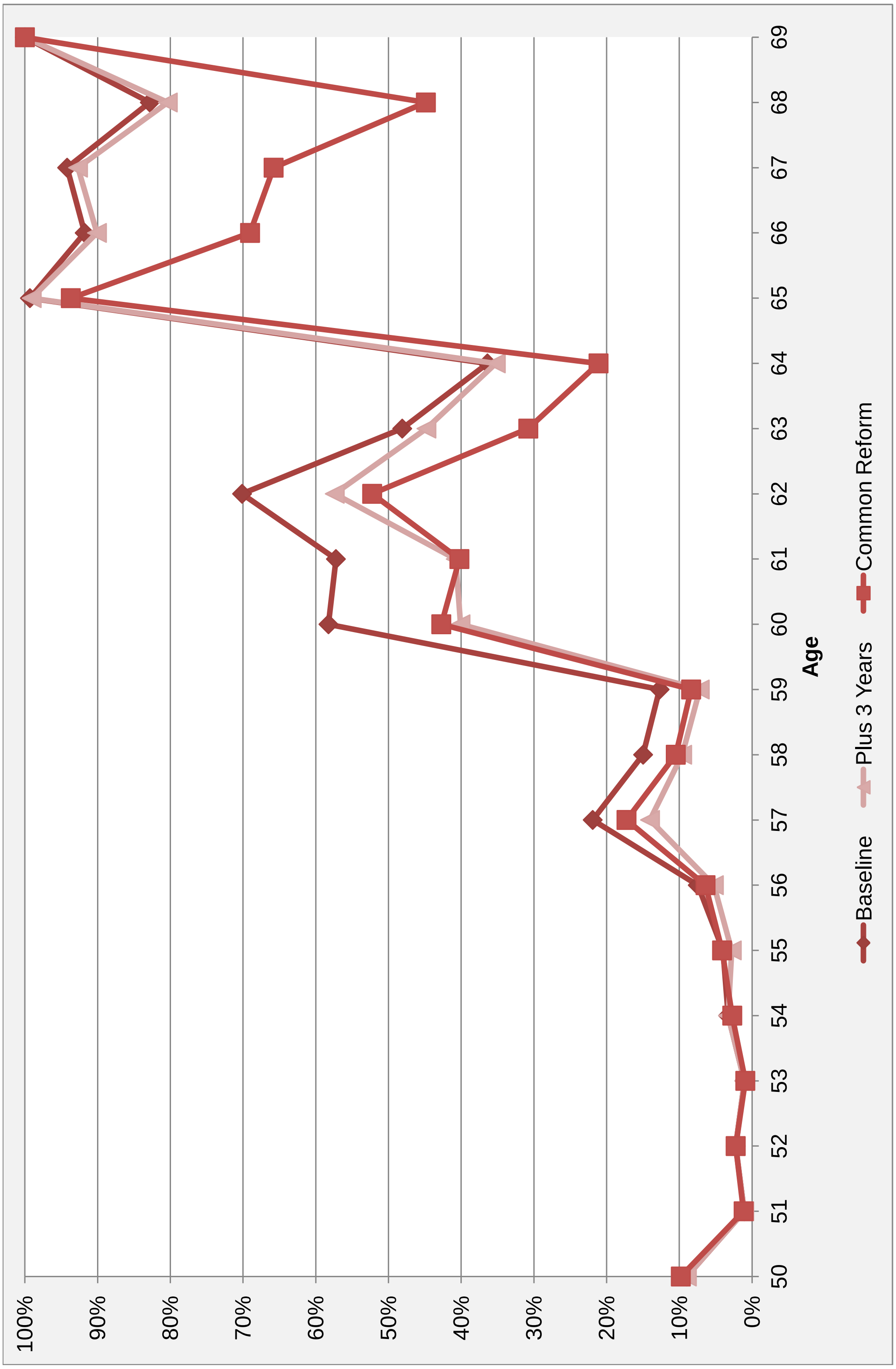
Source: IREA, 2012

Figure E.5: Female Hazard Rate: Option Value/AD



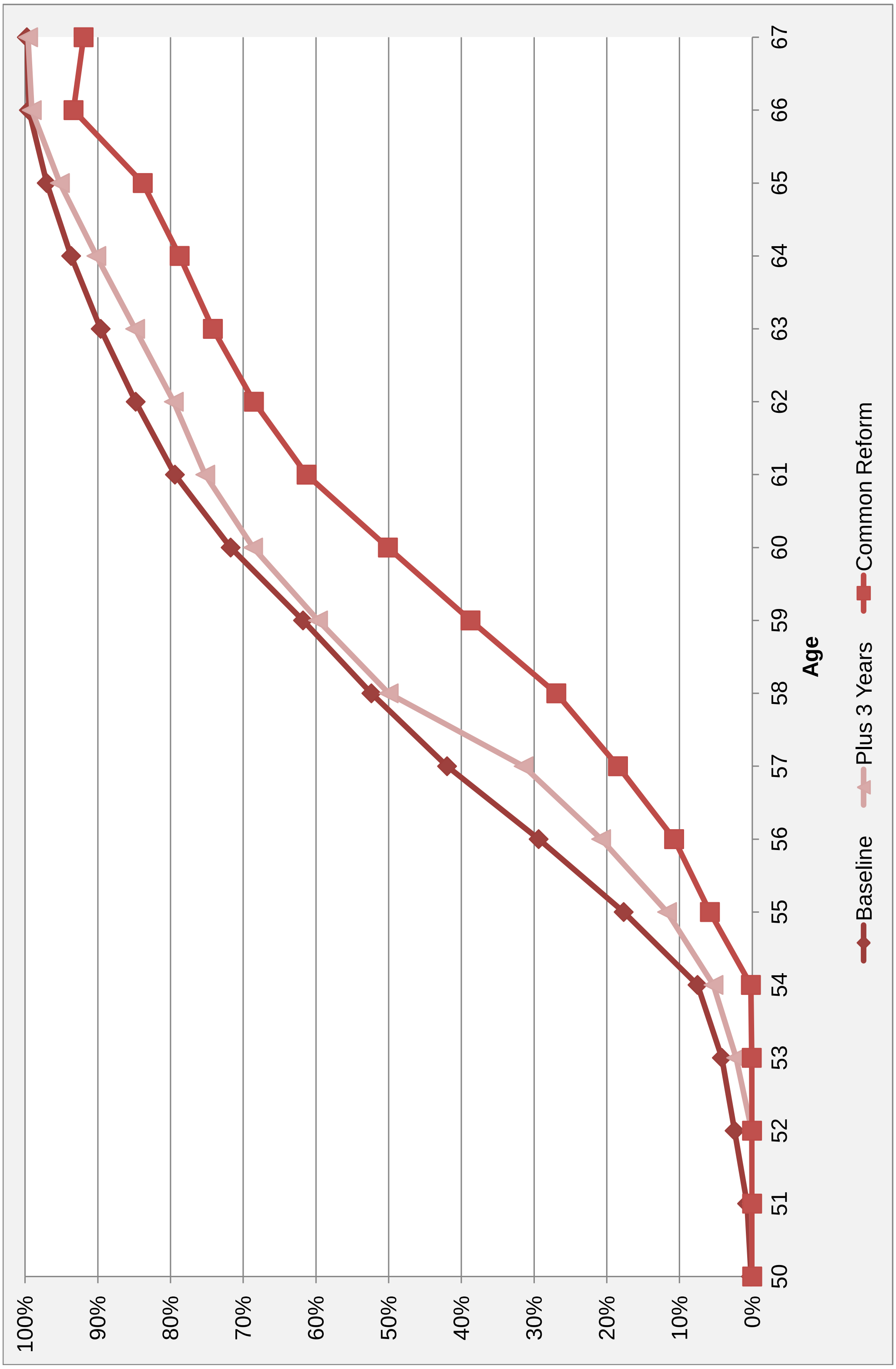
Source: IREA, 2012

Figure E.6: Male Hazard Rate: Option Value/AD



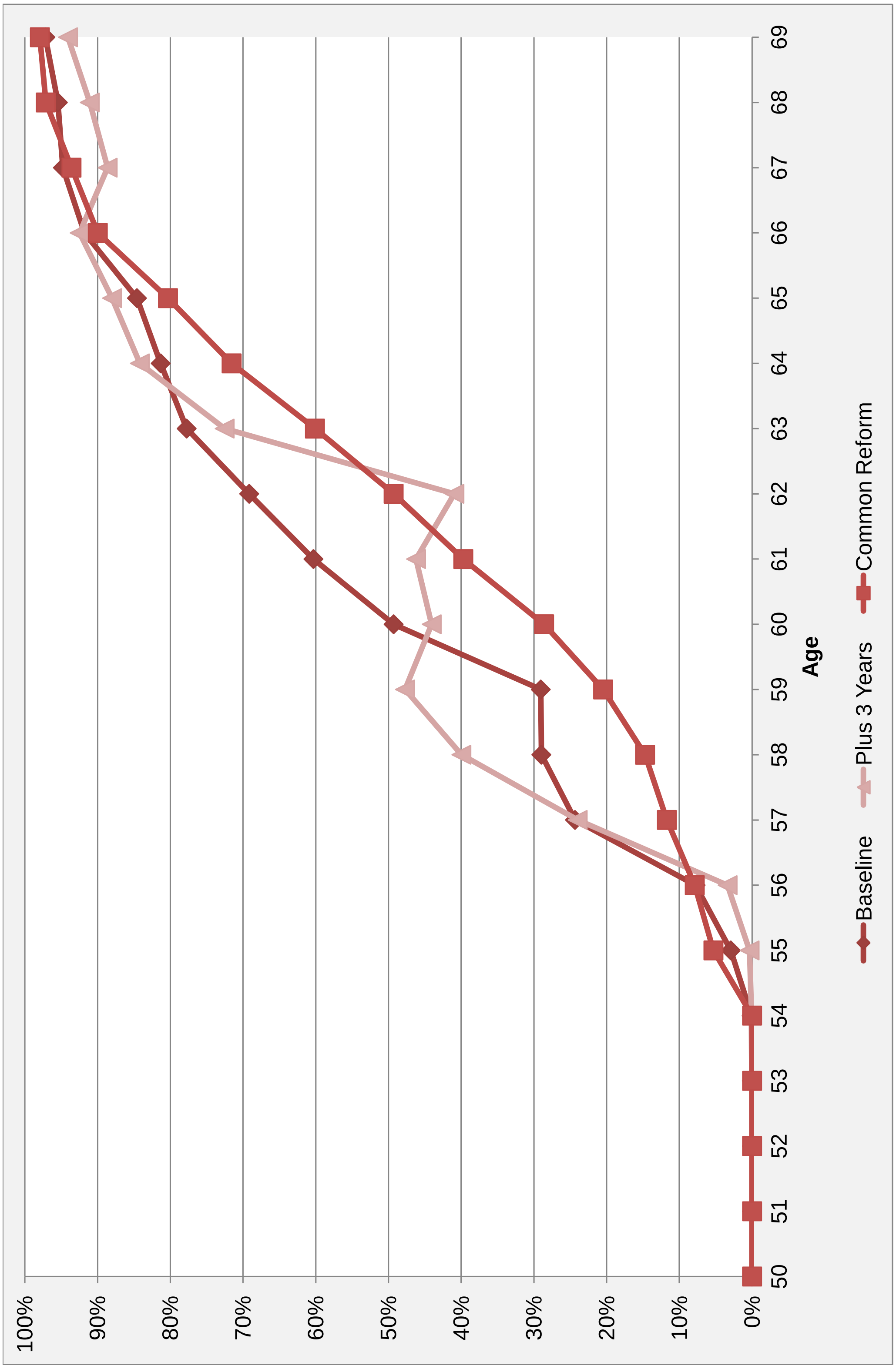
Source: IREA, 2012

Figure E.7: Female Hazard Rate: Accrual Rate/LA



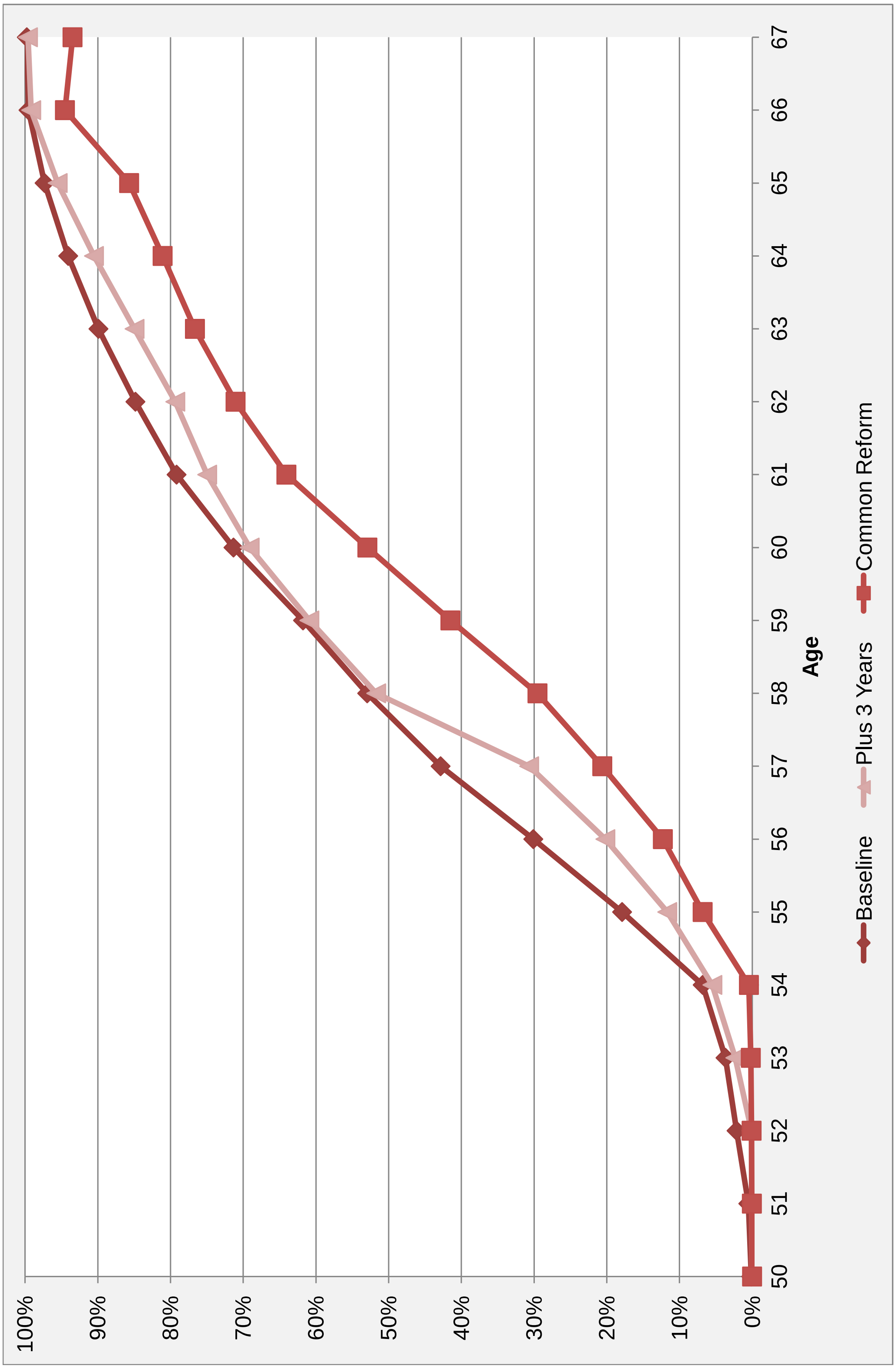
Source: IREA, 2012

Figure E.8: Male Hazard Rate: Accrual Rate/LA



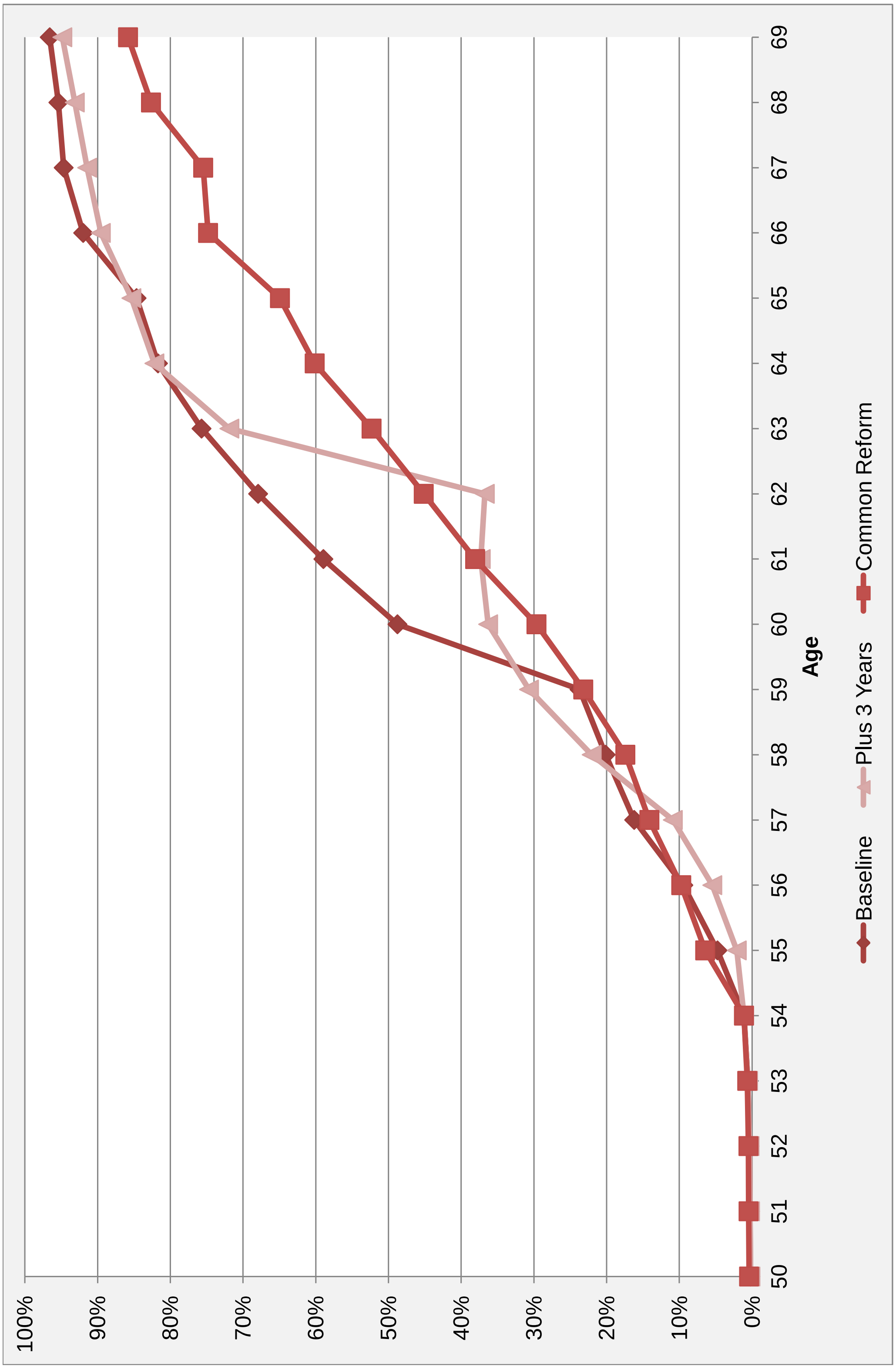
Source: IREA, 2012

Figure E.9: Female Hazard Rate: Peak Value/LA



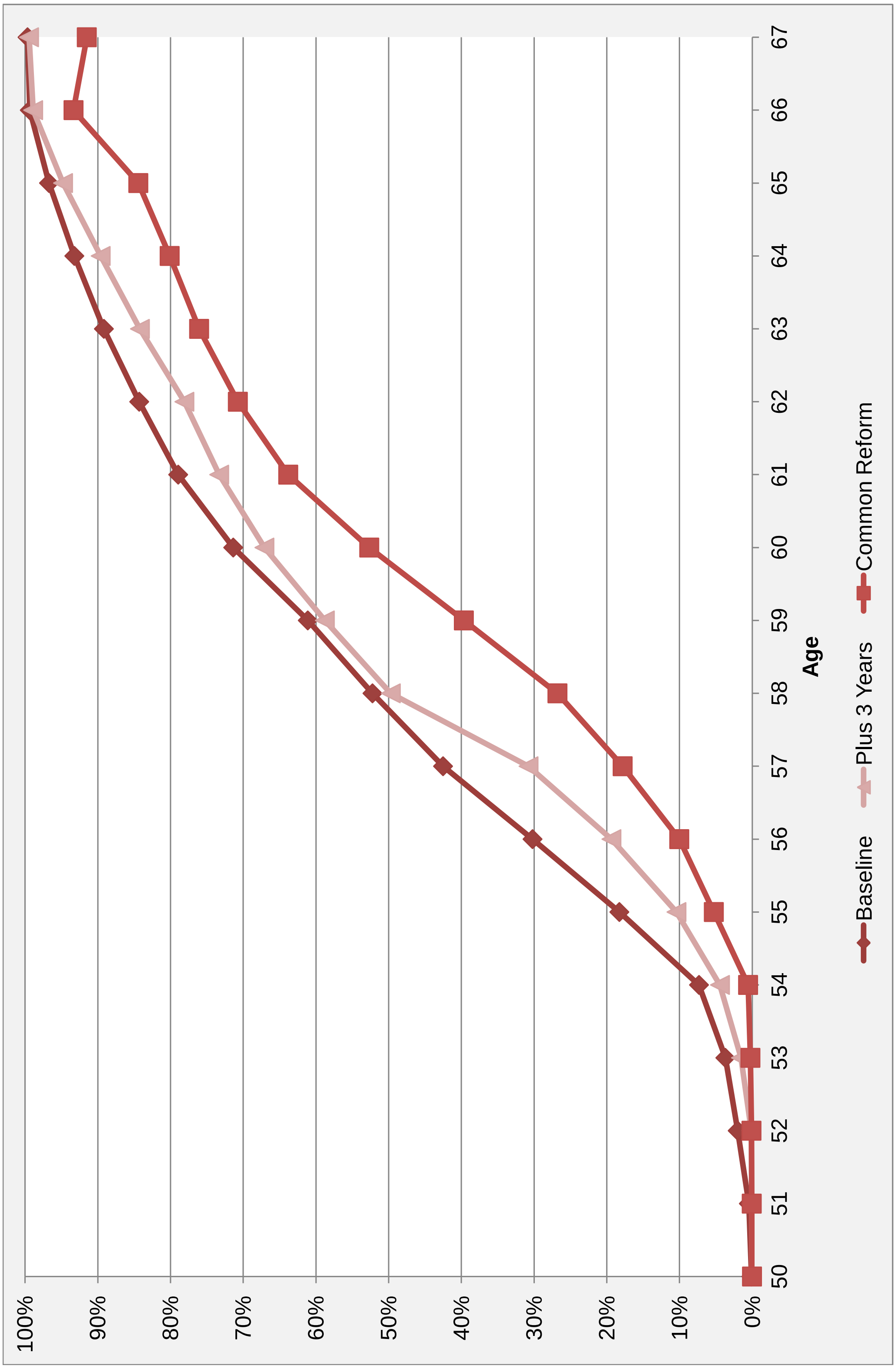
Source: IREA, 2012

Figure E.10: Male Hazard Rate: Peak Value/LA



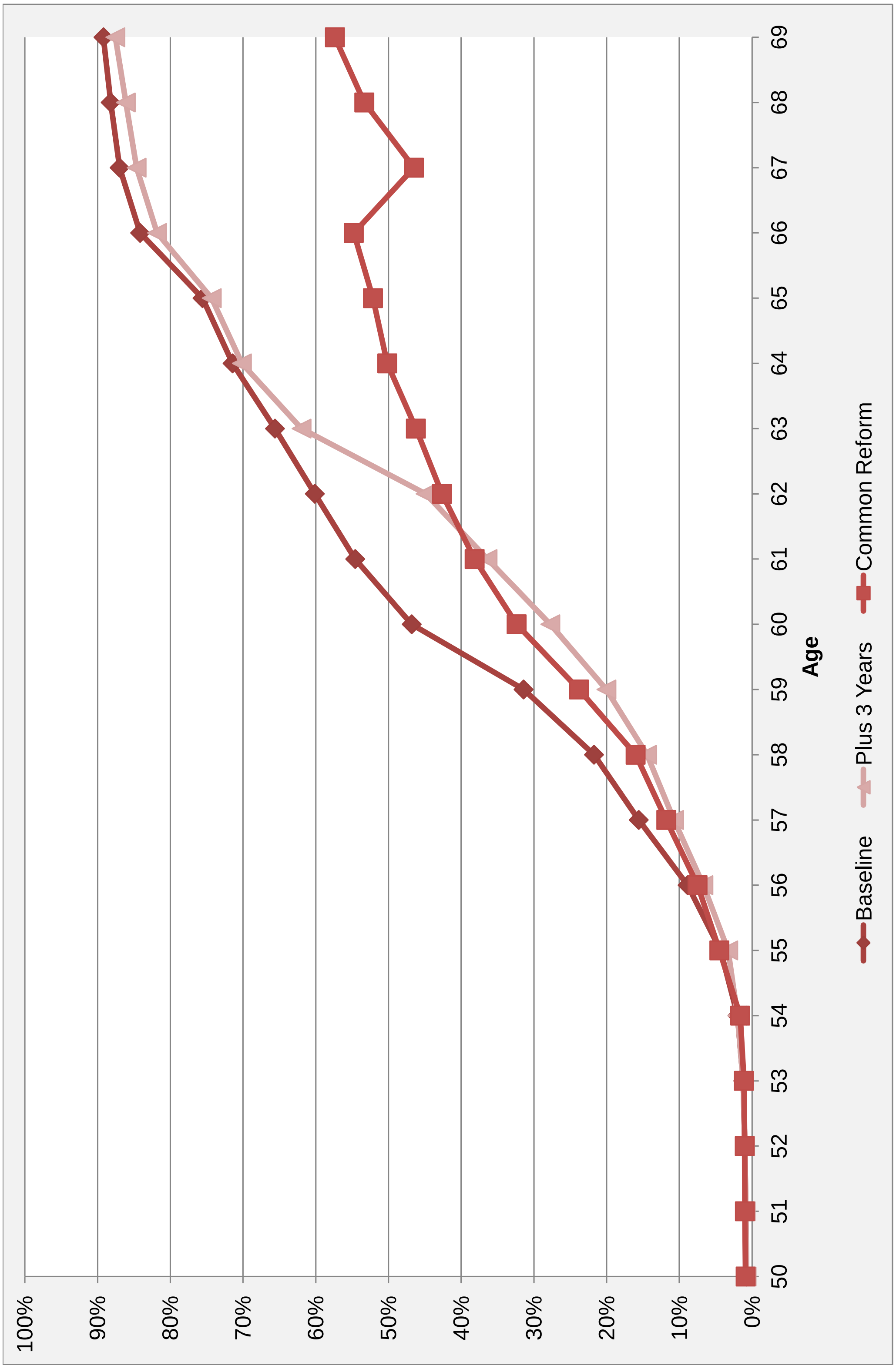
Source: IREA, 2012

Figure E.11: Female Hazard Rate: Option Value/LA



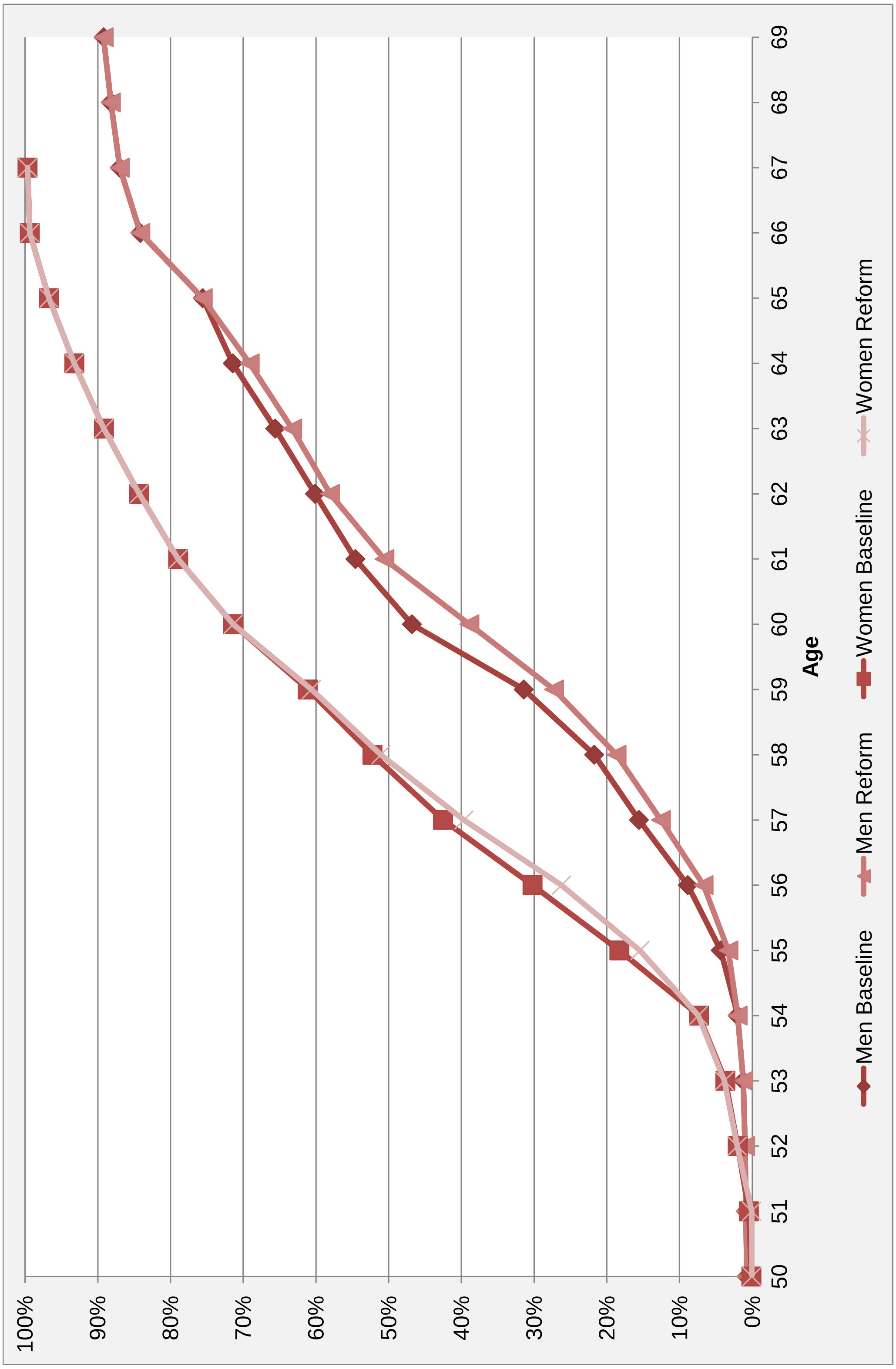
Source: IREA, 2012

Figure E.12: Male Hazard Rate: Option Value/LA



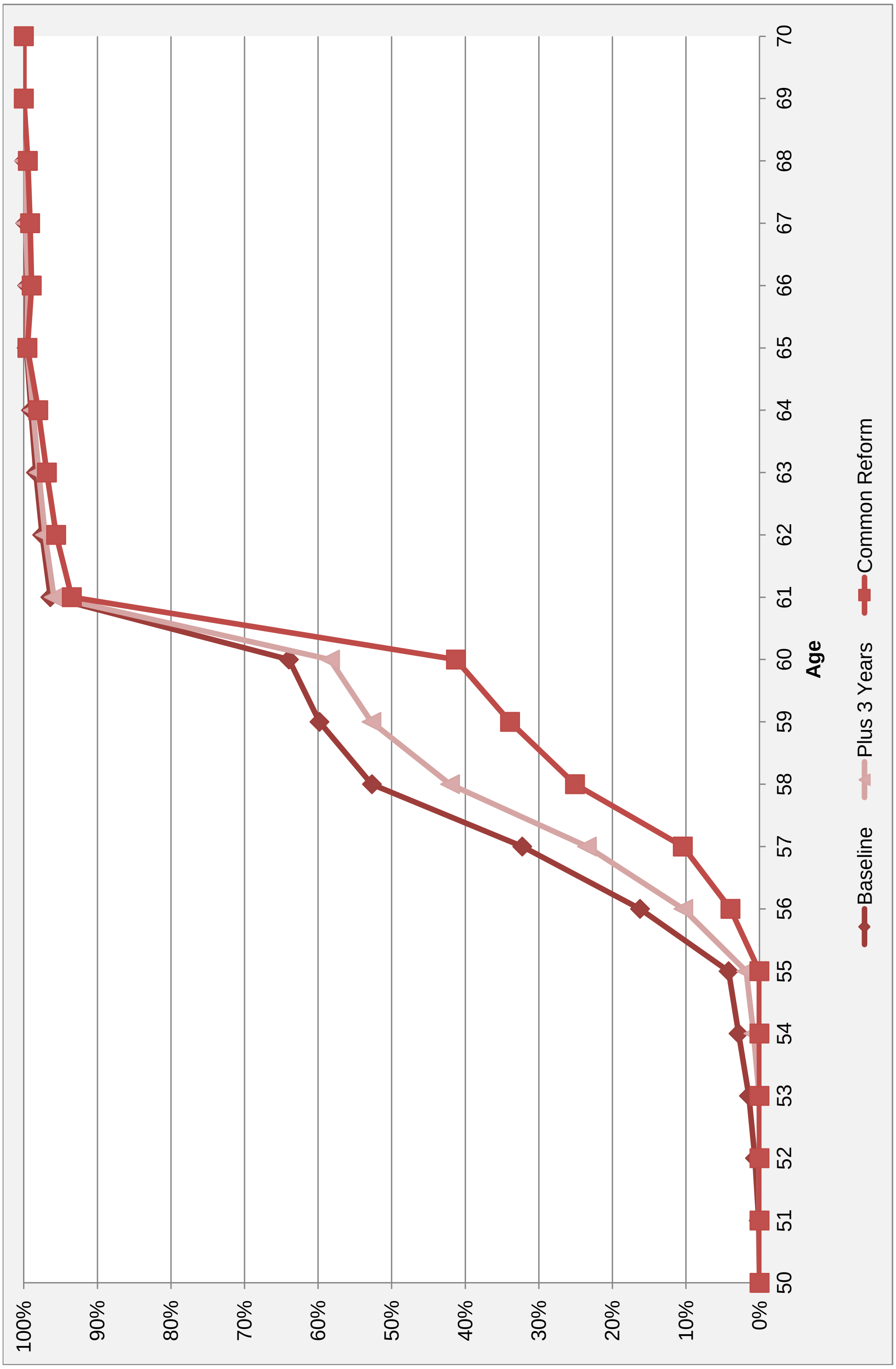
Source: IREA, 2012

Figure E.13: Hazard Rate without *Hacklerregelung*: Option Value/LA



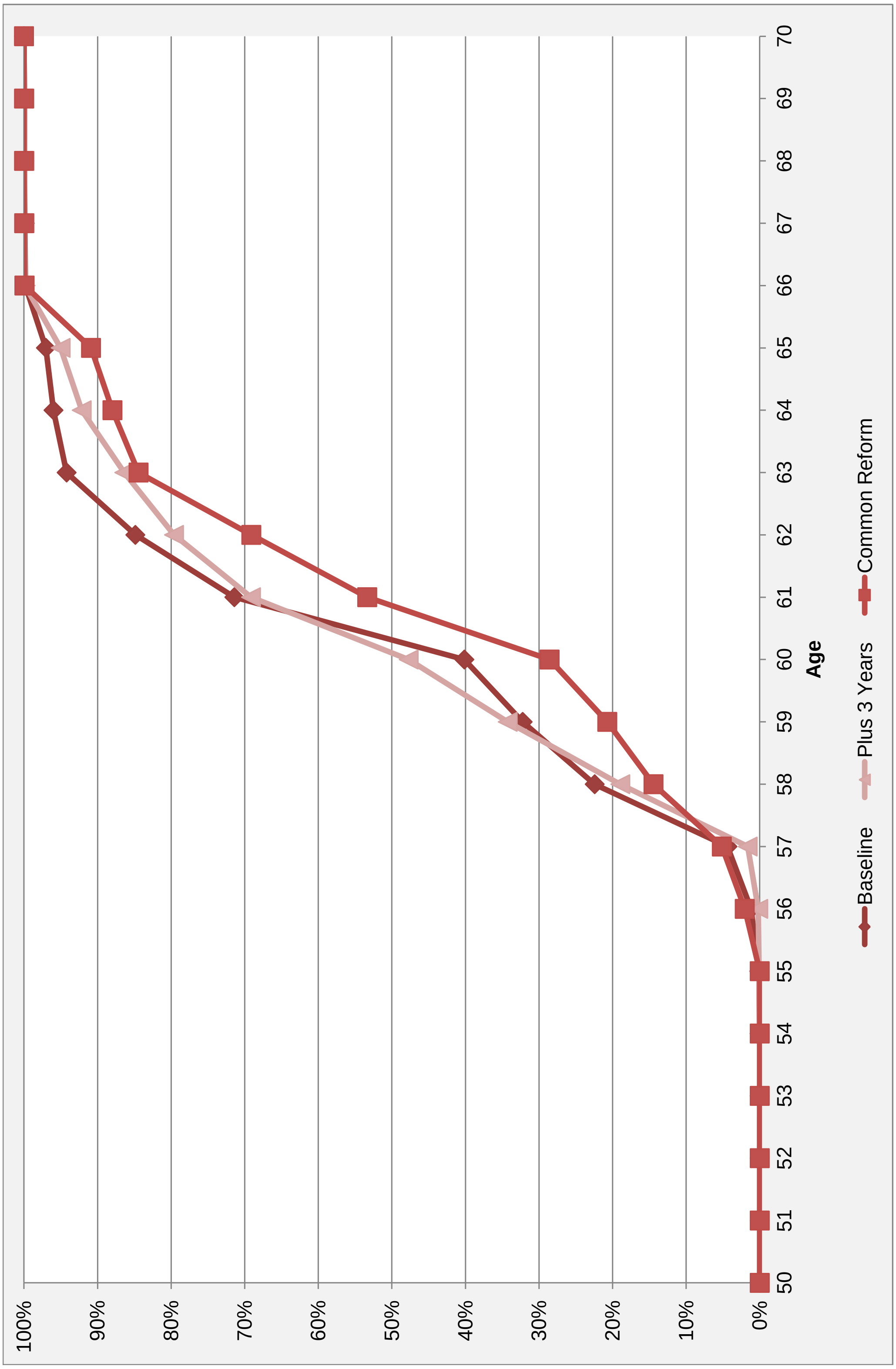
Source: IREA, 2012

Figure E.14: Female Cumulative Hazard Rate: Accrual Rate/AD



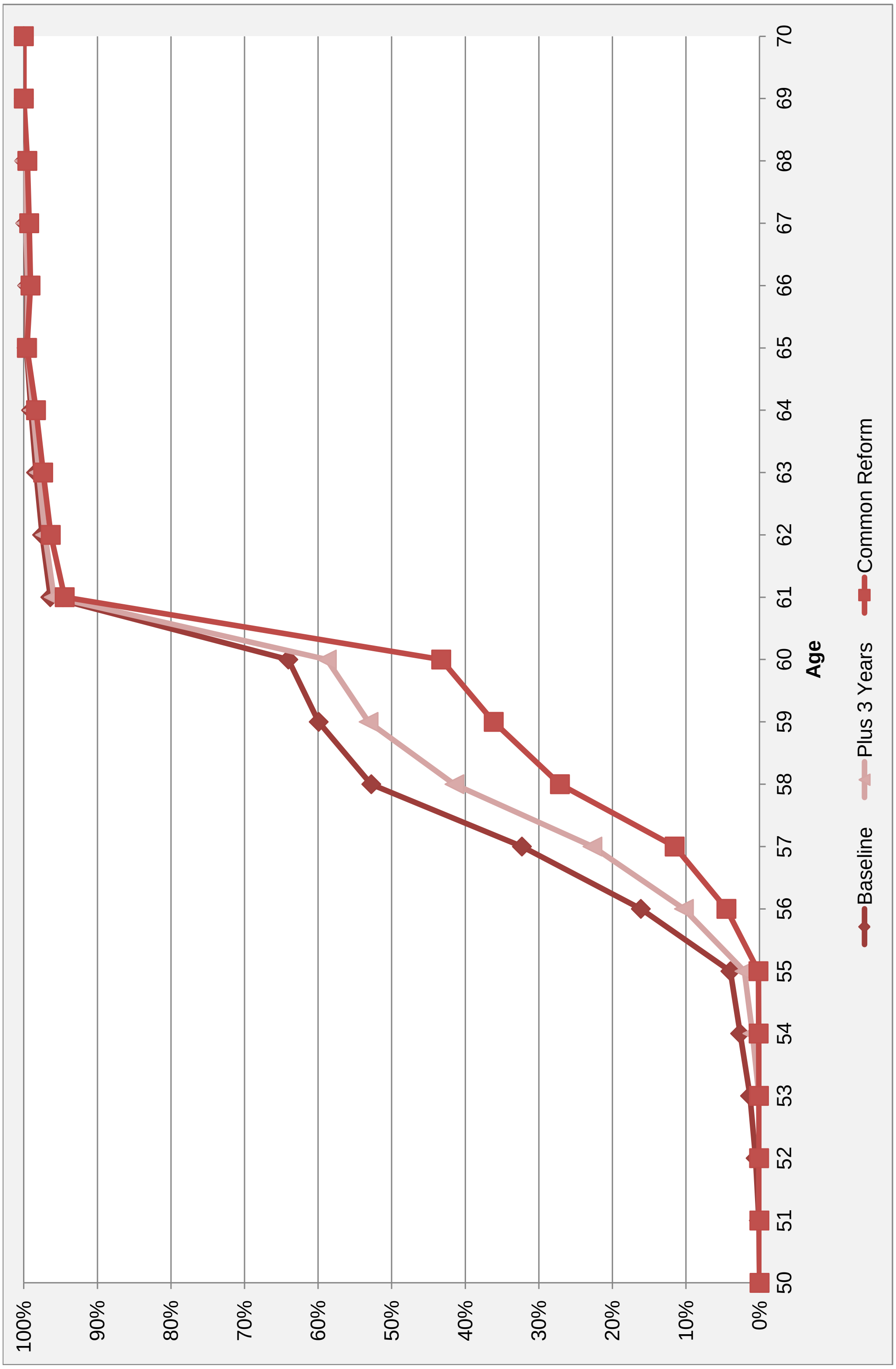
Source: IREA, 2012

Figure E.15: Male Cumulative Hazard Rate: Accrual Rate/AD



Source: IREA, 2012

Figure E.16: Female Cumulative Hazard Rate: Peak Value/AD

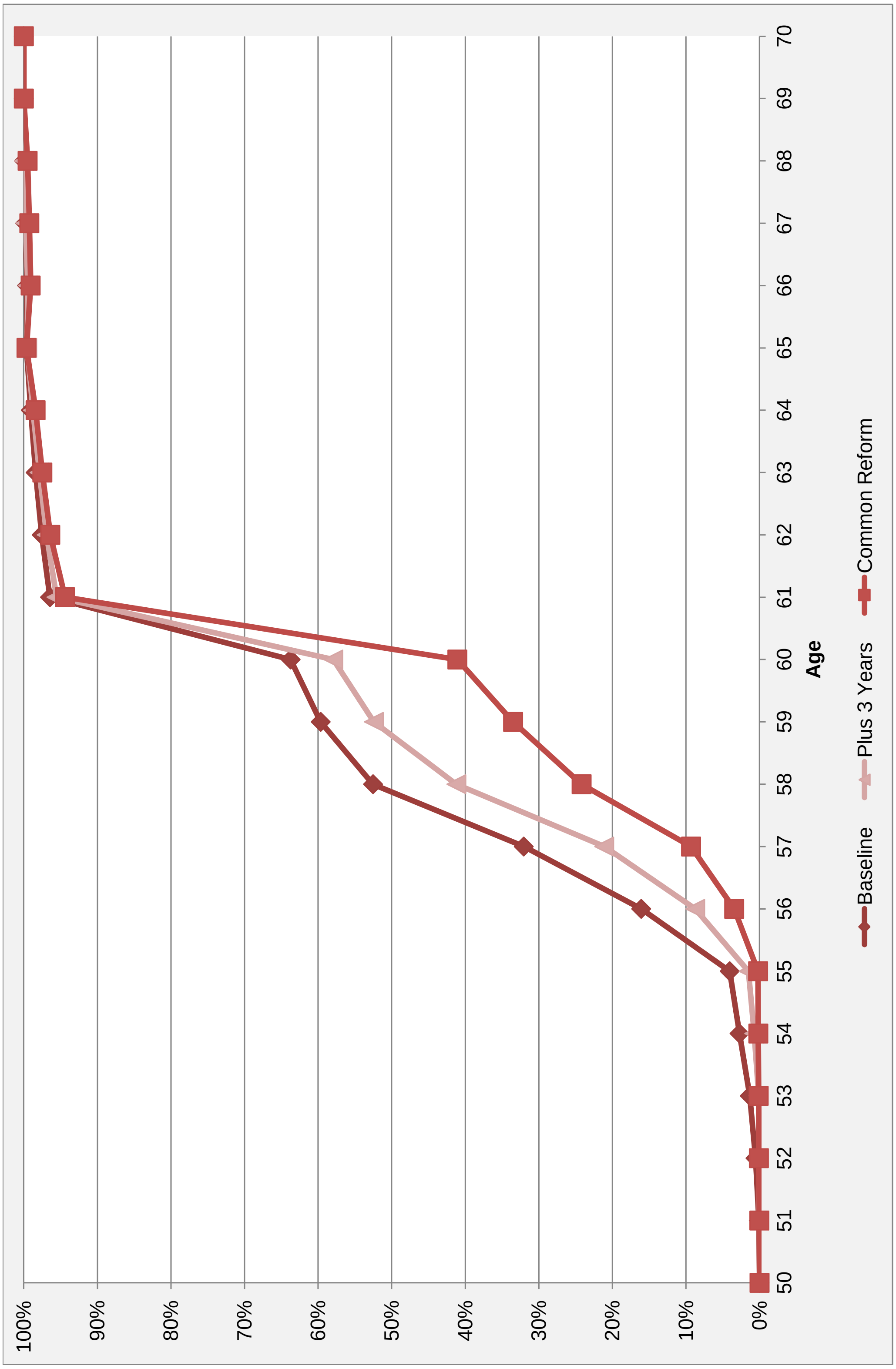


Source: IREA, 2012

Figure E.17: Male Cumulative Hazard Rate: Peak Value/AD

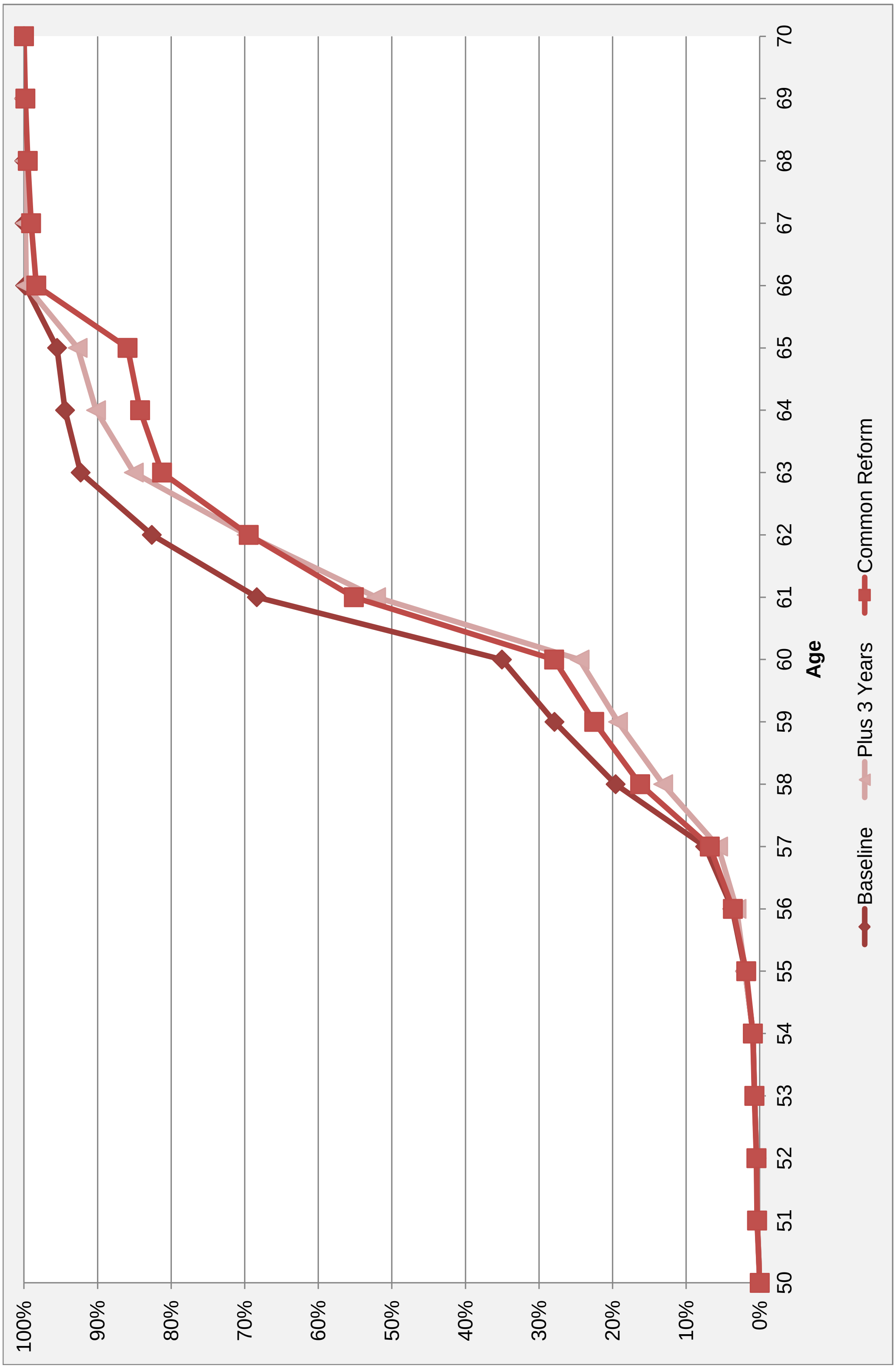
Source: IREA, 2012

Figure E.18: Female Cumulative Hazard Rate: Option Value/AD



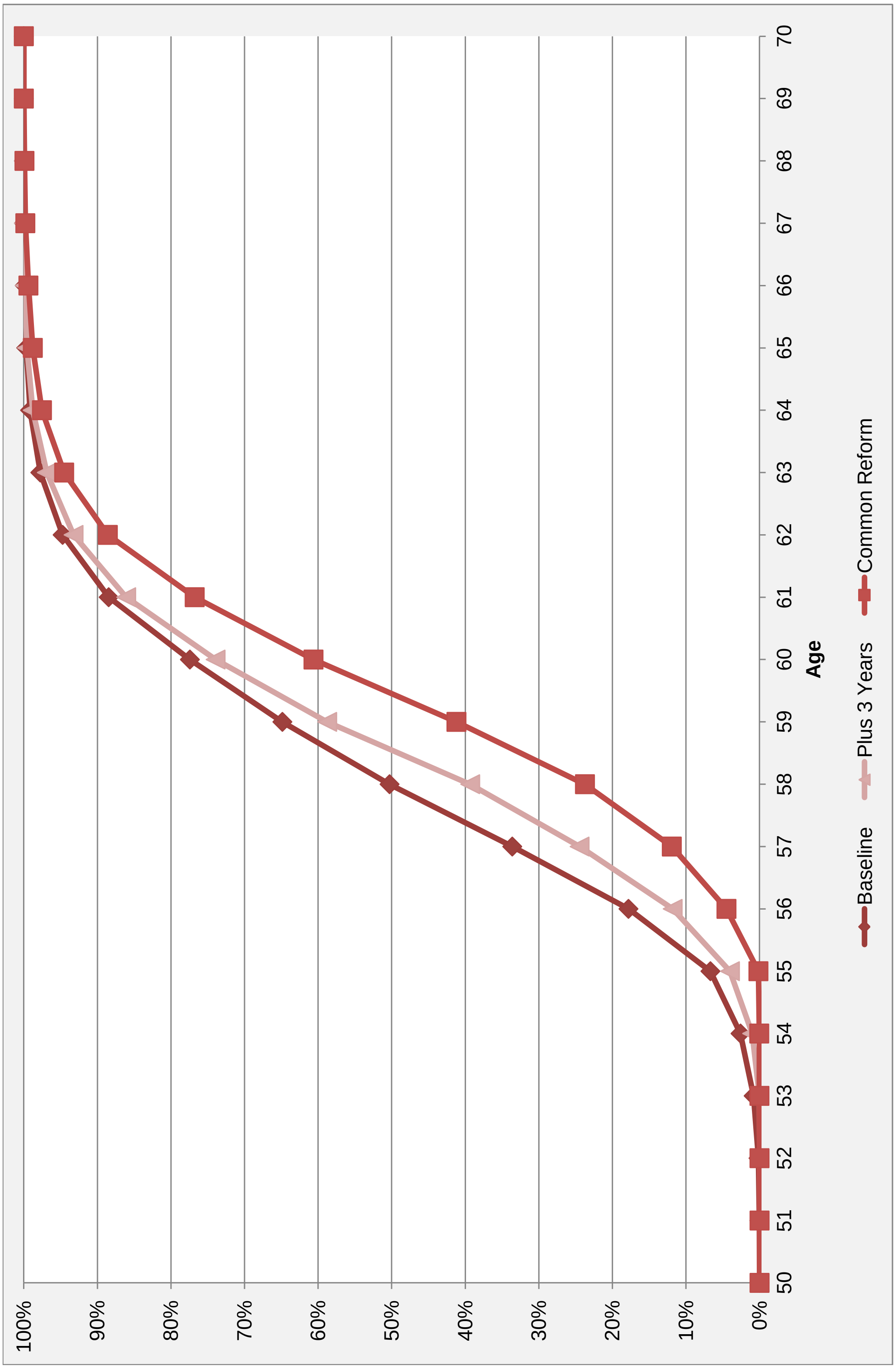
Source: IREA, 2012

Figure E.19: Male Cumulative Hazard Rate: Option Value/AD



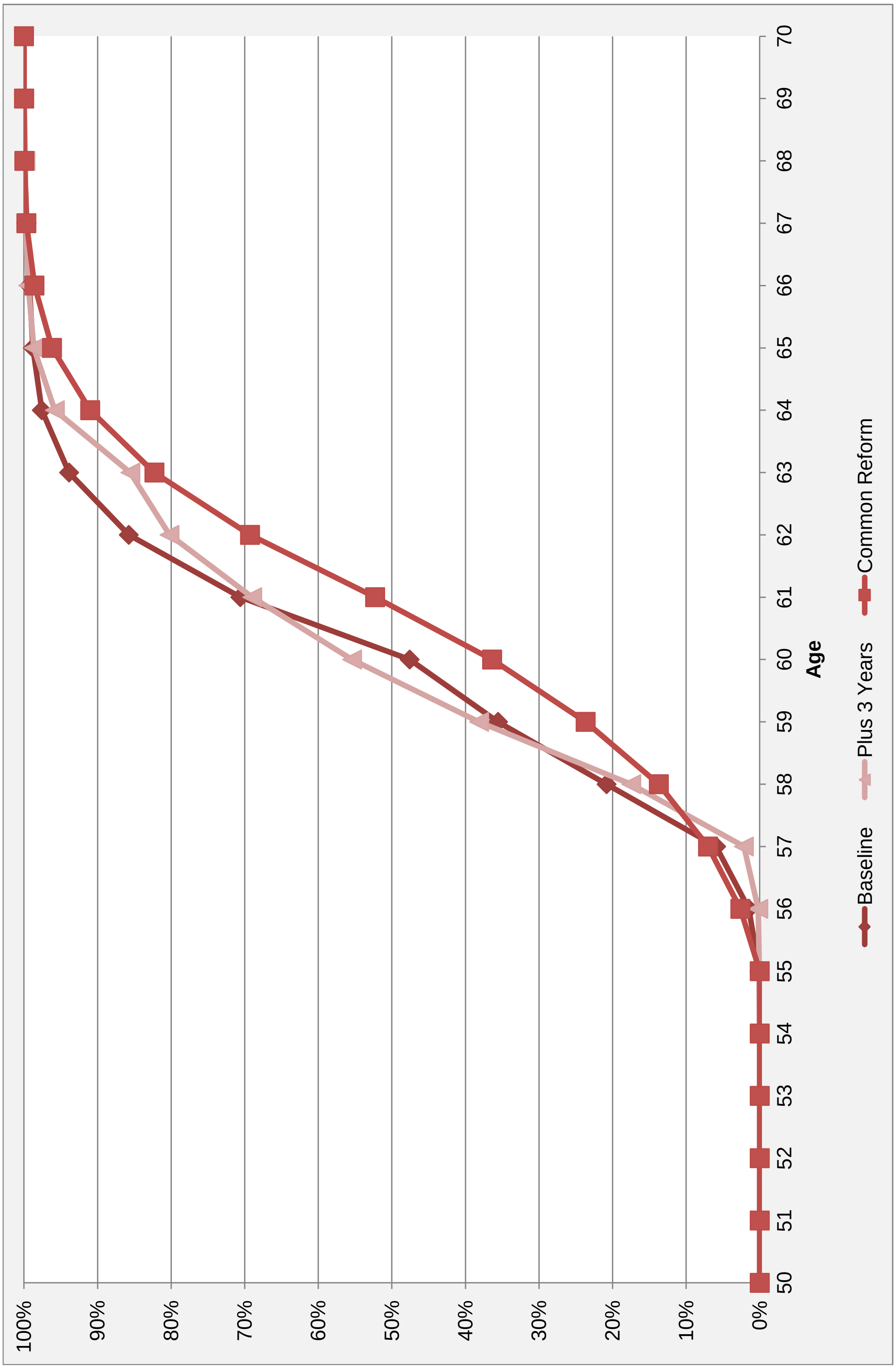
Source: IREA, 2012

Figure E.20: Female Cumulative Hazard Rate: Accrual Rate/LA



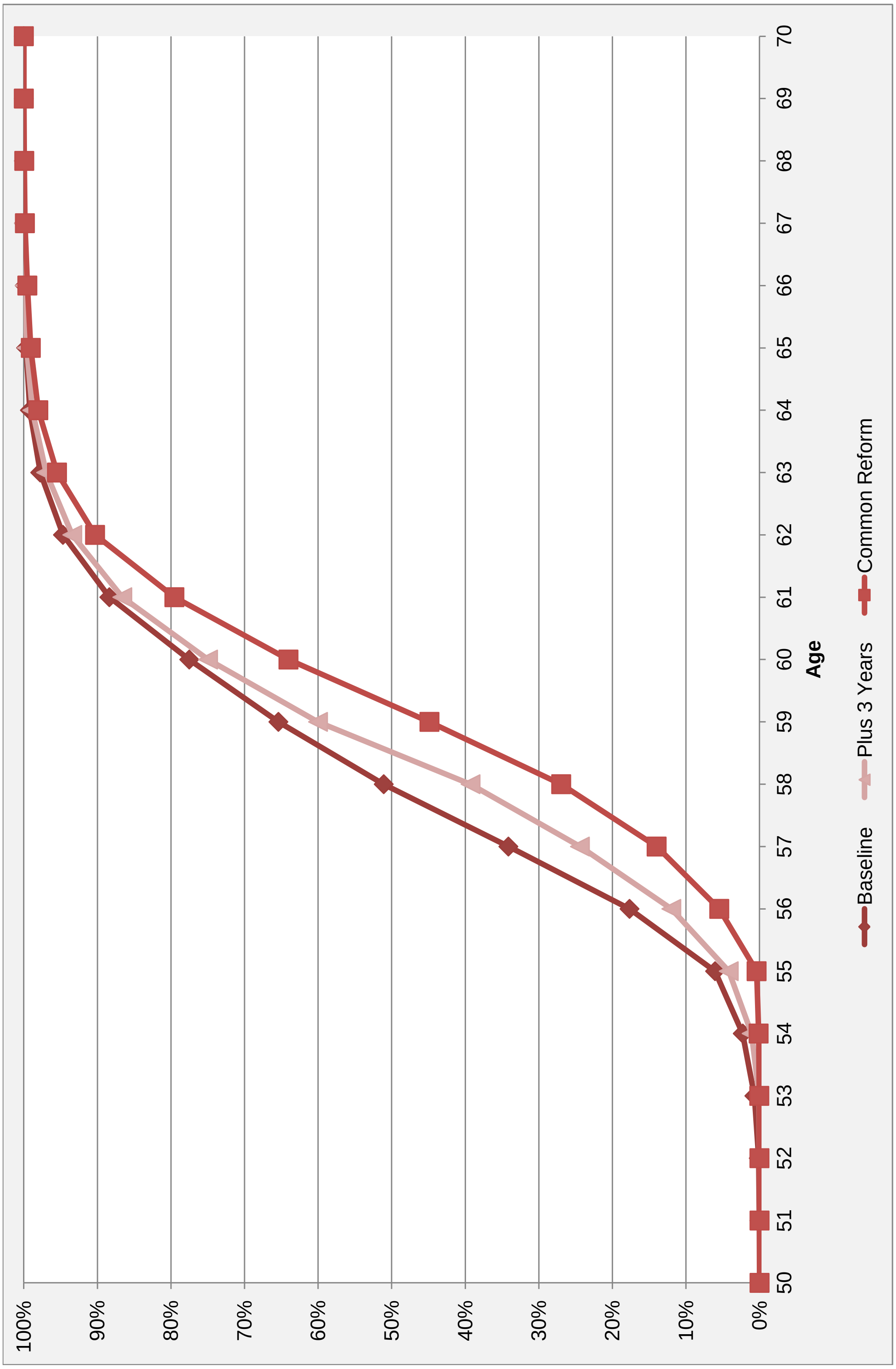
Source: IREA, 2012

Figure E.21: Male Cumulative Hazard Rate: Accrual Rate/LA



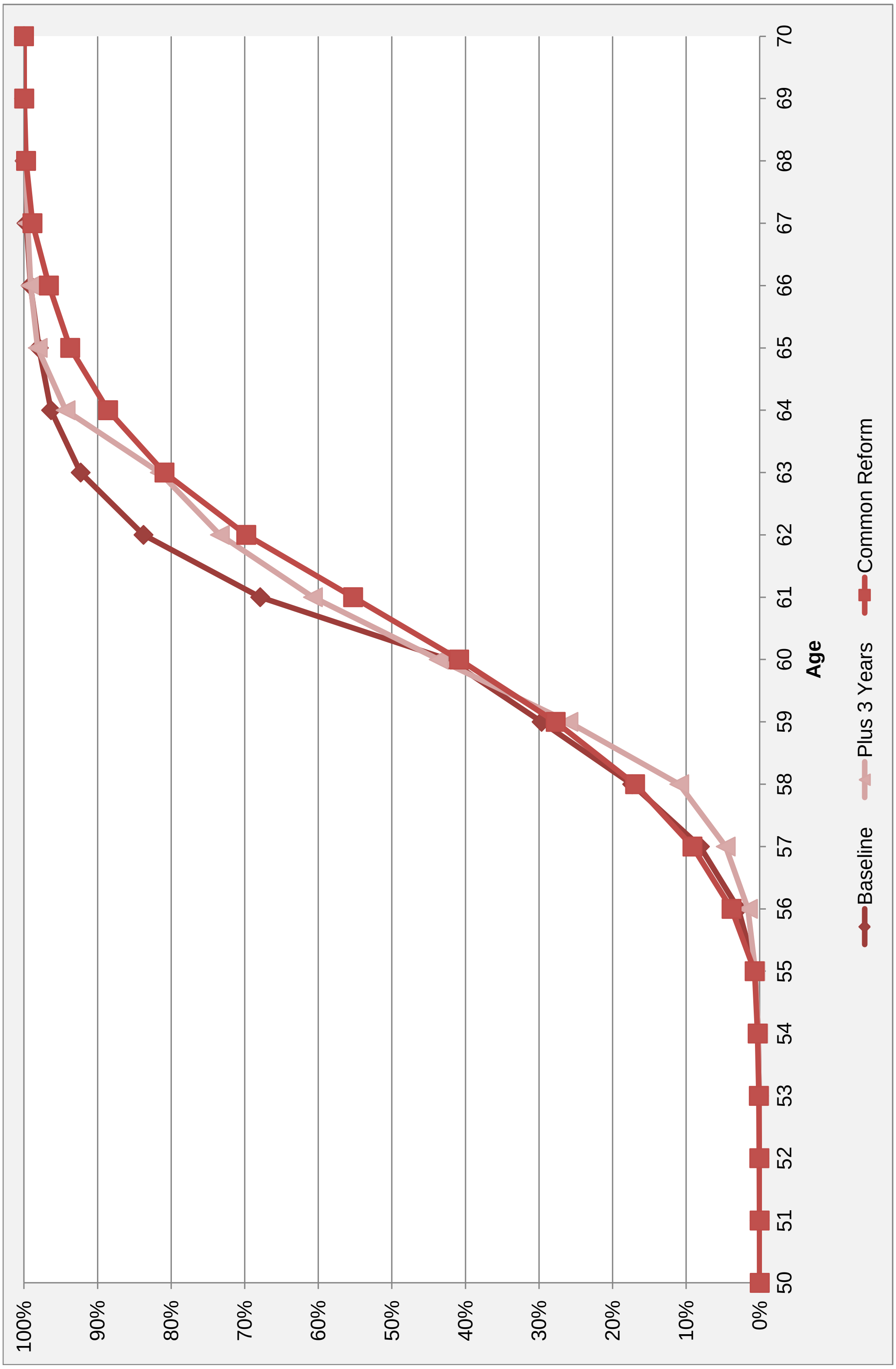
Source: IREA, 2012

Figure E.22: Female Cumulative Hazard Rate: Peak Value/LA



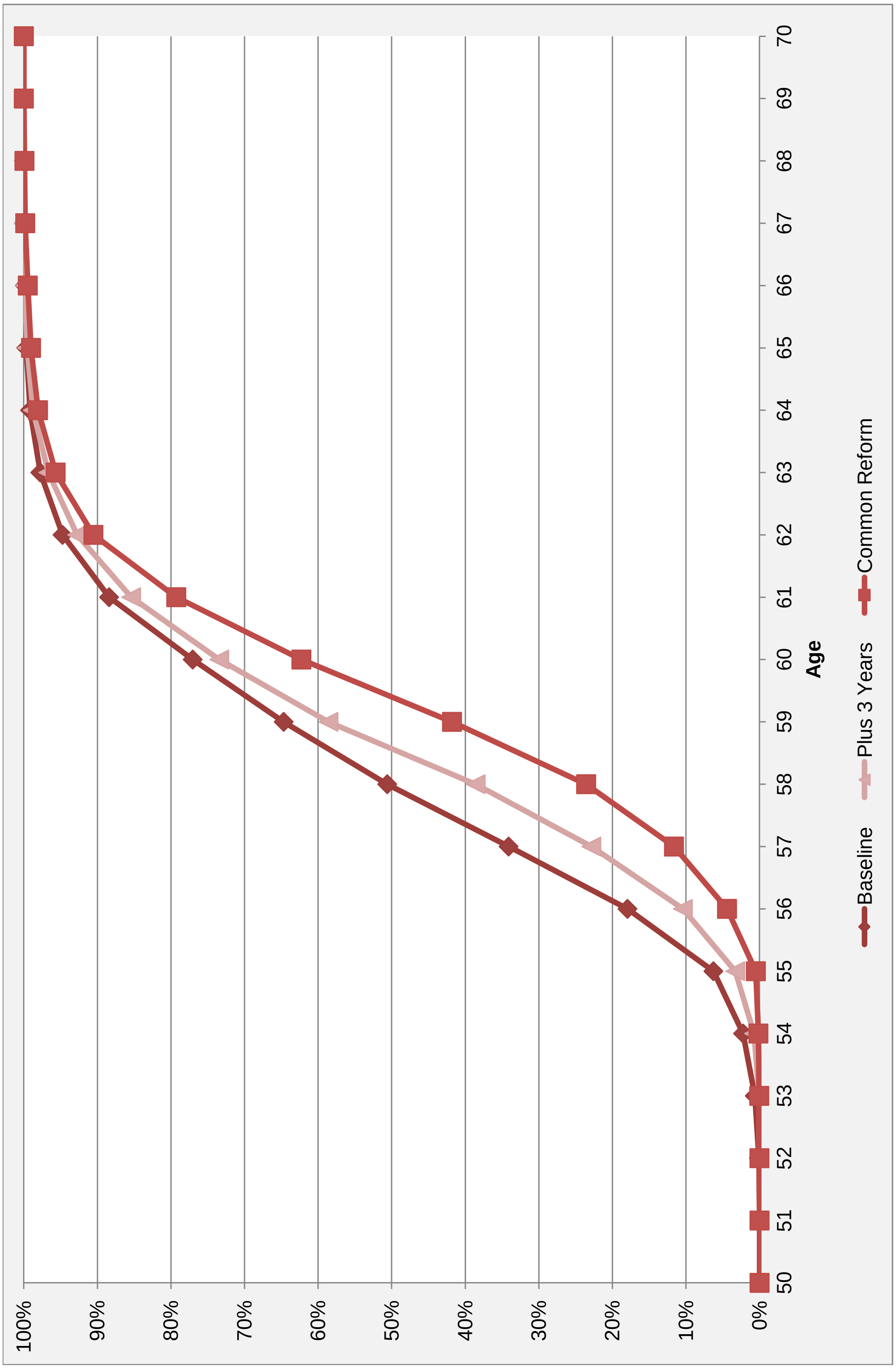
Source: IREA, 2012

Figure E.23: Male Cumulative Hazard Rate: Peak Value/LA



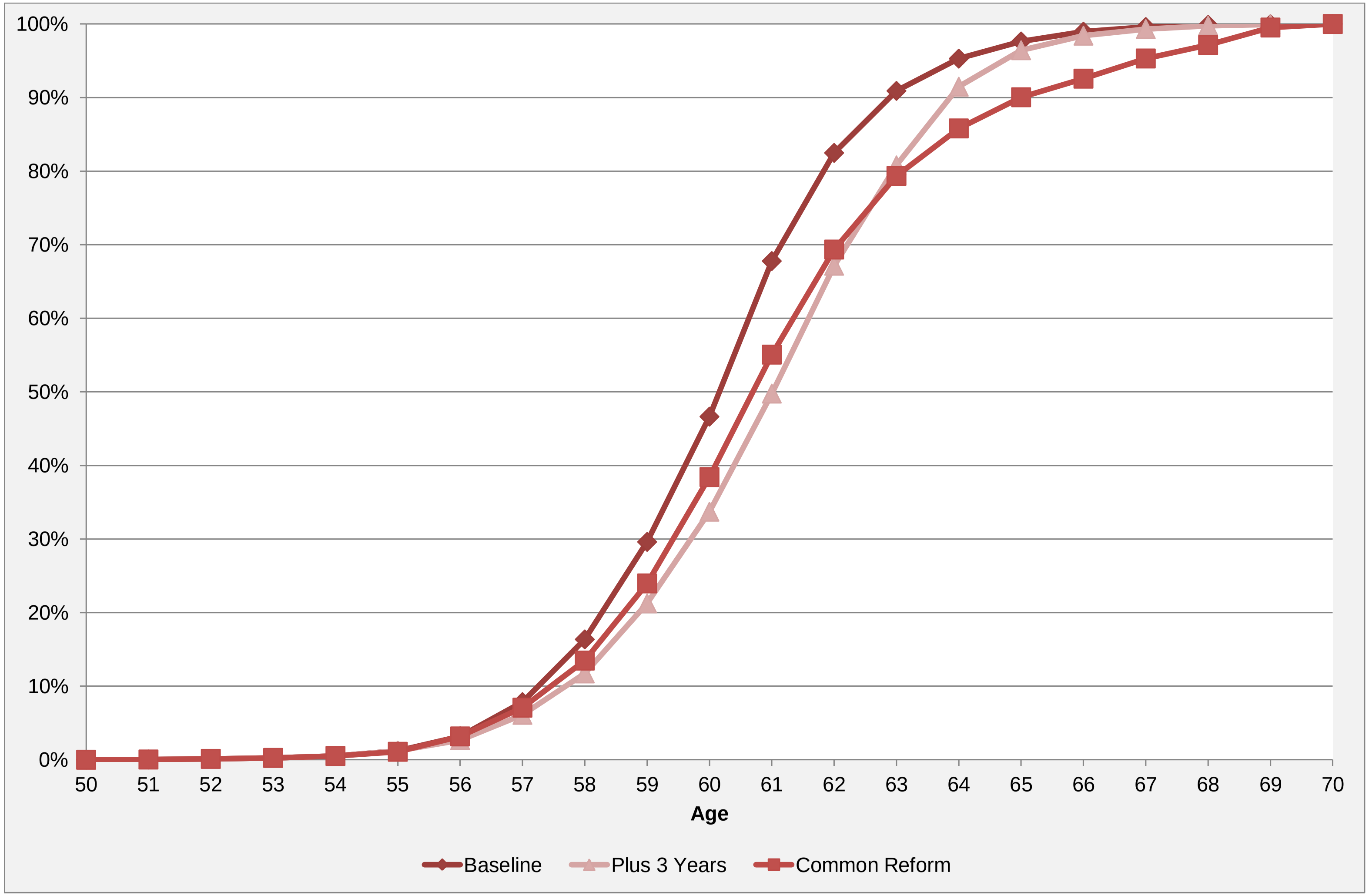
Source: IREA, 2012

Figure E.24: Female Cumulative Hazard Rate: Option Value/LA



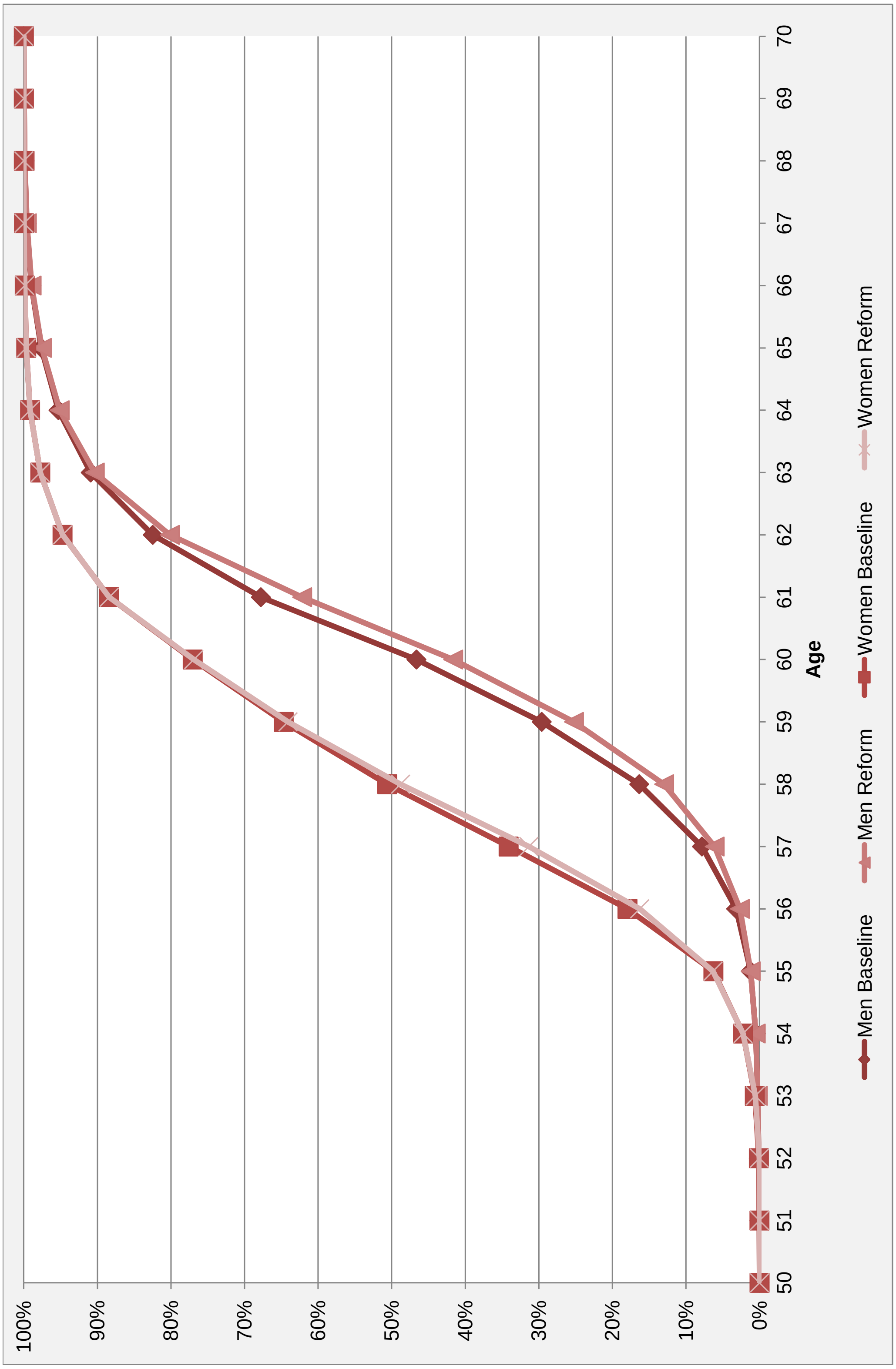
Source: IREA, 2012

Figure E.25: Male Cumulative Hazard Rate: Option Value/LA



Source: IREA, 2012

Figure E.26: Cumulative Hazard Rate without *Hacklerregelung*: Option Value/LA



Source: IREA, 2012

Appendix F

Supplement: Development of Pension Systems in Europe

The modern notion of retirement as a period of leisure time in old age, funded by a public benefit for everyone beyond a certain age, or who has worked a certain number of years, is a relatively new idea. Indeed, major parts of the European population were not entitled to an old age pension before World War II. (Esping-Andersen, 1990)

Before the industrial revolution the structures of society and employment were different to modern day Europe, and so were the means of protection against poverty and inability to work. With the exception of Britain, the majority of the European population still worked in agricultural production in the mid 19th century. A (very) basic provision of social security for these people was usually provided by their masters. As far back as the late middle ages, craftsmen organised themselves in guilds which, in addition to their political function, also provided insurance; similar organisations were founded by other groups such as mine workers. The main source of poverty was inability to work or the passing of an earning spouse or parent. Accordingly, the main benefits provided by friendly societies and the like were disability and sickness benefits, burial costs and pensions for surviving dependents (Sigerist, 1999). However, these plans were only accessible to those who could afford to pay the contributions. Also, the church provided relief for the poor and — increasingly over time — so did the public sector. However, this help was only given on an individual basis and was means tested, such that most people, also those older than the age of 65, continued to work or otherwise depended on their family's support. (Esping-Andersen, 1990)

The first ideas for a public pension system were already formulated during the French revolution, but at the same time, the idea that poor relief might adversely effect labour supply emerged. In the early 19th century, England spent a comparatively large percentage of GDP on poor relief (estimated to about 2.7 %), but by 1834 Malthus' arguments against extensive public poor relief resulted in the establishment of the new poor law which led to a tightening in the eligibility criteria for benefits (Cousins, 2005).

In the late $19th$ century industrialisation changed the living conditions for the masses; cities experienced a rapid growth, dependent work increased, as did the risk of unemployment due to economic conditions or inability to work. In general, wages were too low to accumulate savings to rely on. This led to an incidence of poverty that the so far existing systems of poor relief were not able to deal with (Sigerist, 1999).

F.1 Establishment of the First Pension System

In 1889, Germany was the first country to establish a general pension insurance scheme. Bismarck, the German chancellor at that time, wanted the state to take responsibility for social security and its funding. One motive for introducing social security was to weaken public support for the social democratic movement by fulfilling their most important demands within the existing political framework. Bismarck's idea of a social insurance was a system for all economically disadvantaged groups, centrally organised and administered by occupational groups. The former charity from the government would become a subsidy and the necessary contributions would be split between employers and employees (Sigerist, 1999).

These ideas were heavily opposed in parliament, and Bismarck had to make major concessions. The modified proposal approved by the Reichstag was a regional pension plan, with the administration and some subsidy to the pensions paid by the state, but premiums to be covered by employees and employers in equal shares. Insurance was for people doing manual work independently of their earnings and other workers who were earning less than a given threshold. It established a disability pension by granting payments to disabled or sick individuals for the time after accident insurance payments and an old age pension for all individuals of at least seventy years of age (Sigerist, 1999).

Bismarck was able to improve on this minimum social security and enhance regulations over time. The pension insurance was extended to white collar workers in 1911, changing it from insurance for the poor to one for the majority of the population. By establishing different pension institutions, this was also a manifestation of social class division between the workers and the middle class (Ebbinghaus and Schulze, 2007). In 1916, the pension age was reduced to 65 (Sigerist, 1999). Despite being the first example of a comprehensive public social insurance system, the German system was no pay-as-you-go system, but fully funded before the Second World War. This was possible because for the first years there were no benefits to be paid out (Ebbinghaus and Schulze, 2007).

F.2 Spread across Europe

After Germany had introduced a public pension system, the number of countries which provided old age pensions to their workers increased rapidly. Denmark was the second country to install this kind of pension system in 1891. The introduction in Italy (1919) was somewhat delayed, due to less industrialisation and a different setting of social institutions, most prominently the stronger position of the Catholic Church and a weaker labour movement than in other European countries. In the Netherlands, an earnings related pension scheme for employees was introduced in 1913 due to lobbying by the Christian parties, while the workers movement and the liberal party had pressed for a universal pension scheme. In Britain, a universal retirement benefit for all citizens above 70 who did not reach a certain earnings threshold was introduced in 1908. Sweden introduced a similar system in 1913 (Ebbinghaus and Schulze, 2007). By 1920, almost all Western European countries had introduced old age pensions (Schludi, 2005).

An important factor in the development of social insurance systems was the degree of industrialisation. The countries with the highest shares of population working in industry had the broadest welfare programmes in 1920 (namely the four insurances: accident, sickness, old age and unemployment). The states with the most advanced welfare programmes were mainly constitutional monarchies: Constitutional monarchies might have had an interest in state funded welfare programmes to appease the strengthening labour movement; also their better established bureaucracies were more apt to provide for the administration of such big schemes. Among these early establishing countries were Germany, Denmark, Austria and Sweden. A country that introduced welfare regulations despite relatively low economic development was Romania, but also Spain had a relatively low development status at the time of introduction. France and Belgium in contrary introduced their welfare schemes relatively late (Schludi, 2005).

In the following decade welfare systems and benefits were expanded considerably, but with big differences between the countries. Countries with an autocratic legacy, such as Germany and Austria, had the broadest welfare system and relatively high benefits. The level of industrialisation and trade unionism was comparatively high, while openness to trade was quite limited. The United Kingdom had a high level of industrialisation and trade union coverage, but benefits were relatively low. With regard to the development of social security schemes and the size of the benefits, the small open northern economies (Belgium, Denmark and the Netherlands) fell in the middle between these two. Other developed countries in Europe at that time, such as France, Switzerland or Norway, which were on average slightly less industrialised, had relatively limited welfare schemes.

Government spending on social insurance was low, the highest spenders in Europe were Norway, Denmark and the UK, who spent around one percent of GDP on social programmes. Until the Second World War, social spending in these countries consisted mainly of poor relief, and to a lesser extent spending on health services. Only after 1924, the young Weimar republic of Germany took leadership in social spending, trying to establish some social peace. In this effort Germany spent more than 4.8 % of its GDP on social transfers in 1930.

After the great depression public and political opinion was dominated by a Keynesian confidence in the state, and the emphasis was put on employment as a foundation for social insurance. The Second World War raised a sense of solidarity within the population and expanded the institutional framework that eased the organisation of larger welfare programmes. The term "Social Security" was coined by the Atlantic Charta of Roosvelt, meaning the "freedom of want and fear". A policy concept concretizing the aims and measures was the Beveridge Plan, published in 1942. It became a unifying aim of the Allies, but also a very important issue for Scandinavia and the resistance movements in continental Europe. The International Labour Organisation also strongly oriented its claims on the lines set out by Beveridge (Glootz, 2005). The plan proposed to grant equal welfare benefits to all citizens, independently of their income, while at the same time providing some income insurance depending on individual circumstances (like the number of children). The plan also proposed a public health system which should not depend on insurance payments. Also, organisational structures should be merged to a national level. Although it relied on heavy intervention by the state, the plan was based on a liberal ideal, focusing on basic needs, while leaving the rest to private insurance companies (Hockerts, 1983).

After the war spending on social security substantially increased in the Netherlands, Belgium, Austria and Italy, partly because of the hardships of the war and the increased awareness of the risk of poverty for the middle class. Besides, the threat of expanding communism made the church and conservative parties favour measures of redistribution. (Lindert, 2005) The systems, however, remained largely the same, only the Netherlands switched from an income dependent to a universal pension system, and in Germany and Italy formerly funded financing was transformed into pay-as-you-go systems (Ebbinghaus and Schulze, 2007).

Britain had introduced its generous social system by 1948, which was very much based on Beveridge's advices. One part of it was the old age pension insurance which was based on the principles of equal benefits without needs test and the inclusion of the whole population. Also the Scandinavian countries introduced social security systems with universal coverage (Glootz, 2005), (Hockerts, 1983).

In France, plans existed for the establishment of a similar system, but their full implementation was hindered by the opposition of the middle class. While in Great Britain about 90 % of the workers were employees, in France less than two thirds of the population were wage dependent employees (the agricultural sector and self employment were more important). They introduced old age insurance on an autonomous occupational basis but did not mandate other insurances for the whole population (Hockerts, 1983).

Western Germany hardly restructured its social insurance system after World War II, although the Allied Forces proposed changes. These were rejected because on the one side existing benefits would have been reduced and on the other side social insurance was becoming an issue of national identity, being a prominent and positive characteristic of the German state since before the war(Hockerts, 1983).

F.3 The Golden Age of Welfare

The economic growth of the 1950s and the accompanying wage increase devalued pension payments which so far had not been indexed in any way. The countries with Bismarckian pension systems reacted to this by expanding the state pension system, while countries with Beveridge-style systems shifted the responsibility to the employer, the employees or the unions. In Germany, an indexation to gross wages (leading to higher pension than wage growth) was introduced. Italy and Austria extended pension systems stepwise to new groups, and the replacement rate rose to 80 %, making public pension provision sufficient as a sole old age income (Ebbinghaus and Schulze, 2007).

But also in countries with a Beveridge-style system, the "golden age of welfare" led to an increase in pension benefits. Already in the early 1950s, Sweden introduced an income dependent second tier of the public pension system in addition to the pre-existent low universal benefits. Other countries followed in the 1960s and 70s, leading to a convergence of the Beveridge and Bismarckian types of pension systems. Also, contributions for periods without a proper wage income, like maternity leave, military service or unemployment, were increasingly paid by the state (Ebbinghaus and Schulze, 2007).

The United Kingdom was a late-bloomer in the group of countries with a Beveridge-style system, introducing the SERPS (State Earnings-Related Pension Scheme) in 1975. At that time occupational pension schemes were already well established, so a possibility to opt out of SERPS was provided. Only Denmark and the Netherlands abstained from introducing an income dependent tier, leaving this part to occupational or industry sector plans established on a collective bargaining agreement (Ebbinghaus and Schulze, 2007).

During this expansion period (1950-1975), many countries experienced increases in public spending on welfeare as a percentage of GDP that were in the double digits; the biggest increase was from 27 to 54 % in the Netherlands. Social transfers amounted to between around 15 % of GDP in Switzerland and 27 % in the Netherlands. Not only the Scandinavian countries but also continental European countries like Germany, France, Italy and Austria spent a similar proportion of their GDP on welfare. The enormous economic growth within this era also enabled the introduction of social benefits beyond the relief of utter poverty. Moreover, part of the spending rises in this period were due to the factors still troubling social security systems today, namely technical development in the medical sector and the effects of an ageing population on the pension system (Lindert, 2005); (Hockerts, 1983).

F.4 The Retrenchment Period of Pension Systems

The first oil crisis put an end to this expansive development. The main causes of of the emerging problems of the pension systems were the demographic development, deficits in government budgets and the increase of unemployment. Early retirement regulations were frequently thought to be an adequate remedy against raising unemployment. But also technological development in combination with increased international competition made older employees less attractive for firms, and agreements for employee pensions and subsidies were struck to encourage early retirement. But also unofficial early retirement options such as disability pensions or special regulations for older long term unemployed persons were created or extended. This increase in early retirement, however, put enormous pressure on public budgets (Ebbinghaus and Schulze, 2007).

For example the German pension reform of 1972 introduced the option of early retirenment for those over 63 with a long insurance history and facilitated early retirement for the unemployed. This led to a decrease in the percentage of those who retired at the regular retirement age of 65, from about 50 % of men and 25 % of women at the time of the reform, to only about 10 % for both sexes in 1983. Similar early retirement options were introduced in Austria and many other continental European countries (Talos, 2006). In the Scandinavian countries as well as in the UK, early retirement was and still is a much less used option today. Nevertheless, also in these countries, pension systems imposed pressure on public budgets. In an effort to contain pension expenditures, Germany, the UK and Sweden changed the indexation of pensions (Ebbinghaus and Schulze, 2007).

In Austria, this turning point in welfare state development occured somewhat later, with budgetary pressures becoming evident around 1980 with the pension system being a major cause. Since then state contributions to the public pension system have experienced large increases. Contributions have risen between 1980 and 2003 by close to 200 % while expenditures increased by almost 240 % (Talos, 2006). In the last three decades of the twentieth century, the average retirement age has fallen from close to 62 for men to 58.4 and from 60.4 to 56.7 for women (Hofer and Koman, 2006).

At the same time, new types of workers to whom the pension system was poorly atuned, emerged, such as part time employees or people with a discontinuous employment history. Even though service sector and female employment increased, total contributions to the pension system did not rise sufficiently, because these types of employees were typically poorly remunerated. Furthermore, their own pension entitlements are often not sufficient, which is why they rely on their families' pensions or minimum incomes (Ebbinghaus and Schulze, 2007).

Although actual social benefits in Europe didn't shrink substantially between 1980 and 1995 — with the exceptions of Austria and the Netherlands — the political discourse about social welfare changed fundamentally.

Before this period, the social consensus implied that economic growth would result in increased social spending. But after growth slowed down, unemployment increased and the consequences of an ageing population became obvious, the question arose, how the growth of social spending could be curbed (Lindert, 2005); (Hockerts, 1983).

F.5 Typologies of Pension Systems

F.5.1 Esping-Andersen's Three Worlds of Welfare Capitalism

According to Esping-Andersen (1990) three welfare state models emerged out of the two main historical tracks (Bismarck and Beveridge). This was mainly due to the numerical decline of the working class: the universal benefits did not appeal to the newly developed middle class, since they were very low — as the middle class grew in numbers, these benefits lost support within the population as the number of beneficiaries decreased. The three systems developed as a way of dealing with this new preference structure. There are three major characteristics, along which Esping-Andersen distinguished the three regimes.

The first characteristic is de-commodification, by which he means policies that counteract the dependency of the individual on the market to provide for his or her own living by selling his or her labour [. . . the degree to which individuals, or families, can uphold a socially acceptable standard of living independently of market participation [. . .] i.e. the strength, scope, and quality of social rights.][Esping-Andersen (1990), p.37] A second factor is stratification, which means the consolidation or weakening of existing hierarchical structures. Besides income distribution and poverty the main focus hereby is on factors constituting social citizenship, like class mobility in the education system. The third measure is the quality and spread of post-industrial employment, meaning non-production work in the service sector. Here the main factors analysed are the composition of these jobs, gender division and how these factors are influenced by the welfare state.

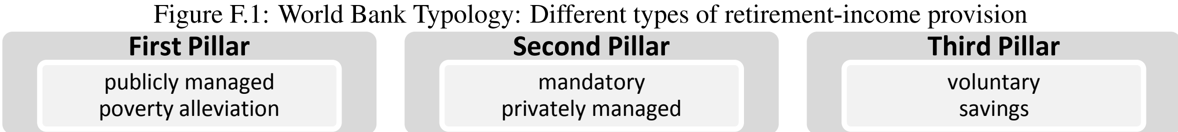
The first system type which underwent little serious transformation comes from the traditional Bismarck system to a wider ranging social insurance system, which Esping-Andersen calls "the corporatist system". It mainly dealt with the increasing middle class by including new groups into the government system, but keeping an institutional separation. A typical example of the corporatist state is Germany. Germany tied pension benefits to earnings instead of contributions in the late 1950s, accentuating inequalities in pension. The corporatist system often originated under an autocratic regime and was designed to consolidate support of the regime. It is therefore characterised by fostering stratification in the society and very favourable conditions for civil servants. Because the church often played a role in the construction of pension schemes in the coporatist state, it favours the traditional family. There is a strong earnings-benefits relation, frequently based on insurance schemes, separated by class, replicating the position an individual obtained in the society. On average the benefits are high, but mostly excluding women who did not participate in the labour market. Furthermore, care facilities are frequently scarce and benefits encourage mothers to stay at home. Apart from women's labour market participation, also the employment rate of disabled and the elderly is low because of regulations with favourable conditions for early retirement. Since benefits mostly depend on contributions de-commodification is higher for those who have a history of continuous employment. In addition to Germany, other central European countries like France and Austria belong to this group.

Esping-Andersen dubs the second type of welfare system prevalent in Anglo-Saxon countries "the liberal system". In countries with the liberal system the diminution of the working class led to a dualistic system, where the better-off looked for insurances provided by the market and/or benefits negotiated with their employers, while those who could not afford this relied on low state benefits. Since major parts of the population do not rely on the state benefits, political support for them is decreasing, while government expenditures to support private insurances have been increasing. The liberal regime type is characterised by low benefits paid on a needs tested basis. Consequently, the labour market participation of the elderly, women and the disabled is high, as is commodification. Post-industrial employment is common, providing labour for professionals under good conditions and poorly paid jobs for the less educated. The better-off buy their social security on the market, the worse-off have to rely on low benefitsTherefore, stratification is rather high in the liberal system.

A third type of regime also started from an egalitarian system, but instead of leaving major parts of social insurance to the market, this type decided to increase state provision to meet the demands of the middle class and therefore found their support for further increases. In these cases a flat-rate benefit was topped up with an earnings-related scheme. This regime type is called "social-democratic regime", mainly the Scandinavian countries fit this description. This regime type aims to diminish stratification in the society. The benefit level is usually high and based on the demands of the middle class but the access is universal. To maintain this benefit level high labour market participation is necessary. Therefore, employment among the disabled and the elderly is encouraged and, while unemployment benefits are generous, the measures to induce employment are rather strict. Benefits are mostly earnings related but the contributions are paid by taxes. As in the corporatist system there is little private provision of social insurance. Female employment is encouraged — high taxation makes it difficult to live comfortably off one salary, also facilities like child care are easily available and at the same time provide jobs that are mainly performed by women. De-commodification and "de-stratification" are high but limited by their affordability to the state.

F.5.2 World Bank Three Pillar Typology

Figure F.1: World Bank Typology: Different types of retirement-income provision



Source: The World Bank (1994); IHS (2011)

One of the most widely used typologies of pension systems is the *three pillar system* the World Bank developed in its 1994 report "Averting the Old Age Crisis". It suggests to divert pension provision to a multi-pillared system.

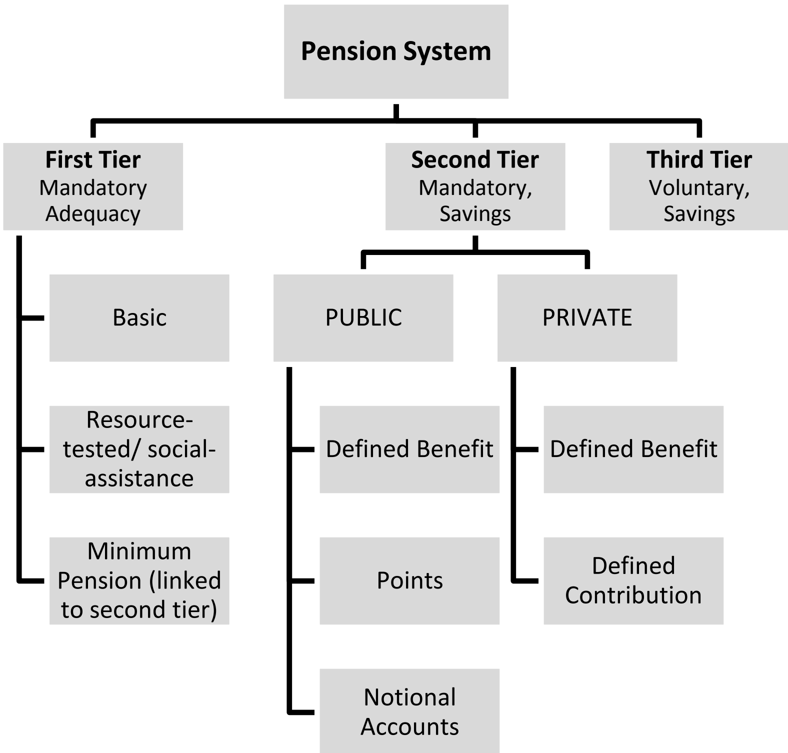
The *first pillar* is publicly managed poverty alleviation. It could be a means-tested benefit, a minimum pension or a flat benefit. It is funded by tax revenues on a PAYG basis, giving a further incentive to keep benefits at a rather low level. This is also meant to encourage market insurances to grow. Its main objectives are income redistribution towards the poor and an insurance in case of low returns to savings.

The *second pillar* should — as the first one — be mandatory, but privately managed. It is supposed to consist of personal savings or an occupational plan. This shall prevent relative poverty, meaning a decrease in consumption after retirement by introducing an earnings-related part.

The *third pillar* is made up of voluntary savings.

F.5.3 The OECD Typology

Figure F.2: OECD Typology: Different types of retirement-income provision



Source: OECD (2009b)

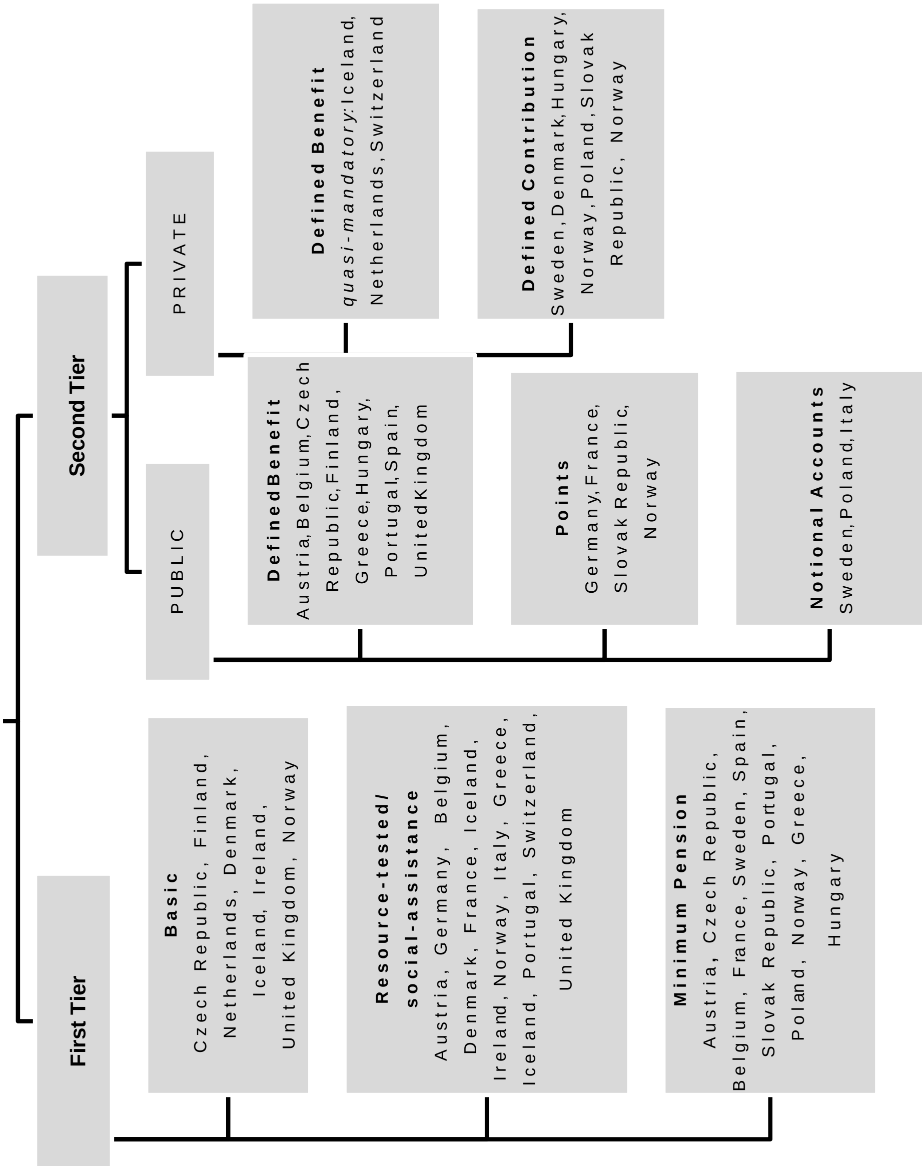
The OECD typology is more descriptive than the World Bank's, but the two bear many similarities. Here the first and second tier are mandatory, the second tier can either be public or private. The *first tier* is similar to the first pillar of the World Bank typology. It is designed to prevent old age poverty and exists in all OECD countries in one of four possible forms: basic pension, targeted pension, minimum pension or social assistance. Basic pensions are flat rate universal benefits, which are not affected by income (neither before nor after retirement), but might be affected by years of work. *Targeted pensions*, on the other hand are reduced by additional income.

Minimum pensions are similar to targeted pensions with the difference that one must be entitled to earnings related pension from the second tier to receive a minimum pension. Minimum pensions are the most widely used type in Europe under the first tier. In countries with none of the former measures or additional to former measures elderly are eligible to general social assistance if they receive insufficient other pension income.

The *second tier's* task is not only to prevent poverty of elderly but to generate an appropriate standard of living. In Europe a public *defined benefit plan* is the most common way to achieve this objective, where retirement benefits are defined by time of contribution payments and height of earnings. Further public alternatives are *pension points*, where workers accumulate points according to their contributions which are multiplied by a certain value at retirement, and *notional account schemes* in which a fictional account is set up for each contributor where contributions and rates of return are noted. In most cases, but not necessarily, public schemes are PAYG (pay-as-you-go) financed. If the administration is not undertaken by the government, the scheme is counted as private, also in case the employer acts as an insurer. *Private second tier systems* might take the form of defined benefits or defined contribution schemes. In the latter case the contributor gets an individual account where contributions are accumulated and invested and usually an annuity has to be bought at retirement.

Finally, the third tier consists of voluntary private pension plans. (OECD, 2005a), (OECD, 2005b), (OECD, 2009b)

Figure F.3: Pension Schemes in European countries



Source: OECD (2009b); IHS (2011)

F.5.4 Empirical Patterns

Soede and Vrooman (2008) tested empirically if pension systems could indeed be categorised according to Esping-Andersen. They performed a categorical principal component analysis with 34 variables on the mandatory parts of the pension systems of 19 countries of the European Union and four additional states. The two main dimensions of the principal component analysis along which the countries were categorised were the generosity of the system and the amount of mandatory private insurance.

They found four clusters of which two largely correlate with Esping-Andersen's typology — the corporatist and the liberal cluster —, while of the other two one partly corresponds to the social-democratic cluster and the last one does not appear in the typology. The corporatist cluster is found to have a high pension level but with little funding. It consists of most central European countries, but also Finland and Portugal. The main characteristics corresponding to this pension regime are a high replacement rate and high expenditures, differentiated occupational schemes, low participation rates especially among the elderly while already having a relatively high dependency ratio. For recent reforms typical measures were found to be an increase in the pension age or contribution period and a reduction in benefits.

The liberal cluster has very low benefits, but also funding for some countries, namely the US and Canada is below average, and only slightly above for the UK and Ireland. Traits that were found typical for this group are low replacement rates but with considerable difference between low and high paid workers, high participation and a strong expected increase in the dependency ratio.

The cluster comprising most social-democratic regime countries was called mandatory private since this is its main characteristic, but the level of benefits is quite disperse. Beside Sweden and Denmark also Australia and Poland can be found in this cluster. One feature of these countries is a generally high indexation of pensions, but the group is also characterised by schemes based on defined contributions, easily accessible minimum pensions and a less important mandatory earnings related scheme. Furthermore, high participation rates and an early ageing process (mainly before 2025) can be observed.

The last cluster is called moderate pensions and consists of Norway, the Czech Republic, Slovakia and Belgium. The funding here is similar to the liberal countries while the pension level is a bit higher, but still below average. Pensions consist to a large part of PAYG earnings related schemes; also, other features are similar to the corporatist cluster with lower benefits, but the countries within the group are relatively varied.

There seems to be a lot of overlapping with the terminology of Esping-Andersen, but there are also countries which do not neatly fall into his scheme.

Rhodes and Natali (2004) set up a new classification by combining the "old" OECD three pillar model, Esping-Andersen's three worlds as well as a classification by Ferrera (1993) based on the sharing of social risks and a publication of Bonoli (2003) where the prevalence of public provision is examined. Further the primary administrator of the pension system — state or social partners — was emphasised by Marier (2002). As a result Natali and Rhodes obtained four different regime types:

(i) Austria and Germany fall into the "pure occupational system", where the social insurance manages insurances which are divided according to occupational categories.

(ii) The next category is also organised along occupational lines but adds to the status maintaining system a means-tested scheme as an influence from the Beveridge systems. Among others, Spain, France and Italy belong to this group. Both groups are also characterised by an underdeveloped private pension sector.

(iii) This is not the case for the "universal + occupational" group, to which the Netherlands, Denmark and Great Britain belong. Basic pensions in these cases are universal and generally low, but accompanied by a second pillar which might be public, occupational or private.

(iv) The fourth case is the "pure universal system" in which the first and the second pillar are combined. Both are universal and financed on a PAYG basis through taxation. This system is the prevailing one in the Scandinavian countries. (Rhodes and Natali, 2004)

Similar to Soede and Vrooman (2008), who found the reforms most necessary in the corporatist cluster, Rhodes and Natali (2004) found that reforms were most needed in the two groups that organise pensions along occupational lines (i) and (ii). Rhodes and Natali (2004) diagnosed them with poor GDP growth rates, inequity between generations and classes, instability in financing and political difficulties in changing the system. Reforms point into the direction of increased funding to compensate for reductions in first pillar benefits, harmonise pension schemes and create a credit system to include new career patterns and improve independent pensions for women.

Similar problems were found in the "pure universal model", especially in Sweden which carried out a major pension reform in the late 1990s (see G). But in these countries also factors which provide stability to the system can be found, like the aforementioned high participation rates and the financing of the pension system out of tax revenues, which makes it less vulnerable to cuts due to competitiveness effects. Problems seem to be less grave in the mixed system, partly because important reforms have already been undertaken. Their multi-pillar design makes them politically less assailable, which on the one hand makes it easier to reform them, on the other hand less pressure is created for problems of inequality or due to new career patterns. A problem for these systems — as has been shown in the early 2000s and also in the past few years — is the dependency on financial market conditions and the threats this might pose on retirement incomes.

Appendix G

Supplement: A Country Comparison of Pension Systems

Table G.1: Overview Classification of Selected Countries

	AT	DE	CZ	SE	UK
Esping-Andersen	Corporatist	Corporatist		Social democratic	Liberal
Sooede & Vroman	Corporatist	Corporatist	Moderate Pensions	Social democratic–mandatory private	Liberal
Natali & Rodes	Pure occupational	Pure occupational		Pure universal	Universal & occupational

Source: IHS, 2011

G.1 Germany

Germany is categorised as a *"corporatist state"* with a *pure occupationally* managed pension system. Its public pension system is pay-as-you-go. Until 2005, the Statutory Pension Insurance had three institutional branches: blue-collar workers and insured self-employed were administered by 23 regional insurance funds, the federal railway insurance fund and the seamen insurance fund; white-collar workers were administered by the Federal Insurance Fund for Salaried Employees; and the third used to be the Federal Insurance Fund for Miners. In 2005 the fund for salaried workers and miners were merged and the number of regional insurance funds was reduced through mergers (Guardiancich, 2010).

Germany's **first tier** is social assistance for people with low income. The publicly organized **second tier** is a point scheme which calculates pensions as

Pension = Personal Points * Pension Value Point * Pension Factor

For each year of insurance individuals receive one pension point if they are average earners, adequately more or less if they are above or below average. When they retire, their points are summed up and multiplied by a "pension point value", which is linked to average earnings (with a different value for the New Länder). Additionally, there is a pension factor. The pension factor depends on changes in the contributions to the statutory and subsidized private pension schemes and on a sustainability factor which relates pensions to the country's dependency ratio. Thus, pension income is not only indexed by gross wages, the increases due to valuation are limited. In 2008/2009 total contributions amounted to 19.9 % and were equally split between the employer and the employee (Guardiancich, 2010). Germany has one of the highest coverage through voluntary private pension plans and in particular the highest among low earners (OECD, 2009a). Most **third tier** private plans are defined-contribution plans of 4 % as these yield most public subsidies. (OECD, 2009a)
The eligible retirement age is 65, rising to 67 by 2029 (Guardiancich, 2010). With 45 years of contribution or with reductions of 3.6 % people can retire at the age of 63. If they decide to work after the age of 65 a bonus of 6 % per year is granted. (OECD, 2009a) The German replacement rate is 61.3 % for median earners, 59.2 % for those 50 % below median earnings and 60.3 % for those 50 percent above median earnings. (OECD, 2009a) The public pension spending results in 11.4 % of GDP. (OECD, 2009a)

G.2 Czech Republic

The Czech Republic reformed its pension system right after the collapse of the communist regime by establishing a pay-as-you-go system. (Pension Funds Online, 2011)
In the Czech Republic the **first tier** consists of a basic pension which accounts for 7.5 % of average earnings and is independent of individual earnings. Besides, there is a minimum pension (included in the basic pension) which accounts for 11.4 % of average earnings plus targeted social assistance. The **second tier** is publicly provided by an earnings-related scheme. The accrual rate is 1.5 for each contributing year. In addition, there is a progressive benefit formula with three replacement codes: for incomes below 46.5 % of average earnings the replacement rate is 100 %, for incomes below 111.4 % it is 30 % and above this threshold it is 10 %. The retirement age will be gradually increased to 65 for men and between 62 and 65 for women, depending on the number of children. Retirement is possible three years before the standard retirement age with a reduced accrual rate; for people who work beyond the standard age, the accrual rate is raised. Around 45 % of employees have a voluntary occupational or personal pension, but the **third tier's** contributions tend to be small.(OECD, 2009a)

G.3 Sweden

Sweden is categorised as *"social democratic"* and has a pure universal pension system. Primarily, contributions are paid as taxes and are part of the state budget, but there is also a privatised mandatory contribution part which is managed by the Premium Pension Authority (Guardiancich, 2010).
Sweden's **first tier** is called a "guaranteed pension". It is an income-tested top-up for low earners above the age of 65. Besides, means-tested housing benefits are an important source of income for pensioners (OECD, 2009a). The **second tier** consists of a PAYG-system with notional accounts and of a private defined-contribution

scheme. 14.88 % of gross earnings are paid to the worker's personal account (OECD, 2009a). On retirement, the total pension balance is divided by an annuitisation divisor which is based on average expected remaining life expectancy (the same for men and women) and a notional future growth factor of 1.6 % (Socialdepartementet Ministry of Health and Social Affairs/ Riksförsäkringsverket, 2003). Since life expectancy decreases with age, the divisor decreases, hence the calculated annual pension income increases with age. Therefore, there are no incentives to retire early and, thus, a statutory retirement age can be avoided. Furthermore, the system ensures the so called lifetime-earnings principle, as old workers can combine work and pension by withdrawing only a part of their annual pension (OECD, 2009a). Furthermore, 2.33 % of labour income are paid into a private investment account (premium pension) and yield interest according to the return on the capital fund chosen by the pension-saver (Socialdepartementet Ministry of Health and Social Affairs/ Riksförsäkringsverket, 2003).
The median net replacement rate yields 64.1 %; people with 50 percent below median earnings receive 79.3 % and people with 50 % above median earnings 81.2% (OECD, 2009a). The public pension spending amounts to 7.7% of GDP (OECD, 2009a).

G.4 United Kingdom

The United Kingdom is categorised as *"liberal country"* with a universal and occupational pension system. Its pension system is partly a pay-as-you-go system. The state provision is seen more or less as a top-up mechanism for pensioners on low incomes. Private provision is popular which represents a difference to most other European countries (Mayshew, 2001).
The **first tier** scheme in the United Kingdom is a flat rate basic pension which accounts for 14 % of average earnings, and applies for those with a work history of 39/44 years for women and men, respectively (OECD, 2009a). Reduced basic pension can be received at the age of 65 and after at least 11 years of contribution (Mayshew, 2001). For women the eligible age for retirement used to be 60, but it is in the process of being equalised. By 2046 for both men and women the retirement age will be raised to 68. In addition, means-tested benefits are given to people over 60 under the "minimum income guarantee" (OECD, 2009a). The **second tier** consists of two schemes. First, there is the state earnings-related scheme (SERP) which adds up the replacement rate based on workers' lifetime earnings (OECD, 2009a). Secondly, workers have the option to "contract out" of SERP and pay either into an occupational scheme, personal scheme or into a mixed scheme (Mayshew, 2001). The most popular voluntary pensions are occupational and defined-benefit schemes (OECD, 2009a). Compared to Germany, the voluntary coverage by the **third tier** is smaller for low, but higher for high earners in the United Kingdom. (OECD, 2009a)
The median net replacement rate is 40.9 %, people with 50 % below median earnings receive a higher replacement rate of 63.8 % and people with 50 % above median earnings a lower replacement rate of 29.2 % (OECD, 2009a). The public pension spending amounts to 5.7 % of GDP. (OECD, 2009a)

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Final Report

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