Unemployment Accounts and Employment Incentives over the Life Cycle

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General Introduction

1.1 Research Motivation

Individuals face many exogenous shocks during their working life with direct consequences for the volatility of their income streams. Events such as unemployment, sickness and child birth can have a substantial impact on the wage profile of an individual. In general, welfare states are designed to cushion against these shocks.

The income gaps, which may arise due to job loss, are bridged with help of the German unemployment insurance system. In this system, the unemployment benefits, which are paid to the unemployed in a given year, are financed by the employed, who pay an obligatory tax rate on their wage income. As the employed pay taxes without knowing whether they will ever benefit themselves from this system, and unemployed can receive money without ever internalizing the cost they produce, the incentives to work of both groups of individuals are therefore considerably affected. The current design of the German UI system therefore raises the question whether the system allows to generate sufficient incentives to work or whether alternative designs may offer the same benefits without creating these distortions.

Alternative designs of unemployment insurance systems could provide a solid foundation for triggering stronger working incentives. The unemployment account system e.g., explicitly aims at improving those incentives by strengthening the link between contributions and withdrawals. In the unemployment account system, employed individuals pay a certain contribution (as percentage of their wage) to their individual unemployment account. When unemployed, individuals are allowed to withdraw their unemployment benefits from their individual accounts. Anything that is left over upon retirement can then be used to top up pension income. Through this final payout upon retirement individuals explicitly benefit from not using their accounts. Thus, they gain additional incentives for remaining employed or for leaving unemployment as soon as possible. Therefore, the main advantage of this system is that it creates more transparency with respect to the actual cost that unemployment imposes on the society. In the account system the unemployed internalize more of these costs than in the current design of the traditional German unemployment insurance system. In this way, the unemployment account system promises to maintain the redistributive power to reduce income instability without distorting the incentives to work.

The success of implementing such an unemployment account system in Germany rests heavily on the underlying structure of the present tax-transfer system. In detail, one needs to ensure that the unemployment account system builds on a basic, solid foundation, in which the share of unemployment benefits that are self-financed throughout the life cycle of anindividual is relatively high. This income redistribution which takes place within the life cycle of one individual is called intrapersonal income redistribution.

Such a high extent of intrapersonal income redistribution in Germany is likely to ensure the functioning of a system of unemployment accounts, which is explicitly designed to facilitate the transfer of income over time to finance periods of unemployment.

This empirical foundation (which identifies the extent of the German intrapersonal redistribution) has not yet been established for Germany.

1.2 Research Objectives and Main Results

The major goal of this thesis is to explore the potential impact of an unemployment account system on individuals' employment incentives. This thesis consists of three parts. In the first part (Chapter 2) we identify the extent of the intrapersonal income redistribution, which is inherent in the German tax-benefit system. In order to facilitate this analysis we generate lifetime data (on income, taxes and transfers) by matching homogenous groups of individuals belonging to different age cohorts. We find that measuring the redistributive effect of the public tax-transfer system with annual data appears to overestimate the redistribution that actually occurs across individuals. Most of the transfers are less redistributive in a lifetime perspective than in the annual perspective. This implies that a substantial fraction of the transfers is actually financed by the taxes of the same individual at some point during his life.

In order to identify the exact extent of self-financed transfers we disentangle the interpersonal from the intrapersonal income redistribution. In other words, we calculate which part of the German redistribution serves to reduce inequality across individuals (from the lifetime rich to the lifetime poor) vs which part helps to smooth consumption over the life cycle by redistributing income within the life cycle of one and the same individual. Disentangling the income redistribution in this way shows that the extent of intrapersonal income redistribution in Germany is indeed very high.

Moreover, we find that the extent of the German intrapersonal income redistribution is also sensitive to the different kinds of taxes which are included in the calculations. These results apply to a combination of transfers which are received by the average German household. Detailing our analysis further, we calculate the intrapersonal income redistribution associated with selected transfers. Our results show that the extent of self-financing differs enormously with respect to the specific transfer in question. In particular, unemployment benefits exhibit a large share of redistribution that occurs within the life cycle of one individual.

A high extent of intrapersonal income redistribution is a prerequisite for a well-functioning accounts system. As in particular German unemployment benefits are to a large extent self-financed, which suggests a high potential for the introduction of unemployment accounts. In Chapter 3 we therefore turn to the implementation of the unemployment account system. In particular, we are investigating whether replacing the traditional German unemployment insurance system by unemployment accounts will improve employment incentives and thereby also the overall unemployment rate.

We employ a stochastic life-cycle framework to study how the trade-off between labor market incentives, consumption and savings is affected under a system of unemployment accounts.

In the account system individuals internalize the cost of their unemployment, and expect to receive a payout upon retirement. This induces changes in their behavior and strengthens employment incentives. As a consequence we find that the unemployment rate falls for all age groups. The account system proves to be particularly efficient at reducing old-age unemployment. In order to further stimulate the employment incentives of the younger generations, we introduce multiple payout periods. It turns out, that once those multiple payouts during the working life are implemented, the employment incentives are indeed amplified even further.

Our dynamic optimization model also allows us to analyze the welfare implications of unemployment accounts. From the individuals' point of view, a reduced leisure choice may be welfare decreasing as leisure is part of individuals' utility. However, our results show that labour market entrants expect higher welfare under the UA system than under the UI system. This holds in particular for poor individuals, who accordingly experience a larger welfare gain under the UA system.

Finally, looking at the unemployment account system from a financial perspective, we see that the account system is superior to the UI system. The government budget improves even with multiple payout periods.

In Chapter 4 we stress the role of the financial perspective and determine the optimal tax rate both in the long-run and during a transition period. Our first goal in this chapter is to implement a pay-as-you-go structure in the unemployment account system with a balanced government budget and identify the optimal long-run tax rate. Moreover, we investigate how the incentives and the unemployment rate behave in the long-run and how they react to the adjusted tax rate, which prevails in the long-run. We find that the optimal tax rate is lower when the tax rate is adjusted to achieve a balanced budget (with PAYG account structure) in the long-run. In consequence, this raises the employment incentives in the aggregate. Furthermore, our results highlight the importance of analyzing individual behavioral patterns, as the tax cut reduces the incentives to work for certain groups of individuals. Overall, however, the long-run unemployment rate is reduced when compared with the UI situation.

Our second goal is to identify the optimal tax rate during the transition period when switching from the UI system to the UA system. The optimal tax rate is not constant, but decreasing during the transition period. In the first years of the transition period the tax rate which balances the budget is comparatively high. Nevertheless, even right after the switch from the UI to the UA system there are enough employment incentives generated, such that it is financially feasible to introduce the accounts. After a relatively high tax rate in the first years, the tax rate then drops and is much lower than in the UI system. When evaluating the welfare implications during the transition period, we find that the vast majority of the individuals experiences large welfare gains in each year of the transition period when switching to the account system.

Chapter 2

Synthetic Life Cycles and Intrapersonal Income Redistribution in Germany

2.1 Introduction

The welfare state performs two main functions through the tax-benefit system: The first function is the interpersonal redistribution of income from the rich to the poor. The second function is the intrapersonal redistribution of income within the individual's lifetime. Reallocating resources from rich to poor individuals is meant to reduce income inequality between these individuals, while intrapersonal income redistribution refers to the fact that a large part of the taxes, which finances transfers, is actually channelled back to the individual at a different point in his life. Reallocating resources within the lifetime of individuals acts as an insurance mechanism to facilitate consumption smoothing over the life cycle. It mitigates income shocks arising for example due to unemployment, child birth and ill health.

Fennel and Stark (2005) assert that the interpersonal income redistribution is based on normative judgements, while the intrapersonal income redistribution responds to shortcomings in the life-cycle hypothesis arising from imperfect consumption smoothing. According to Fennel and Stark (2005) there are several barriers to perfect consumption smoothing over the life cycle. Uncertainty over future income earnings serves as one barrier, but also borrowing constraints, and illiquidity issues impede individuals from perfect consumption smoothing. Furthermore, Fennel and Stark (2005) point out that since people consume as part of their household and not individually, this might eventually be reflected by their lifetime consumption pattern. Finally, Fennel and Stark (2005) argue that behavioral aspects, such as self-control problems of the individual, habit formation and other preferences relating to the evolution of consumption patterns have a strong impact on the consumption decision of the individual.

Thus, intrapersonal income redistribution stabilizes consumption patterns over time and consequently may attribute to reducing income inequality over the life cycle of the individuals. Yet in the case of Germany, so far only few studies have dealt with the extent of the German intrapersonal income redistribution. Instead, most of the literature focuses on the overall redistributional impact of the tax-benefit system. This is commonly measured by comparing the income inequality of the pre- and post-fiscal income [1]. OECD (2012) reports a Gini coefficient of 0.42 for the German pre-fiscal income of the working population in the late 2000s compared to 0.3 for the post-fiscal income. The reduction of the Gini coefficient shows that in Germany income inequality is reduced considerably via taxes and transfers. However, measuring the redistributional impact by comparing the pre- and post-fiscal income at a single point in time is problematic for several reasons. One problem is the counterfactual. In order to analyze the extent of the redistributive effect of the tax-benefit system, one would ideally need to compare the post-fiscal income to a situation in which the state does not engage in redistribution, instead of simply using the pre-fiscal income. The mere existence of the tax-benefit system will influence the individuals' labour market behavior, such as entering or leaving the labor market and the choice of working hours. Therefore, pre-fiscal income is not equivalent to the hypothetical income earned when no government intervention follows. However, a situation without government intervention is clearly unobservable and therefore cannot serve as a point of reference. Instead, we follow the standard approach in the literature and use pre-fiscal income as the point of reference.

Another more important drawback of relying on annual income inequality is the focus on one function of the welfare state: the redistribution from rich to poor individuals. Using a single point in time - usually a year - is misleading as it overestimates this interpersonal redistribution. According to ter Rele (2007), data in one single year represent just a snapshot

[1] The Gini coefficient is one popular measure of income inequality. It ranges between 0 and 1, with higher values implying more income inequality. A value of 1 implies that one person owns all income, while others own nothing.

of the income distribution prevalent in the population and does not take into account that the earnings profile of an individual is not constant over the lifetime.

A young student may be poor early in life, but he may enjoy a relatively high income later in life. In a lifetime perspective this student will appear much richer than in a single year at the beginning of his working life. The same reasoning holds for pensioners, who may appear more poor in an annual perspective than in a lifetime perspective. The extent of intrapersonal redistribution, or the income smoothing that is observed over a lifetime is completely ignored.

Using lifetime income data instead of annual data takes into account that the tax-transfer system induces individuals to shift income over time. Therefore, lifetime income is expected to be much more equally distributed than annual income[2]. Sandmo (1999) argues along the same lines claiming that the redistributional effect of the tax-benefit system tends to be overstated, since much of it would arise from income smoothing, which can be thought of as really a substitute for private saving and insurance.

The purpose of this chapter is to disentangle the German income redistribution that takes place within the life cycle from the redistribution that takes place from the lifetime rich to the lifetime poor. As we have argued before, a large share of intrapersonal income redistribution can provide a fertile soil for the effectiveness of unemployment accounts on labor market incentives. As no historical data on German taxes and transfers are available that cover the entire lifetime of individuals, we generate synthetic life cycles to infer lifetime income data.

Our results suggest that the German lifetime income is indeed more evenly distributed than annual incomes. Consequently, annual data on German income tend to overestimate the redistributive impact of the tax-benefit system, as a large share actually occurs within the life cycle of an individual. Moreover, we also find that next to the income which is redistributed via the public tax-benefit system, a large part of the redistribution takes place within households. In fact, households income redistribution reduces lifetime income inequality almost to the same extent as the public tax-benefit system does.

Next, we calculate the extent of the intrapersonal income redistribution for Germany,

[2] See e.g. O'Donoghue (2001) for an extensive analysis of the effect of the length of the accounting period for the income redistribution analysis.

by using our generated lifetime data on taxes and transfers. Our estimations show that almost two thirds of all transfers received by the average German over the life-cycle are self-financed. This share of self-financed transfers rises over the income distribution. These results refer to a broad combination of the main transfers received by the average German household [3].

Decomposing the intrapersonal redistribution further shows, that the extent of the intrapersonal income redistribution differs enormously across transfers. We calculate the intrapersonal redistribution for selected transfers and find that the intrapersonal income redistribution is particularly high in the case of unemployment benefits, while the average share of self-financed transfers is much lower for e.g. maternity benefits. Furthermore, the analysis reveals that the share of self-financed unemployment benefits is remarkably high in all income deciles.

Finally, we show that the extent of the intrapersonal income redistribution is also sensitive to the kind of taxes which are included in the model. In the German case, we find that using indirect taxes in addition to direct taxes raises the intrapersonal redistribution even further (about 10 percentage points).

The remainder of this chapter is organized as follows: Section 2.2 reviews the literature with respect to the methodology and the results on the intrapersonal income redistribution. Section 2.3 presents our approach to modeling synthetic life cycles. In Section 2.4 we analyze the synthetic life-cycle data. Section 2.5 computes the intrapersonal redistribution of income and Section 2.6 concludes our analysis.

2.2 Previous Studies on Intrapersonal Redistribution

Only few studies have dealt with the intrapersonal and the interpersonal elements of the transfers and taxes in the German welfare state. Bartels (2012) distinguishes the German inter-individual income inequality from the intra-individual income inequality of West German households over a 20 year period and finds that the majority of the reduction in long-term income inequality can be attributed to income smoothing (via insurance) as opposed

[3] with the exception of old-age pensions

to inter-individual redistribution. This points to a comparatively high share of interpersonal income redistribution. Another study related to this context focuses on the intragenerational and intergenerational components of the German welfare system [4]. Several studies have attempted to calculate the intrapersonal and interpersonal income redistribution for some countries, other than Germany. Table 2.1 provides a brief summary of those studies. In general, the share of the intrapersonal redistribution is quite high across those countries, which indicates that a substantial share of the income redistribution takes place within a taxpayer's own life cycle, as opposed to between taxpayers.

Country	**Intra**	**Inter**	**Source**	**Year**	**Sample Size**
Australia	38 (52)	62 (48)	Falkingham and Harding (1996)	1986	4000
Britain	62 (71)	38 (29)	Falkingham and Harding (1996)	1985	4000
Denmark	74	26	Sorensen et al. (2006)	1994-2002	10% of 18+ pop.
Ireland	55	45	O'Donoghue (2001)	1994	4048
Italy	77	23	Baldini (2001)	1991 & 1993	4000
Sweden	82	18	Pettersson and Pettersson (2003)	1999	112 000

Table 2.1: Related Literature on Intrapersonal Income Redistribution.
Inter(Intra) refers to the inter- (intra)personal income redistribution. For Australia and Britain, the values in brackets denote the intra- and interpersonal income redistribution levels using also indirect taxes as opposed to only direct taxes.

However, the share of the intrapersonal income redistribution varies largely between countries, from 38% in Australia to 82 % in Sweden. This large range must not always purely reflect differences between countries but might actually, at least partly occur due to the different underlying methods applied to compute the intrapersonal redistribution. These methods vary due to differences in 1) modeling lifetime data, 2) transfers, 3) taxes allocated to finance transfers, 4) the base year of the data and 5) the nature of the welfare states. In the following, we provide a more detailed description of the methodological differences between different studies.

Differences in Modeling Lifetime Data

There are different approaches to modeling lifetime data when historical data are unavail-

[4] Börsch-Supan and Reil-Held (2001) identify the intragenerational vs intergenerational transfer share which is inherent in the German pension system.

able. Estimates on intrapersonal redistribution varying across countries may therefore be the result of inherent differences in the models which are used to generate lifetime data.

One method to generate lifetime data is to create dynamic microsimulation models, using either cohorts of individuals or an entire population. Dynamic cohort microsimulation models e.g. simulate the personal characteristics and the behavior of a cohort of individuals. In order to capture the idiosyncrasy of life cycles, these models account for major events during an individual's life cycle. The set of these events encompasses e.g. educational training, marriage, divorce, parenthood, labor market participation, retirement and death. The events that are simulated differ in every model and the transitional probabilities that lifetime events occur are based on cross-sectional data in one specific base year. Usually these probabilities depend on the age of the individuals. Furthermore, cohort models assume a steady-state world, in which the economic environment of the base year prevails during the entire lifetime. Prominent dynamic cohort models are HARDING for Australia by Falkingham and Lessof (1991) and LIFEMOD for Great Britain by Harding (1993). Falkingham and Harding (1996) use these models to evaluate the redistributive effect of the tax-benefit system with regard to annual and simulated lifetime data in both countries. They disentangle the intrapersonal redistribution from the interpersonal redistribution and find that it amounts to 38% - 51% in Australia and 62%-71% in Britain, depending on the underlying financing of the transfers. O'Donoghue (2001) applies a dynamic cohort microsimulation model to Ireland and finds an intrapersonal redistribution of 54%.

However, dynamic cohort microsimulation models have several disadvantages. According to OECD (2007), one such disadvantage arises from the static data which leads to a weak behavioral component of the data set. Another disadvantage of dynamic cohort microsimulation models are the costly requirement of using large data and potential problems of validating the simulation results.

An alternative method that circumvents some of these problems is applied in Sorensen et al. (2006) for Denmark. Their approach is to generate synthetic life cycles by matching homogenous individuals from different age cohorts. Sorensen et al. (2006) do not use a dynamic microsimulation model that ages a certain cohort but instead links panel data of different age cohorts together. The resulting intrapersonal income redistribution that is attributed to the Danish tax-benefit system is 74%. In addition, Sorensen et al. (2006)

also distinguish the intrapersonal income redistribution that takes place within a given year from the intrapersonal income redistribution that takes place in other years of the life cycle. Overall, Sorensen et al. (2006) find that most self-financing of Danish transfers occurs within a given year.

We assert that the method by Sorensen et al. (2006) of generating synthetic life cycles is most appropriate for our analysis, because of the dynamic components of income, transfers and taxes. In particular, the analysis of intrapersonal income redistribution will benefit from the behavioral component, which - to a certain degree - is represented by intervals of real-world data in the synthetic life cycle. A detailed description of our methodology is presented in Section 2.3.

Differences in Transfers

The estimates on intrapersonal redistribution in Table 2.1 may also vary because different transfer types are included in the analyses. Pettersson and Pettersson (2003) e.g. distinguish between intrapersonal redistribution with and without old-age pensions and find that including old-age pensions raises the intrapersonal redistribution from 68% to 77%.

Another source of potential divergence is the private use of public subsidies (or non-cash benefits), which is excluded by most studies. One exception is Pettersson and Pettersson (2003), who explicitly model publicly financed private consumption[5]. They incorporate an extensive list of public subsidies, such as various types of education, care of relatives (children and the elderly), labor market activities and health care services and argue that supplementing the disposable income with these public subsidies is a better way to approximate individual utility. The resulting intrapersonal redistribution amounts to 82%. Similar to Sorensen et al. (2006), Pettersson and Pettersson (2003) also distinguish between the intrapersonal redistribution within a given year, and the one within other years of the the individuals' life cycle. They conclude that, when disentangling the intrapersonal redistribution this way, more than half of it actually occurs within a given year. According to Pettersson and Pettersson (2003), a large fraction of the intrapersonal redistribution within a given year occurs because most of the Swedish transfers are subject to income tax.

[5]The value of the subsidy is assumed to equal production costs net of fees.

Differences in Taxes Allocated to Finance the Transfers

In order to isolate the extent of a tax payer's share of self-financed transfers, it is necessary to correctly identify that part of the taxes, which is used to finance the transfers. In general, most models include different variants of the personal income tax and social insurance contributions. One additional difference may arise when indirect taxes are included in the analyses. According to O'Donoghue et al. (2004), in most countries indirect taxes are regressive or at least income-neutral with respect to disposable income, whereas the income tax is progressive. The decision to include progressive or regressive taxes will affect the results on the extent of the intrapersonal redistribution. Using both, direct and indirect taxes (as opposed to only direct taxes) should raise the amount of intrapersonal redistribution. The reasoning is as follows: when the principal recipients of transfers are the poorer income groups, they finance less transfers themselves under progressive taxation (than the rich individuals). This conjecture is confirmed by the results of Falkingham and Harding (1996), who find that the extent of the intrapersonal redistribution varies considerably with the inclusion of indirect taxes. Falkingham and Harding (1996) find a higher intrapersonal redistribution after including indirect taxes in addition to direct taxes (i.e. the income tax, and insurance contributions.) The intrapersonal redistribution increases from 38% to 52% in Australia and from 62% to 71% in Great Britain.

Baldini (2001) also studies the intrapersonal redistribution for two different methods of financing the transfers. He distinguishes between the personal income tax with and without social insurance contributions, ignoring the indirect taxes completely. Baldini (2001) reports an intrapersonal redistribution of about 77%, irrespective of the financing method. However, the intrapersonal redistribution exhibits a more progressive pattern, when social insurance contributions are ignored. Furthermore, Baldini (2001) singles out that part of the redistribution which occurs within the same household and argues, that in Italy the largest part of the redistribution can be attributed to the role of families instead of to the redistribution via the public tax-benefit system.

Differences in the Base Year of the Cross Section

The timing of the cross-section data that has been used in the different models varies considerably as can be seen in Table 2.1. Falkingham and Harding (1996) e.g. use data on Britain from the mid '80s while most other studies rely on data from roughly ten or more years later. Most recent data from 2002 is used by Sorensen et al. (2006).

Different timing of cross-section data will distort the comparison of intrapersonal income redistribution even when applying the same method for one country, since differences in data will also be affected by external factors, such as e.g. different policy regimes and business-cycle fluctuations.

Differences that Reflect Various Welfare States

The different results of the various models may also be partly explained by the underlying social security system of the respective country that is analyzed. Naturally, different welfare states offer different kinds of transfers. But even when considering the same transfers across countries, large differences may arise, when the entitlement to the transfer in question varies across countries. Moreover, the duration over which the transfer can be received may vary substantially. Generally, one can expect that in countries, in which the tax-benefit system is mainly based on social insurance, the intrapersonal redistribution will be higher than in countries with mainly means-tested transfers. Social insurance is designed to transfer the risk over the life cycle of an individual, while the main purpose of means-tested transfers is to alleviate poverty. Ceteris paribus, one would expect Sweden to have a higher intrapersonal redistribution than e.g. Australia which, according to Falkingham and Harding (1996) is one of the purest social-assistance systems in the world. As can be seen in Table 2.1, this is exactly a finding that these studies reveal. Extrapolating this insight, we expect the extent of the German intrapersonal redistribution to lie somewhere between the one of Australia and Sweden.

In general, the calculation of intrapersonal income redistribution will be severely affected by the methodological differences which we have highlighted above. It is therefore crucial to keep in mind, which methodology has been applied, when comparing the results for various countries or even within one specific country.

2.3 Modeling Synthetic Life Cycles

2.3.1 Preparation of the Data Set

In this study we use the German Socio-Economic Panel (SOEP 2011) data set. This is a longitudinal panel surveying approximately 12,000 private households in Germany. The underlying dataset covers East and West German data. For our analysis we are interested in those individuals whose data are reported consistently over time, between the years 1996 - 2004 in the SOEP sample. In order to ensure that major economic effects due to the German reunification and the immediate economic effects in the following years are not driving the results of the calculations, the sampling period starts in 1996. The end of the sampling period in 2004 ensures that a major change in the social security system that was introduced in 2005 is not included in the dataset.

We focus on individuals in their working age (18 - 64 years) and therefore drop retirees and children from the sample. Moreover, we focus on those individuals whose income is mainly obtained from wages and salaries. Therefore we exclude those individuals who have been predominantly self-employed (e.g. for more than 5 years) and disregard civil servants.

Some of the remaining individuals have changed their occupational position during the investigated time period. They will only be dropped from the sample if they are part of one of the categories above (children, self-employed, retirees, civil servants) for at least four years. This implies that an individual, who is for instance employed during the age 60 to 64 will still remain in the sample, even though the individual enters retirement at age 65. Overall this leaves 7,774 individuals (2,970 men and 4,804 women) in the sample, which we use in our matching procedure to generate synthetic life cycles. On average these individuals represent about 26.5 million working-age Germans.

From the SOEP data set we extract data on transfers (on the individual and household level), annual income (gross labour income, and income from other sources), as well as various personal characteristics such as the education level, gender and marital status. Tax data are based on our own calculations. In the following, we provide a detailed overview of our data preparation process.

Transfers

For our analysis, we consider cash benefits such as means-tested benefits and insurance benefits. We disregard non-cash benefits (e.g. the private use of public subsides). We distinguish between individual and household transfers. Since our analysis focuses on individuals, we have to break down the household transfers to individual levels. Therefore, we assume that the transfer is incident equally on each adult member of the household. Consequently, we divide the household transfers by the number of adults. Table 2.2 lists all transfers that are included in this analysis. Unemployment benefits e.g., make up 20% of all

Individual transfers
Unemployment benefits
Unemployment assistance
Subsistence allowance
Early retirement benefit
Maternity leave benefit
Student grants
Household transfers
Child allowance
House assistance
Nursing allowance
Social assistance
Social assistance for special circumstances
Social assistance for the elderly
Housing support for owners - occupiers

Table 2.2: List of Transfers Included in the Analysis

transfers in 2004. This is clearly the biggest share within the group of individual transfers and the level of unemployment benefit is income-related. The entitlement of unemployment benefits depends on the individual history of contributions to unemployment insurance. Within the group of household transfers, the child allowance is by far the most important transfer, making up 20% of total transfers [6]. Finally, old-age pensions are a very important part of the transfers that individuals receive over their lifetime. However, as our analysis focuses on the working life of the individuals, the effect of old-age pensions is disregarded.

Taxes

Unfortunately, data on individual tax liabilities are not provided by the SOEP data set. As

[6] If applicable, the child allowance includes also the tax reduction due to tax exemption for dependent children.

a consequence, we have to compute the annual individual tax liabilities. In particular, we use the the German tax code together with the individuals' idiosyncratic characteristics, such as the number of children and marital status to calculate the individual tax burden.

The progressive income tax rate is applied to the individual income, while the tax burden for married couples is based on the combined household income. In the latter case, we assume that each partner pays income taxes on half of the taxable income of the household. Thereafter, we attribute a share of the tax payment to the individual, according to the actual original income. This ensures that e.g. the individual tax payment of a woman, who does not earn any income, is zero. The whole tax burden of the household is attributed to her (working) husband, even though it is determined through the income-splitting tax rule. Neglecting this aspect would bias our results, as individuals with zero income would finance transfers that they receive through their "artificial" tax payment.

The SOEP data set does also not include individual data on earnings from dividends and interest. We therefore use the provided household data and assume, that each adult member of the household earns an equal amount of these earnings. We proceed likewise in calculating individual data on rent income.

In order to determine the taxable income of the individuals and married couples, we apply all standard allowances and standard exemptions. Accordingly, we deduct the lump-sum allowance for professional expenses and for earnings from dividends and interest, the standard deduction for special expenses, the provisional lump-sum with regard to old-age insurance, and the single-parent tax allowance, whenever applicable. The tax allowance for the elderly is not applied, as our life cycle ends with 65 years. The tax exemption for dependent children is considered if it is more advantageous for the tax payer than receiving child allowance transfers. Table 2.3 provides the details on the calculation of the German taxable income.

The SOEP data also does not provide information on the individual indirect tax payments. There are two approaches in the literature reviewed in Section 2.2. The first approach, followed by Falkingham and Harding (1996), uses a percentage of gross income to model direct and indirect taxes and argues that the joint impact of both taxes is proportional on gross income. In the German case however, the progressive effect of the income tax (including social security contributions and solidarity surcharge) dominates the regressive

Sign	Legal income concepts and their components
	Income from agriculture, forestry and business enterprise
+	Income from self-employment and dependent employment
+	Income from capital, renting and leasing
+	Other income
=	Positive income from all sources
-	Negative income
=	Income from all sources
-	Tax allowance for elderly persons (for people over 64)
-	Tax allowance for agriculture and forestry
=	Adjusted gross income
-	Special and extraordinary expenses (actual or lump-sum)
-	"Loss-deductions" (reimbursements, loss carry forwards)
=	Income
-	Tax allowance for children (Kinderfreibetrag)
-	Single parents' tax allowance (Alleinerziehendenentlastungsbetrag)
=	Taxable income (the tax base)
	Progression Clause (Progressionsvorbehalt)
+	Unemployment Benefits (also from part-time unemployment)
+	Short-term Work Compensations
+	Insolvency and severance Benefits
+	Parental-leave and Maternity-leave Benefits
+	Sickness and injury Benefits
+	Transfer and seasonal Short-term Work Compensations
+	Benefits for Early Retirement
+	Supplemented labour costs for employment
=	Taxable income according to p.c. (determining the tax rate)

Table 2.3: Taxable Income, adapted from Ochmann and Fossen (2012)

nature of indirect taxes and social security contributions. The joint effect on the equivalent net household income of both kinds of taxes therefore remains progressive (RWI and Fifo Köln (2007)). The second approach, followed by Sorensen et al. (2006), determines the percentage of the annual disposable income that equals the indirect tax burden in each income decile. We adopt the latter, more detailed approach. The data on the indirect tax burden of German households are based on RWI and Fifo Köln (2007). The indirect taxes include the value-added tax, the mineral tax and the motor vehicle tax.

Studies using dynamic cohort microsimulation models commonly assume a world with a constant economic environment. In these studies the tax- and transfer rules are fixed according to one specific base year and prevail throughout the whole simulated lifetime. One common justification for this approach is, that these studies aim at analyzing one policy and aim at isolating the effect of this specific policy from others. However, labour participation decisions of the individuals (such as the incentive to work and the individuals' leisure choice,... etc) are all affected by the tax-benefit system that prevails in the corresponding year. It is therefore problematic to decouple the behavior and labour participation decisions from the corresponding tax-benefit rules that prevail in that year. We therefore use the contemporaneous tax environment for each year.

Another important aspect to consider is that the tax-benefit system used for modeling synthetic life cycles is not in financial equilibrium. Over the lifetime of the individuals, the sum of total direct taxes exceeds the sum of all transfers. Only a share of taxes is therefore used to finance the transfers. The rest is devoted to financing other public expenditures such as infrastructure and education. In order to achieve financial equilibrium over the lifetime of the individuals, we need to identify the correct share of taxes that is used to finance the transfers. Following the literature we use the percentage of the lifetime taxes, that equals the lifetime transfers. We call this adjusted amount of taxes "allocated taxes".

According to our discussion above, our analysis uses two different scenarios for the underlying financing of transfers. In the first scenario, we assume that only direct taxes (i.e. the income tax and the unemployment insurance contributions) are used to finance the transfers. In the second scenario, we assume that direct and indirect taxes are used to finance the transfers.

Income

We want to create the synthetic life cycles by relying on an income definition that is a close proxy for the standard of living standard. Table 2.4 shows how we use the SOEP data set to determine the equivalent disposable income.

	Income type
	Labour Income
+	Capital Income
+	Rent Income
=	Original Income
+	Transfers
=	Gross Income
-	Direct Taxes
-	Indirect Taxes
=	Disposable Income
/	Equivalence Scales
=	Equivalent Disposable Income

Table 2.4: Income Definitions

When we use the term original income, we refer to the combined labour income, capital income and rent income of the individual. In order to derive the gross income, we add the transfers received by the individual. As already explained, these transfers include the individualized household transfers. We calculate the disposable income by deducting the income tax, social security contributions and the supplementary tax (e.g. solidarity tax) from the gross income. We do not deduct the church tax, as we regard this being a voluntary expense.

In order to derive the equivalent disposable income, we have to account for different household sizes and family structures of each individual. Therefore, we apply equivalence scales to the disposable income of the household. There are several equivalence scales that can be applied. They differ according to the weights that are given to each member of the household. We apply the modified OECD equivalence scale to the income, as this is widely accepted. This scale attributes a weight of 1 to the first adult household member, a weight of 0.5 to each additional adult and a weight of 0.3 to each child.

2.3.2 The Matching Method

As already mentioned, the GSOEP data set does not provide data on income, transfers and taxes for the entire working life of a German individual. Our approach to deal with this problem is to generate synthetic life cycles by linking data of several individuals from our reduced SOEP sample dataset. Algorithm 1 presents our matching algorithm. The individuals forming one synthetic life cycle should ideally exhibit the same personal characteristics. We impose some criteria for homogeneity among the individuals in our sample and group them according to their education level and gender. In particular, we distinguish three levels of education attainment. The lowest education level (1) represents all individuals who have less than eleven years of education. The medium education level (2) contains all individuals with at least eleven and less than twelve years of education. The highest education level (3) includes all individuals with more than twelve years of education. In the subsequent matching procedure the individuals will only be matched to form a life cycle if they are in the same education level group.

Algorithm 1 - Matching Algorithm for Generating Synthetic Life Cycles

This algorithm describes the procedure of matching individuals to generate synthetic life cycles. Required information are individual's gender, education level, equivalent disposable income, taxes, transfers and personal weight in the data set. The data are required for nine consecutive years.

(Grouping phase)

Step 1: *Sort all individuals into groups of gender and three education levels.*

Step 2: *Generate eight life-cycle cohorts. Each life-cycle cohort consists of individuals born in the same year and those individuals being born eight or multiples of eight years apart. Each life-cycle cohort consists of 6 or 7 life-cycle groups.*

Step 3: *Combine Steps 1 and 2 to obtain 54 life-cycle groups.*

(Matching phase)

Step 4 *Within a life-cycle cohort, match individual i with income I_i and year of birth y with individual j with income I_j and year of birth $y+8$ if: $\mid I_i - I_j \mid \leq m_1 + m_2 \cdot I_i^2$. Repeat for all life-cycle groups.*

(Synthesizing data phase)

***Step 5**. Combine contemporaneous data on income, taxes and transfers of the matched individuals to generate data of the synthetic life cycles.*

(Weight adjustment phase)

***Step 5**. Gather information on the frequency of each individual in the synthetic life cycles. Use that information together with the individual's weight in the original data set to compute a representative weight of each synthetic life cycle.*

The matching procedure itself is similar to the one used by Sorensen et al. (2006). In our model one synthetic life cycle consists of the observations of six or seven individuals. For instance, an individual of group 1 in life-cycle cohort 1 (born in 1978 - 26 years old in 2004) is matched with another individual of the same gender and education level (born in 1970

- 26 years old in 1996, of group 2) in life-cycle cohort 1. This procedure is repeated until a synthetic life cycle is created which consists of the data provided by six (or seven) real individuals. The same matching procedure is applied to all life-cycle cohorts. The exact allocation of years of birth among the different life-cycle cohorts is shown in Figure 2.1.

Group	Age1996	Age2004	Year of Birth
1	18	26	1978
2	26	34	1970
3	34	42	1962
4	42	50	1954
5	50	58	1946
6	58	66	1938

Life-Cycle Cohort 1

Group	Age1996	Age2004	Year of Birth
1	17	25	1979
2	25	33	1971
3	33	41	1963
4	41	49	1955
5	49	57	1947
6	57	65	1939

Life-Cycle Cohort 2

Group	Age1996	Age2004	Year of Birth
1	16	24	1980
2	24	32	1972
3	32	40	1964
4	40	48	1956
5	48	56	1948
6	56	64	1940
7	64	(72)	1932

Life-Cycle Cohort 3

Group	Age1996	Age2004	Year of Birth
1	15	23	1981
2	23	31	1973
3	31	39	1965
4	39	47	1957
5	47	55	1949
6	55	63	1941
7	63	(71)	1933

Life-Cycle Cohort 4

Group	Age1996	Age2004	Year of Birth
1	14	22	1982
2	22	30	1974
3	30	38	1966
4	38	46	1958
5	46	54	1950
6	54	62	1942
7	62	(70)	1934

Life-Cycle Cohort 5

Group	Age1996	Age2004	Year of Birth
1	13	21	1983
2	21	29	1975
3	29	37	1967
4	37	45	1959
5	45	53	1951
6	53	61	1943
7	61	(69)	1935

Life-Cycle Cohort 6

Group	Age1996	Age2004	Year of Birth
1	12	20	1984
2	20	28	1976
3	28	36	1968
4	36	44	1960
5	44	52	1952
6	52	60	1944
7	60	(68)	1936

Life-Cycle Cohort 7

Group	Age1996	Age2004	Year of Birth
1	11	19	1985
2	19	27	1977
3	27	35	1969
4	35	43	1961
5	43	51	1953
6	51	59	1945
7	59	(67)	1937

Life-Cycle Cohort 8

Figure 2.1: Allocation of Years of Birth among Life-Cycle Cohorts

Our matching procedure is based on the equivalent disposable income of the individuals in the year in which the individuals are matched. As explained in Section 2.3.1 this takes into account the family size and the family structure. Furthermore, it is a more accurate measure of the individual living standard than any other income variable. In practice, using the equivalized income implies that two individuals are matched when they experience the same living standard. Consider e.g. individual A, who has a disposable income of 100,000 and is living in a family with 2 children and no spouse. According to the equivalence scale procedure, the income of individual A will be scaled down by a factor of 1.6, which results in an equivalent disposable income of 62,500. Next, consider individual B who lives in a single household and has a disposable income of 62,500. The equivalent disposable income of individual B is also 62,500. Both, A and B will be matched since they have the same equivalent disposable income (as in this example) or if their incomes are within a certain range, as described by step 4 in algorithm 1[7]. As a consequence, some individuals will not be matched at all, because their income is not close enough to the income of someone

[7]In particular, we use $m_1 = 5,000$ and $m_2 = 3 \cdot 10^{-}6$.

from the older (younger) life-cycle group. They drop out of the data set. In the end 2,454 men and 3,086 women are actually matched. Some of them are matched more than once. In some cases (e.g. many individuals with zero income) our approach generates a large amount of matches. In such a case, we draw a random sample from the matched data. In total, our matching procedure generates 200,000 synthetic life cycles out of the initial 7,774 individuals.

The individuals from the original SOEP data set are each associated with a personal weight. If an individual e.g. has a sampling weight of 100, it means that the individual represents 100 Germans of working age. The subset of individuals in the database used for the calculations represents on average 26.5 million Germans. Ignoring the individual weights would lead to biased results, as certain subsets of the population would be oversampled. A similar problem could occur with our synthetic life-cycle data. Since some of the individuals are matched multiple times while others are not matched at all, our generated synthetic life-cycle data set is no longer representative of the German population. The individual weights that are provided by the SOEP data set are not valid and need to be adjusted. We therefore use the SOEP data set weights for all individuals, who form one synthetic life cycle, to adjust for their disproportional occurrence in the synthetic life cycles.

2.4 Analysis of Synthetic Life-Cycle Data

Here, we present the results of the synthetic life cycles that were generated using the matching procedure explained in Section 2.3.2. First, we look at the development of the income data over the life cycle. Next, we analyze the redistributional impact of our synthetic lifetime data. We compare the distribution of the lifetime income with the annual income data and investigate whether the German lifetime income is indeed more evenly distributed than the annual income as shown for other countries in the related literature. This gives a first indication for the extent of intrapersonal income redistribution. The latter will be analyzed in more detail in Section 2.5.

2.4.1 Annual vs Lifetime Income

We calculate the lifetime income of each synthetic individual by summing up the income over all years[8]. Using the life-cycle weight for each individual, we compute the average income for each age of the entire synthetic working-age population. The left plot in Figure 2.2 depicts the labour income and the equivalent disposable income. The average labor income

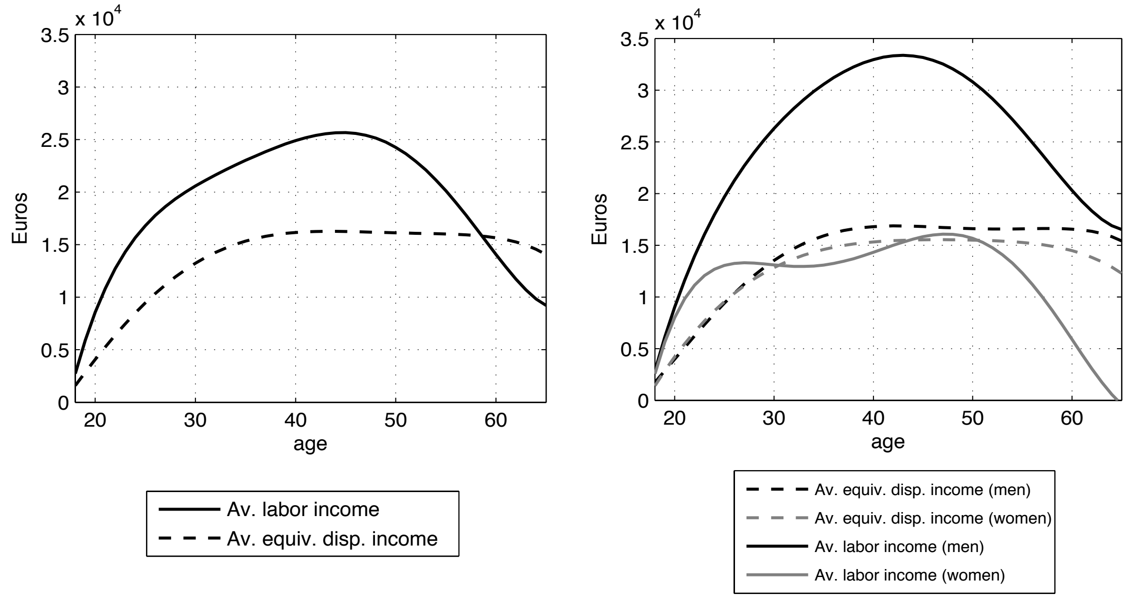

Figure 2.2: Average Labor- and Equivalent Disposable Income: Total (left) and Gender-Specific (right).

(black line) follows a hump-shape pattern with a sharp rise until the age of 25. Our results imply that highest earnings are concentrated in the prime working years between 25 and 55 with a maximum at around the age of 43. A similar result is obtained by Fennel and Stark (2005). Finally, labor income falls rapidly beyond the age of 55. The equivalent disposable income rises less sharply up to age 35 after which it basically remains constant. Our data show only a slight decline after age 60. One interesting result is that while labor income is initially clearly higher than equivalent disposable income, individuals aged 59 and older actually have a lower labor income than their corresponding equivalent disposable income. One reason for that observation could be that a sharp drop in the equivalent disposable

[8]As in Sorensen et al. (2006) and Falkingham and Harding (1996), we assume that the discount rate equals the real economic (earnings) growth rate.

income does not occur after e.g. age 55 because lower equivalence scales are applied to the income of parents whose children left the joint household. Other reasons can be found when looking at gender-specific income data as shown in the right plot of Figure 2.2. The dotted lines indicate that the equivalent disposable income of men (black) and women (grey) exhibits the same pattern, with men having a slightly higher income. However, we see a huge difference in the actual labor income between men and women. Men experience on average a hump-shaped income pattern with a maximum income in their early forties, reflecting intuitive assumptions on working experience and productivity patterns. On the contrary, the average labor income of women clearly seems to be affected by starting a family, thus hampering their career perspectives. Women's labor income picks up only slightly between age 35 and 50, but sharply falls thereafter and even reaches zero for the 64 and 65 year old[9]. In general, the average labor income of women between age 25 and 55 is about only half of the labor income of men. Furthermore, women between age 30-43 and beyond age 50 experience their labour income being below their equivalent disposable income. Certainly, one reason for that is the change in equivalence scaling. Another reason seems to be a large amount of redistribution within households, with a large transfer of income from men to women. The latter fact also provides an explanation for the equivalent disposable income of men generally being far below their average labour income.

2.4.2 Transfers and Allocated Taxes

Table 2.5 compares annual data from 2004 with the corresponding synthetic life-cycle results. In order to facilitate the comparison with the annual data, the lifetime incomes, transfers and taxes have been annualized, i.e. divided by the number of years of each synthetic life cycle.

Regarding the income, Table 2.5 shows that, income is more evenly distributed using annualized lifetime data than when using annual data. Furthermore, the absolute value of allocated taxes is rising with higher income deciles, but less steep over a lifetime than in the cross-section. In both cases the allocated taxes exhibit a progressive pattern, as the shares

[9]The latter fact however, might be due to our matching procedure. Some women who actually do have positive labor income at age 64 and 65 are not being matched at all.

of taxes relative to income rise with higher income deciles. The share of taxes relative to income ranges from 0 to 19% using the annual allocated taxes relative to annual income, and from from 7% to 22% using lifetime allocated taxes relative to lifetime income. Thus, the progressivity of taxes is more harmonized over the lifetime.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Annual Data (2004)										
Income	438	4036	7449	10062	12092	14068	16186	18922	22854	33329
Transfers	630	2371	2000	1599	1646	1561	1210	1458	1243	1435
Allocated Taxes	0	48	242	275	464	613	1075	1707	2567	6535
Transfers/Income	1.5	0.64	0.27	0.16	0.14	0.11	0.07	0.08	0.05	0.05
Allocated Taxes / Income	0	0.09	0.033	0.03	0.04	0.04	0. 07	0.9	0.11	0.19
Annualized Lifetime Data										
Income	8226	10323	11333	12153	12914	13669	14512	15537	16949	20533
Transfers	2186	1993	1891	1810	1794	1711	1702	1708	1726	1691
Allocated Taxes	581	903	1110	1282	1471	1670	1881	2187	2701	4431
Transfers / Income	0.27	0.19	0.17	0.15	0.14	0.13	0.12	0.11	0.11	0.08
Allocated Taxes / Income	0.07	0.09	0.10	0.11	0.11	0.12	0.13	0.14	0.16	0.22

Table 2.5: Means of Annual and Annualized Lifetime Values (in 2004 euros) by Deciles of Equivalent Disposable Income

Next, we consider lifetime transfers. Table 2.5 shows that the lifetime transfers fall with rising income. Furthermore, when looking at the transfers-income ratio, the progressive nature of the transfers is clearly observable in the lifetime data. The transfers of the lowest decile constitute on average 27% of their lifetime income. This share falls to 8% for the 10th decile.

In a next step, we provide more information on our lifetime data. In particular, we discuss how taxes, transfers and income are distributed over the lifetime of individuals. Table 2.6 reports the lifetime shares of allocated taxes, transfers and equivalent disposable income, which are attributed to each decile of the synthetic working-age population. We note that the share of lifetime transfers is quite harmonized over the income deciles. While the lifetime poorest decile receives about 12% of total transfers, the lifetime richest decile receives about 9.3% of total transfers.

On the contrary, allocated taxes are more heterogeneously distributed over the lifetime income deciles. Our data show that nearly a quarter of the entire allocated tax burden of the whole working-age population is borne by the lifetime richest 10% of the population.

Lifetime Data	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Transfers	12	10.9	10.4	10	10	9.4	9.3	9.4	9.5	9.3
Allocated Taxes	3	5	6	7	8	9	10.3	12	14.8	24.33
Income	6	7.5	8.3	8.9	9.5	10	10.7	11.4	12.5	15

Table 2.6: Lifetime Shares of Allocated Taxes, Transfers and Equivalent Disposable Income.

This indicates the effectiveness of the German welfare state to redistribute income. In fact, we observe that when considering equivalent disposable life-cycle income, the richest decile accounts for less than three times the income of the poorest decile.

The results shown in Tables 2.5 and 2.6 suggest that for Germany, the current estimates on the redistributive impact of the tax-benefit system overestimate the actual redistribution between individuals. A significant share of the income redistribution can be attributed to a reallocation of income over the entire life cycle of individuals. The principal recipients of transfers are in the lower part of the income distribution, while the highest two deciles contribute about 40% of the tax payments. This indicates that the extent of self-financed transfers will rise with higher income deciles. We will calculate the extent of this intrapersonal income redistribution in Section 2.5.

2.4.3 Implications for Income Inequality

Our results so far indicate that using equivalent disposable income instead of pure labor income will have strong implications for the assessment of the income distribution. When looking, e.g. at the gender-specific labor income, Figure 2.2 suggests that women are disproportionately located in the lower end of the income distribution, while using equivalent disposable income brings about much more equality between genders. In the following, we put special focus on the implications of our synthetic life-cycle data on income inequality.

Extending the accounting period from one year to a whole lifetime indeed reduces the inequality of income of Germany. The Gini coefficient drops from 0.3685 using annual data to 0.1492 using lifetime data. Lifetime estimations thus significantly reduce the income inequality (The Gini drops by 60%). This confirms the expectation that annual data overestimate the extent of interpersonal income redistribution. The snapshot of the income in the cross-section neglects the intrapersonal redistribution that takes place over the lifetime of the individuals. As individuals are mobile between income deciles during their life, the lifetime incomes are more equally distributed than the annual data. For example, a student who appears to be poor in a cross-section sample may earn considerably more later in life, and therefore move to a higher income decile when annualized lifetime data are considered. Consequently, a large part of the redistribution can be attributed to a reallocation of resources within the life of an individual, resulting in a lower Gini coefficient of lifetime incomes.

Comparing our Gini coefficient with official statistics, we note that our Gini coefficient is higher and thus reports a higher level of income inequality. For instance, the Gini coefficient reported by the OECD is 0.288 for the equivalent disposable household income of the working-age population in the mid 2000s, compared to our Gini coefficient of 0.3685 using annual income data in our calculations. Our higher Gini coefficient reflects the different earnings structure in our initial sample population. As explained in Section 2.3.1 we drop a large number of individuals from our data set and disregard for instance employees who have been self-employed for more than 4 years, civil servants, ...etc. This implies, that our sample includes a disproportionately higher share of individuals with zero or low income. Overall, our sample population is poorer and more unevenly distributed than the average presented by for instance the OECD. Table 2.7 presents the Gini coefficients applied to the different lifetime income concepts.

Income	**Gini**	**Change in Gini**	**Gini (men)**	**Gini (women)**
Lifetime Original Income	0.3028		0.1839	0.2665
Lifetime Gross Income	0.2493	-17.4%	0.1517	0.2014
Lifetime Disposable Income	0.2209	-11.4%	0.1261	0.1734
Lifetime Equivalent Disposable Income	0.1492	-32.5%	0.1384	0.1542
Annual Equivalent Disposable Income	0.3685			

Table 2.7: Gini of Annualized Lifetime Income

According to Table 2.7, the redistribution through transfers (from original income to gross income) is larger than the equalizing effect of taxes. Lifetime transfers reduce the Gini coefficient by 17.4% while lifetime taxes reduce the Gini coefficient only by 11.4%.

Overall, the combined redistributive effect of the tax-transfer system appears to be slightly lower (29.1%) than the redistribution occurring within families (32.5%). The impact of the income redistribution within households on income inequality can be seen by comparing the disposable income with the equivalent disposable income. As shown above, the income earned by women is substantially lower than that of men. Thus, the Gini coefficients above confirm that the redistribution of lifetime income occurring within families (and through the tax-benefit system) is largely a redistribution from rich men to poorer women.

The equalizing effect of transfers is more pronounced for women than for men. Transfers reduce male income inequality by 17.5% while the income inequality of women is reduced by 24.4%. On the other hand, the impact of taxes is more equalizing for men than for women. This may be explained by the fact that women are the principal recipients of transfers, while men contribute more to the overall tax payments.

As mentioned above, using lifetime data discloses strong implications for the inequality of income between the genders. Comparing the Gini coefficients of the lifetime disposable income with the equivalent disposable income, we see that the redistribution within families occurs mainly from men to women. The Gini coefficient of female lifetime disposable income drops from 0.1734 to 0.1542 (equivalent disp. lifetime income), while the Gini coefficient for men even rises from 0.1261 to 0.1384.

The results shown above are consistent with the results of other studies, which also find that the annual income is less equally distributed than the lifetime income (Sorensen et al. (2006), Falkingham and Harding (1996)), Pettersson and Pettersson (2003)).

Our analysis of annual and lifetime income data shows that the income redistribution from rich to poor individuals is overestimated in the annual data. Instead, a large part is can be attributed to intrapersonal redistribution. In the following section we will calculate the extent of intrapersonal income redistribution in Germany.

2.5 Inter- and Intrapersonal Redistribution of Income

In this section, we use the synthetic life cycle data on taxes and transfers to calculate the intra- and interpersonal income redistribution. In order to disentangle these two different components of income redistribution, we apply the method by Falkingham and Harding (1996), which we describe below. Furthermore, we replace the term *allocated taxes* by simply *taxes* for convenience.

The total intrapersonal redistribution of income is the sum of all transfers that has been self-financed during the life cycle of the individuals. Thus, the amount of transfers received in a lifetime needs to be compared to the amount of lifetime tax payments for each individual. The smaller of the two sums can be considered as self-financed over the lifetime. Given the data on all synthetic individuals over t periods, we first calculate the lifetime transfers B_i for each synthetic individual i. We proceed in the same fashion with the calculation of lifetime allocated taxes, which we denote as T_i for individual i. Both, lifetime transfers and taxes are therefore given by:

$$B_i = \sum_t B_{it} \qquad \text{and} \qquad T_i = \sum_t T_{it}$$

Consequently, total life-cycle transfers, which are self-financed by individual i are given by:

$$B_i^{sf} = \min(B_i, T_i)$$

As a result, the total nominal amount of intrapersonal redistribution is given by the sum of all self-financed transfers of all individuals:

$$R^{\text{intra}} = \sum_i B_i^{sf}$$

Next, in order to compute the total nominal amount of interpersonal redistribution, we first calculate net lifetime transfers of individual i by summing up annual net transfers over t:

$$B_i^{\text{net}} = \sum_t B_{it} - T_{it}$$

An individual may have a negative net balance for a certain year if taxes exceed transfers in that year. However, that individual may accumulate a positive net balance over the life course when total lifetime transfers B_i exceed total lifetime tax payments T_i. We call synthetic individuals with $B_i^{\text{net}} > 0$ net recipients and individuals with $B_i^{\text{net}} < 0$ net payers. The interpersonal redistribution of income is the amount of taxes and benefits that are transferred from the lifetime rich to the lifetime poor. We have already mentioned that in our context, allocated taxes denote that part of total taxes that is used to finance the transfers and therefore are equal to total transfers. Therefore, the lifetime negative net balances (= net lifetime taxes) equals the lifetime positive balances (= net lifetime transfers). As a result, the the total nominal amount of interpersonal redistribution of income is the sum of the positive (or negative) net lifetime balances:

$$\begin{aligned} R^{\text{inter}} &= \sum_i B_i^{\text{net}} \qquad \text{if} \quad B_i^{\text{net}} < 0 \\ &= \sum_i B_i^{\text{net}} \qquad \text{if} \quad B_i^{\text{net}} > 0 \end{aligned}$$

We can now use the the total nominal amount of inter- and intrapersonal redistribution of income to calculate the intrapersonal share as $S^{\text{intra}} = R^{\text{intra}}/(R^{\text{intra}} + R^{\text{inter}})$. The decomposition of the income redistribution can be done for selected transfers separately, or for all combined transfers and tax payments. In the following, we discuss both. Finally, we apply these calculations to the extended tax concept, which includes indirect taxes as well as direct taxes.

2.5.1 Intrapersonal Redistribution of Income Using Direct Taxes

We first report the share of intrapersonal income redistribution based on direct taxes. Table 2.8 presents the details of the German intrapersonal income redistribution for deciles of equivalent disposable income.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Lifetime Data										
Income	394820	495500	543980	583320	619890	656120	696580	745790	813580	985570
Allocated Taxes	27874	43342	53258	61530	70602	80122	90285	104980	129630	212680
Transfers	104910	95675	90760	86900	86128	82109	81708	81959	82857	81299
Annualized Lifetime Data										
Balance (Net Recipients)	1688	1349	1134	1023	985	838	841	778	742	727
Balance (Net Payers)	358	525	569	663	735	829	953	1129	1565	3065
Share of Net Recipients	96	87	79	71	62	52	43	34	26	9
Share of Net Payers	4	14	21	29	38	48	57	66	74	91
Share of SF Transfers	31.9	49.67	60.06	67.68	73.94	80.92	84.65	89.06	92.67	97.67

Table 2.8: Means of Lifetime Values (in 2004 euros) by Deciles of Equivalent Disposable Lifetime Income

Over their lifetime individuals in the lowest income decile (D1) receive on average 104,910 € in transfers, while they pay 27,874 € allocated taxes. The vast majority of the individuals belonging to D1 are net recipients over their lifetime: the annualized net lifetime balance of the individuals, who are net recipients over their lifetime, amounts to 1,688 euros on average. However, even in the lowest part of the income distribution some individuals are net lifetime payers. Nearly 18% of the individuals who are net payers over their lifetime belong to the two lowest income deciles (D1 and D2). At the same time, almost 35% of the individuals are net recipients over their lifetime, despite belonging to the upper two income deciles (D9 and D10).

The overall average intrapersonal redistribution of income that is derived from all transfers is 63.06%. It shows that only a minor fraction of the benefits is actually redistributed from the lifetime rich to the lifetime poor. Instead, the majority of the transfers is financed from taxes paid at another point in life of the same taxpayer. As expected, the share of self-financed transfers rises with higher income deciles. It ranges from 31.9% in D1 to 97.67% in D10. This implies that even in the lowest income decile about a third of the transfers is actually financed by the same taxpayer over the lifetime. The rising share of self-financed transfers over the income distribution reflects the progressive structure of taxes and also the decreasing share of lifetime transfers over the lifetime income distribution.

The results of the intrapersonal income redistribution compare well to the results of other studies. The extent of the German intrapersonal income redistribution lies in the range of Italy/Sweden and Australia/Ireland. As discussed in Section 2.2, the inherent model structure clearly affects the estimated results. Our results are most similar to the results for Britain (Falkingham and Harding (1996)), where the transfers exhibit a similarly flat pattern across the income distribution. In general, welfare states in which transfers are mostly based on social-insurance contributions will experience a lower interpersonal redistribution from the lifetime rich to the lifetime poor than a more means - tested welfare system (Falkingham and Harding (1996), OECD (2007)). In our data, one of the main drivers of the lifetime transfers are the unemployment benefits, which are financed by unemployment insurance contributions. This could provide an explanation why the extent of the intrapersonal income redistribution exceeds that of countries, in which transfers are mainly directed at poverty-alleviation, such as Australia.

In general, our estimates on the extent of the German intrapersonal redistribution are rather at the lower bound. One reason is that we focus on the working life of the individuals and do not take the retirement phase into account. Including old-age pension transfers will raise the extent of intrapersonal income redistribution, as the degree of self-financing of old-age pensions is above average (Pettersson and Pettersson (2003)). Other studies confirm our intuition. Sorensen et al. (2006) and Baldini (2001) e.g. include old-age pension transfers and find a higher intrapersonal income redistribution for Sweden and Italy. Moreover, as mentioned in Section 2.3.1, our initial data sample includes a high proportion of individuals with a relatively low income. As the extent of intrapersonal income redistribution rises with higher incomes, our estimates on the intrapersonal income redistribution are likely to increase when individuals with a higher income are included in the analysis.

We find that at least a third of the transfers are self-financed. This suggests that about a third of the current redistribution through taxes and transfers could be reduced if there were another mechanism that allows a reallocation of income over the lifetime. This share is even higher for the higher income deciles.

2.5.2 Results for Selected Transfers - Using Direct Taxes

So far, we have reported the shares of intrapersonal income redistribution using all combined transfers. Next, we present the results on the intrapersonal redistribution for selected transfers. The unemployment benefits are worth considering due to their high share in the overall transfers. The unemployment benefits are financed through unemployment insurance contributions. This suggests that there should be a significant extent of intrapersonal redistribution as all individuals, who are entitled to receive these transfers, have paid unemployment insurance contributions in the past or will do so in the future in case of employment. We also present the share of intrapersonal redistribution for maternity benefits. The extent of the interpersonal redistribution should be higher than for other transfers as maternity benefits are by definition a gender-specific transfer. Only women are entitled to maternity benefits after giving birth. Therefore, there should be a large share of income that is reallocated from men to women, raising the interpersonal component. The last specific transfer we consider, are the child benefits. In contrast to maternity benefits, they are not gender-specific, but rather paid to both parents. The interpersonal income redistribution should therefore be lower than in the case of maternity benefits.

The results in presented in Table 2.9 show that the intrapersonal income redistribution varies considerably when selected transfer types are considered. As expected, the intrapersonal income redistribution with respect to maternity benefits is quite low. It amounts to

21% and is 42% lower than the intrapersonal redistribution for all combined transfers.

	S^{intra}	S^{inter}
All transfers	63.06	36.94
Unemployment Benefits	51.72	48.28
Maternity Benefits	21	79
Child Benefits	64.66	35.34

Table 2.9: Intrapersonal Income Redistribution for Selected Transfers

A large part of the redistribution thus takes place from the lifetime rich to the lifetime poor, and in this case also from men to women. The redistribution from men to women occurs through two channels. First, men are not entitled to receive this transfer type, and therefore only women can "use" their tax payments to self-finance the transfers. Second, men enjoy a much higher equivalent disposable income than women, which raises the interpersonal component even further.

The results with respect to child benefits are also consistent with our expectation, that the interpersonal component should be much lower than in the case of maternity benefits. Child benefits are paid to both partners of the household. This raises the intrapersonal income redistribution to nearly 65%.

Focusing on unemployment benefits only, we find that a major part of the unemployment benefits is self-financed. The intrapersonal redistribution with respect to unemployment benefits is 51.72%. This implies that roughly half of the current unemployment insurance is redistributed from the lifetime rich to the poor. Compared with the result on all combined transfers of Section 2.5.1 there appears to be slightly more redistribution among individuals. Note, however, that even in the bottom decile 28% of the individuals are net payers, compared to only 4% in the case of the combined transfers, as indicated by Table 2.10.

As in the case of all combined transfers, the share of net payers rises with higher income deciles, but is more compressed over the income distribution when focusing only on unemployment benefits. In the top decile, there are more net recipients in the case of unemployment benefits (14%) than in the case of all combined transfers (9%). Out of all unemployment benefits that are received during the lifetime even the low-income individuals finance about 43% of their transfers themselves. This is 34% more than in the case of

Lifetime Data	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Share of SF transfers (all transfers)	32	50	60	68	74	81	85	89	93	98
Share of SF unemployment benefits	43	52	62	66	71	76	80	82	86	94
Share of SF maternity benefits	14	25	35	44	52	68	73	83	93	98
Share of SF child allowance	20	42	58	72	79	82	84	88	92	98
Share of Net Recipients	96	87	79	71	62	52	43	34	26	9
Share of Net Recipients (ub)	72	68	62	55	50	45	38	36	28	14
Share of Net Recipients (mat)	78	74	63	48	29	14	7	3	1	0.2
Share of Net Recipients (child)	99	96	85	69	56	48	45	38	28	10
Share of Net Payers	4	14	21	29	38	48	57	66	74	91
Share of Net Payers (ub)	28	32	38	45	50	55	62	64	72	86
Share of Net Payers (mat)	22	26	37	52	71	86	93	97	99	99.8
Share of Net Payers (child)	1	4	15	31	44	52	55	62	72	90

Table 2.10: Share of Intrapersonal Income Redistribution and Shares of Net Recipients/Payers for Selected Transfers by Deciles of Equivalent Disposable Income. (ub denotes Unemployment Benefits, mat denotes Maternity Benefits and child denotes Child Benefits.)

all combined transfers. Finally, the share of self-financed transfers rises up to 94% in the top decile, which is close to the 98% in the case of all combined transfers.

2.5.3 Intrapersonal Redistribution of Income Using Indirect Taxes

Using a different financing method for the transfers that includes both indirect taxes as well as direct taxes, changes the results on the intrapersonal income redistribution as expected. As explained in Section 2.3.1, indirect taxes exhibit a regressive pattern with respect to income, implying that poorer individuals pay a relatively higher share of indirect taxes to income than rich individuals. Using both direct and indirect taxes implies that the overall tax structure is less progressive than when only using direct taxes. As the principal recipients of transfers are in the bottom decile, including indirect taxes in the analysis should raise the extent of the German intrapersonal income redistribution.

	S^{intra}	S^{inter}
Transfers financed by direct taxes	63.06	36.94
Transfers financed by direct and indirect taxes	73.76	26.24

Table 2.11: Intrapersonal Income Redistribution for Two Different Financing Methods

This is indeed what happens. Table 2.11 shows that the intrapersonal redistribution amounts to 73.76% with direct and indirect taxes compared to 63.06% when only direct taxes are used as financing method.

As in Baldini (2001), we also find that the progressivity of the intrapersonal redistribution changes with a different financing method. Table 2.12 shows that with direct taxes nearly a third of the poor financed their benefits themselves. This rises to almost 50% in the indirect tax case.

Lifetime Data	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Share of SF transfers (direct taxes)	31.9	49.67	60.06	67.68	73.94	80.92	84.65	89.06	92.67	97.67
Share of SF transfers (direct and indirect taxes)	47	64	73	79	83	88	90	92	95	98

Table 2.12: Share of Self-Financed Transfers by Deciles of Equivalent Disposable Income for Two Different Financing Methods

2.6 Conclusion

In this chapter we have calculated the intrapersonal income redistribution for Germany, which is defined as the share of self-financed transfers over the entire life cycle of the average working-age German. Considering that the working horizon marks 47 years (age 18 till age 64) an ideal data set would consists of a representative subset of all Germans over such a long working horizon. Unfortunately, suitable data is only available for a shorter time interval (using the SOEP data set), thus leaving out the most important component for the analysis of life-cycle features, such as the intrapersonal income redistribution. We have therefore applied a method of constructing life-cycle data by matching individuals with similar socio-economic conditions and synthesizing their real-life data. Our method has essentially enabled us to infer the dynamic evolution of income, transfers and taxes over the entire life cycle. One particular obstacle to our method is the low degree of comparability between income levels of individuals which is caused by the heterogeneity of their family structures. We have overcome this comparability problem by applying equivalence scales to the individuals' income levels.

The analysis of our synthetic life-cycle data clearly shows that taxes and transfers are not uniformly distributed over the life cycle and that the welfare state effectively redistributes income from the lifetime poor to the lifetime rich to reduce inequality. In addition, our results also reveal that an almost equally large amount of reduction in inequality is achieved through income redistribution within households. In general, we observe that the life cycle adjusted degree of income inequality in Germany is much lower than the one implied by data reflecting only a fraction or even a snapshot of the entire life cycle.

A closer examination of the income redistribution reveals that almost two thirds of all transfers received by the average German over the life cycle are self-financed. Furthermore, our results are consistent with those obtained in studies on welfare states exhibiting similar characteristics as Germany. Seemingly, there is an enormous potential for the German welfare state to utilize this remarkably high degree of intrapersonal income redistribution for effectively redesigning labor market policies. One such labor market policy could aim at restructuring the current German unemployment benefits system, in order to reduce the distorting labor market incentives of the current tax-transfer system. In particular, a system of individual unemployment accounts could prove to be the better alternative. The average share of self-financed transfers is particularly high in the case of unemployment benefits (51.72%). Out of all unemployment benefits that are received during the lifetime, even the individuals in the poorest income decile finance about 43% of their unemployment benefits themselves. However, most likely, in reality individuals do not perceive that a significantly large share of their income reduction is transferred back to them over their lifetime in the current unemployment benefit system. Therefore, unemployment accounts exhibit a high potential in eliminating this misperception and serve as an engine, powering up the individual's incentives to participate in the labor market.

The following two chapters are devoted to the analysis of unemployment accounts and their effect on employment incentives of individuals, pursuing decisions driven by rational, forward-looking welfare-maximization motives.

Chapter 3

Employment Incentives in the Unemployment Accounts System

3.1 Introduction

In Chapter 2 we show that the income redistribution that is performed via the tax-benefit system is not limited to transferring resources from the lifetime rich to the lifetime poor. Instead, a major part of the tax-benefit system is designed to redistribute income during the lifetime of an individual. We create life cycle data to replicate the development of taxes and transfers during the working life. We are able to compute the intrapersonal income redistribution, which is that part of the transfers which is self-financed by the same taxpayer at another point in his life. We show that the intrapersonal income redistribution makes up more than 60% of the German income redistribution.

Why is such a big share of income redistributed via the public tax-transfer system, when it occurs during the life cycle of one individual? The negative externality created by this public redistribution is a distortion of the individual labour market decisions (e.g. to enter employment, to invest in education,... etc.) due to the imposition of taxes on income (OECD (2007)). Moreover, the availability of transfers may induce the individual to increase moral hazard. It could be more efficient if this individual himself would redistribute his income over time, instead of engaging in income redistribution via the public tax-benefit system. Private savings (or borrowing against future income) could serve as an alternative mechanism through which the intrapersonal income redistribution can be achieved (OECD (2007)). The reason why governments still engage in intrapersonal income redistribution is that market failures such as borrowing constraints impede the efficient functioning of consumption smoothing via alternative mechanisms such as private savings (Sandmo (1999)). Another obstacle to the voluntary private approach is that individuals may tend to "underestimate their own future needs" (Sandmo (1999)), as they cannot foresee their needs in the future perfectly.

In this chapter we introduce mandatory individual welfare accounts as a new mechanism through which the intrapersonal redistribution can be achieved. Transfers that are suitable for the establishment of individual welfare accounts need to exhibit a large share of intrapersonal income redistribution, as the exact purpose of the individual accounts is to facilitate the redistribution of income within the life cycle of one individual. The results of the previous chapter suggest that unemployment benefits are suitable for individual welfare accounts for several reasons: One is that the overall share of intrapersonal income redistribution with respect to unemployment benefits is very high. Nearly half of the redistribution takes place within the life cycle of the same individual. Second, even in the bottom income deciles more than 40% of the unemployment benefits are self-financed by the tax payer. Third, the current design of the unemployment insurance system suggests that individual accounts may substantially improve the efficient functioning of the labour market by reducing the associated distortions. (This is in contrast to other transfers that also exhibit a high intrapersonal redistribution, such as child benefits.)

In the current unemployment insurance system employed individuals pay unemployment insurance and receive unemployment benefits in case of unemployment. Moral hazard will therefore induce some employees to shirk and some unemployed to reduce their effort to find a job. This affects the transition probabilities from employment to and from unemployment.

In our model set-up of individual unemployment accounts, individuals pay an unemployment contribution into their own private account and pay traditional unemployment insurance into a common fund. Once the individual is entitled to transfers, he can withdraw the associated amount from his account. If this balance does not suffice to cover the entire unemployment benefit, the government provides co-financing of the benefit via the common fund. The balance that is left on the account at some pre-specified point in time (for instance upon retirement) can be used to top up (pension) income. The take-up of transfers is directly linked to the remaining balance of the individual account that can be rolled over to the private income.

The unemployment account system is therefore designed to reduce the above mentioned moral hazard problems, as individuals are using "their own" account money to finance their unemployment spells. Thus, by internalizing the cost of unemployment, the individual accounts may eventually reduce the distortionary effects that are present in the traditional tax-benefit system (Brown et al. (2007)). A further advantage of the account system, is that the design of the account system renders the link between unemployment benefits and contributions more transparent. In the traditional insurance system, individuals are obliged to pay unemployment insurance contributions without knowing whether they will ever be entitled to receive unemployment support. In the account system, this money will not be 'lost' but rather paid out upon retirement.

In short, substituting the traditional tax-benefit system with the individual accounts therefore aims at two things: one is the reduction in distortionary taxes and transfers. Moreover, individual accounts aim at stimulating labour market incentives, thereby lowering the overall unemployment rate [1].

The goal of this chapter is to investigate whether replacing the traditional German unemployment insurance system by unemployment accounts will improve the incentives to work and thereby also the unemployment rate. Moreover, what is the impact on private savings? Does the introduction of accounts raise overall private savings or are they a mere substitute? Furthermore, we analyze whether a system of unemployment accounts is self-financing. At last, we will answer the question whether the unemployment account system is superior to the traditional unemployment insurance system in welfare terms.

Chile is one of the few countries which has established individual unemployment accounts[2]. They were introduced in 2002 and have been widely used since then[3]. The Chilean design of the account system is slightly different from our model set-up, in that individuals as well as their employers pay unemployment contributions into the individual unemploy-

[1] As we will see later on, this may in turn induce a further reduction in the tax rate rate.

[2] For more detailed information on the unemployment account systems in Chile and other Latin American countries, please refer to Robalino et al. (2009); Ferrer and Riddell (2009); Acevedo et al. (2006); Sehnbruch (2004).

[3] According to the Superintendencia de Pensiones in Chile, about 136 790 members received unemployment benefits in September 2012 (Superintendencia de Pensiones (2012)).

ment accounts as well as into a solidarity fund. The government contributes additional resources to the solidarity fund. During unemployment, the individuals withdraw money from their individual unemployment account. The access to the solidarity fund is restricted to specific groups of workers based on the layoff of the individual and the previous type of job contract. Moreover, the access to the solidarity fund is limited to individuals who have insufficient balances on their individual accounts. Reyes Hartley et al. (2011) use a mixed proportional hazard rate model to analyze the Chilean account system. They compare individuals, who use the individual unemployment accounts, with individuals who in addition also have access to the solidarity fund. They conclude that an unemployment insurance system based on individual accounts can improve the work incentives, as individuals have lower unemployment exit rates during the months in which they have access to the solidarity fund than those individuals, who rely solely on their individual unemployment accounts.

Several other studies deal with the implementation of unemployment accounts in various other countries. One important question in which these studies differ is what happens once accounts are depleted. Can they turn negative and who pays for the negative balance? Our design of the unemployment account system closely follows that of Brown et al. (2007), who impose that accounts cannot turn negative. Instead, unemployed individuals with a zero account balance receive money from the common fund to finance their unemployment benefits. In this model set-up Brown et al. (2007) find that the switch from the insurance to the account system alters employment incentives and thereby reduces the unemployment rate of selected European countries by 30-51%. The altered employment incentives result from a lower overall tax rate and because workers internalize their cost of unemployment (Brown et al. (2007)). An alternative approach is modeled by Feldstein and Altman (1998), who explicitly allow negative account balances. They find that only about 5% of the employees will end up with negative account balances at the end of their working life. Thus, even with the possibility of negative accounts, the system is financially feasible: the cost of these negative balances correspond to 40% of the cost of the traditional insurance system. Sorensen et al. (2006) model the implementation of individual savings accounts in Denmark. They extend the account concept beyond unemployment accounts and include early retirement benefits, education benefits, sickness benefits, child benefits and parental leave benefits in addition to short-term unemployment benefits. Their set-up also allows for negative account balances, which will be set to zero at the time of retirement. They also conclude that the individual savings accounts are self-financing and improve the government budget. Furthermore, they find that introducing individual savings accounts in Denmark will be a Pareto-improvement despite a small increase in the inequality of the lifetime income distribution.[4]

The models described above are a first step to evaluating the welfare gains from replacing the current insurance system with unemployment accounts. Nevertheless, they exhibit some drawbacks. E.g. Feldstein and Altman (1998) disregard any behavioral responses to the introduction of individual accounts. This constitutes a major limitation, since one interesting question is precisely whether the unemployment account system induces changes in labor market participation. The importance of this aspect is pointed out in Sorensen et al. (2006), who take the behavioral component into account. They find that the behavioral change in the labour supply due to reduced marginal and average effective labour-income tax rates alone covers 75% of the initial revenue loss from the introduction of the accounts. Sorensen et al. (2006) as well as Brown et al. (2007) apply a two-period model and find improved incentives of the unemployed and a reduction in the unemployment rate in one period (the second period) of their model. However, models with such a short time horizon can generally not capture major dynamic effects of an unemployment reform and thus do no exploit the full potential of an unemployment account system. We depart from assuming a short time horizon by extending the number of periods. This enables us to investigate whether the change in incentives to work, in the government budget and in the unemployment rate impacts various age cohorts differently. Moreover, introducing multiple periods is necessary in order to implement a transition phase in which the switch from the current to the new account system can be modeled, an analysis which we perform in the next chapter.

To our knowledge Setty (2011) and Pallage and Zimmermann (2011) are so far the only studies that have studied unemployment accounts with an extended total number of

[4] Several studies consider different aspects or variants of individual welfare accounts. Those include for instance, unemployment savings accounts in Goerke (2007); Brunner and Colarelli (2004); Vodopivec (2008), guidelines for the practical implementation of unemployment accounts in Germany in Boss et al. (2007) or the behavioral effects of unemployment accounts in van Huizen and Platenga (2011). Moreover, Stiglitz and Yun (2005), Orszag et al. (1999) as well as Fölster and Trofimov (1999) investigate individual account systems, in which old-age pensions and unemployment accounts are combined. Other types of welfare accounts, such as health and educational accounts, are for instance addressed in Fölster et al. (2003).

decision periods. Setty (2011) uses a finite horizon life-cycle model to analyze the welfare effects of replacing the unemployment insurance with unemployment accounts. He finds that a switch to the unemployment account system will lead to a significant welfare gain when the employment incentives are a driving force of the model. When frictions are the sole cause of unemployment, the switch to the account system will result in a welfare loss. In Setty (2011) unemployment is driven by both exogenous and endogenous factors. The exogenous factors are the age-dependent firing rate and hiring rate (search frictions). The endogenous factors are worker's labor choice decisions. Setty (2011) also models explicitly a stock of wealth which is not included by Pallage and Zimmermann (2011). Pallage and Zimmermann (2011) use an infinite horizon model with heterogenous employment status to determine the optimal account policy. They compare this to the optimal unemployment insurance policy and a system with self-insurance and investigate the willigness to switch from the traditional insurance system to the account system. They find that even in the absence of moral hazard, e.g. receiving unemployment benefits after refusing a job offer the majority of the individuals (97%) prefer to switch to the account system. This effect is reinforced when moral hazard is introduced; the account system is then welfare-improving.

Our methodology is similar to that of Setty (2011) and Pallage and Zimmermann (2011) who formulate the individual's life-cycle optimization problem as a dynamic programming problem, which they solve numerically using advanced state of the art computational methods. However, in both these studies labor choice is binary, i.e. workers who are offered a job have the option to accept or reject the job offer. Similarly, employed workers have the choice to either retain their job or to quit. Our model departs from these binary decisions in that we allow workers to make continuous-variable decisions regarding their labor effort. This is a very important feature of our model, since we are interested in the behavioral component of the unemployment account system and continuous decision rules allow us to study labor individuals' labor market incentives in much more detail. More specifically, our major focus is to study how the trade-off between labor market incentives, consumption and savings is affected under a system of unemployment accounts.

Indeed, our results suggest that there are enormous positive effects of introducing the unemployment account system. First, we study a system of unemployment accounts with only one payout period upon retirement. For the aggregate economy, we find that aggregate savings as well as consumption patterns are generally higher compared to the unemployment insurance system. This results from a much higher aggregate disposable income caused by the reduced aggregate unemployment rate. The latter is reduced by approximately 23%. In general, switching to the unemployment account system generates stronger labor market incentives and a reduced unemployment rate for all age groups, but is most effective at reducing old-age unemployment. Most interestingly, those incentives are not only visible shortly before the retirement period but already some decades in advance. When looking at the results on the individual level, we observe, that even in the case of a zero unemployment account balance, the individual's leisure choice is about 10% - 15% less when compared to the UI system. This is a strong argument for the effectiveness of unemployment accounts in generating labor market incentives. Looking closer at the heterogeneity of individuals, we find that independent of their age, wealthier individuals react more strongly to the introduction of accounts, meaning that their leisure choice drops more. Finally, consumption levels are much higher under the UA system for all individuals, irrespective of their age, wealth or employment status.

In a next step we introduce a mechanism in order to stimulate labor market incentives of the younger generations and study the sensitivity of the behavioral patterns to multiple payout periods. We find, that additional payout periods strongly amplify the individuals' labor market incentives. E.g., individuals react to the additional payouts well in advance and adjust their behavior accordingly: they raise employment incentives to increase the probability of employment and consequently of receiving the payout.

Finally, we focus on the welfare implications of the unemployment account system. We find that the government budget position is improved, even in the case with multiple payout periods. This implies, that such a change in the unemployment system is also financially feasible. The major driver for the improved government budget is the drastically reduced unemployment rate, which in turn leads to much lower obligations for the government of financing unemployment benefits. Overall, the government has to pay for about two-third of the unemployment benefits under the unemployment account system. For a coherent welfare analysis, we also have to take into account that higher labor market incentives actually might be welfare-reducing from the individual's perspective, since leisure is part of the worker's utility. For that reason, we study the corresponding consumption equivalent under the unemployment account system. In general, upon entering the labor market all individuals, whether initially employed or unemployed, rich or poor can expect higher total welfare under any UA regime compared to the traditional UI regime. Moreover, we find that poor individuals experience a larger welfare gain in the unemployment account system than rich individuals, amounting up to 1%.

This chapter proceeds as follows. Section 3.2 describes the dynamic optimization model and its computational solution method. Section 3.3 presents the results of the model. Here, we focus on some aggregate features of the model as well as the behavioral features of unemployment accounts. Furthermore, we study the sensitivity of our results with respect to multiple payout periods and also perform a general welfare analysis of the unemployment account system. Finally, Section 3.6 concludes.

3.2 Stochastic Life Cycle and Unemployment Accounts

As already mentioned, we are particularly interested in the individual's behavioral characteristics of the unemployment account system. Therefore, we require an explicit formulation of incentives and disincentives for labor. We therefore model the choice of leisure and shirking of the individual as continuous control variables rather than binary discrete choices. This allows us to add an additional, incentive-dependent component to the standard frictions in specifying the probability of changes in the labor market status of the individual. Furthermore, we are interested in how these employment incentives interfere with optimal consumption and savings decisions. Therefore, we model a stock of wealth in addition to the stock of the unemployment account. Overall, given the different age groups, employment status, wealth status and unemployment account level, we implement a significant degree of heterogeneity into our model, which eventually allows us to study how the introduction of a system of unemployment accounts will affect a wide range of individuals.

3.2.1 Structure of the Model

An individual of age t is endowed with asset holdings X_t and unemployment account balance

A_t. Given the employment status S_t, the individual chooses consumption c and leisure[5] l to maximize the expected present discounted life-time utility stream up to $t = T$. Utility in state S is given by $U^{S_t}(c_t^{S_t}, l_t^{S_t})$ with $U_c^{S_t} > 0, U_{cc}^{S_t} < 0, U_l^{S_t} > 0, U_{ll}^{S_t} < 0$ and $U_{cl}^{S_t} > 0$. We specify t $\in$ [18, 19, 20, $\ldots$ 64] as the age of an individual participating in the labor market, where age 65 corresponds to the retirement period. Thus, we have 47 periods with annual time steps. The objective function of the individual can be expressed by:

$$
\begin{aligned}
V_t(X_t, A_t, S_t, t) &= \max_{c_t^{S_t}, l_t^{S_t}} \quad \mathbb{E}\left\{\sum_t^T \beta^{t-1} u^{S_t}(c_t^{S_t}, l_t^{S_t}) + \beta^{T+1}\Omega(X_{T+1}, A_{T+1})\right\} \\
\text{s.t.} \quad X_{t+1} &= \begin{cases} (1+r)X_t + w_t(1-\tau_t^A) - c_t^E & \text{for } S_t = E \\ (1+r)X_t + b_t - c_t^U & \text{for } S_t = U \end{cases} \\
A_{t+1} &= \begin{cases} (1+r)A_t + w_t\tau_t^A & \text{for } S_t = E \\ \max\{0, (1+r)A_t - b_t\} & \text{for } S_t = U \end{cases} \\
S_{t+1} &= \Pi_t(S_t, l_t^{S_t}) \\
X_t, A_t &\geq 0 \qquad c_t^{S_t} \geq 0 \qquad 0 \leq l_t^{S_t} \leq 1
\end{aligned} \tag{3.1}
$$

The discount rate is denoted by β and r is the interest rate. The individual leaves the labor market (retires) at $T + 1$ and has a bequest value given by the bequest function Ω. If employed, the individual receives a wage w_t and deducts an obligatory contribution $\tau_t^A w_t$ to the individual's unemployment account. Asset holdings, X_t, of an employed thus increase with interest earned and net wage. They decrease with higher consumption levels. If unemployed, the individual receives a benefit b_t. Asset holdings of an unemployed increase with interest earned and the benefit. They decrease with higher consumption levels. The unemployment account level of the employed increases each period with interest earned and the obligatory contribution. In case of unemployment, the unemployment account is used to cover the benefit. However, once the UA balance becomes insufficient, the government

[5] Leisure can be seen as on-the-job shirking if employed and job search disincentives if unemployed.

steps in to cover for the remainder. The employment status S_t is a binary Markov chain with two possible values, E when employed and U when unemployed. The Markov chain transition matrix from S_t to S_{t+1} is given by:

$$\Pi_t = \begin{bmatrix} \pi_{EE}(l_t^E) & \pi_{EU}(l_t^E) \\ \pi_{UE}(l_t^U) & \pi_{UU}(l_t^U) \end{bmatrix}. \tag{3.2}$$

Thus, given a leisure level l_t^U of the unemployed, the probability of finding a job is $\pi_{UE}(l_t^U)$ and the probability of staying unemployed is $\pi_{UU}(l_t^U) = 1 - \pi_{UE}(l_t^U)$. Similarly, given a shirking level l_t^E of the employed, the probability of loosing a job is $\pi_{EU}(l_t^E)$ and the probability of keeping a job is $\pi_{EE}(l_t^E) = 1 - \pi_{EU}(l_t^E)$. Figure 3.1 summarizes the model structure.

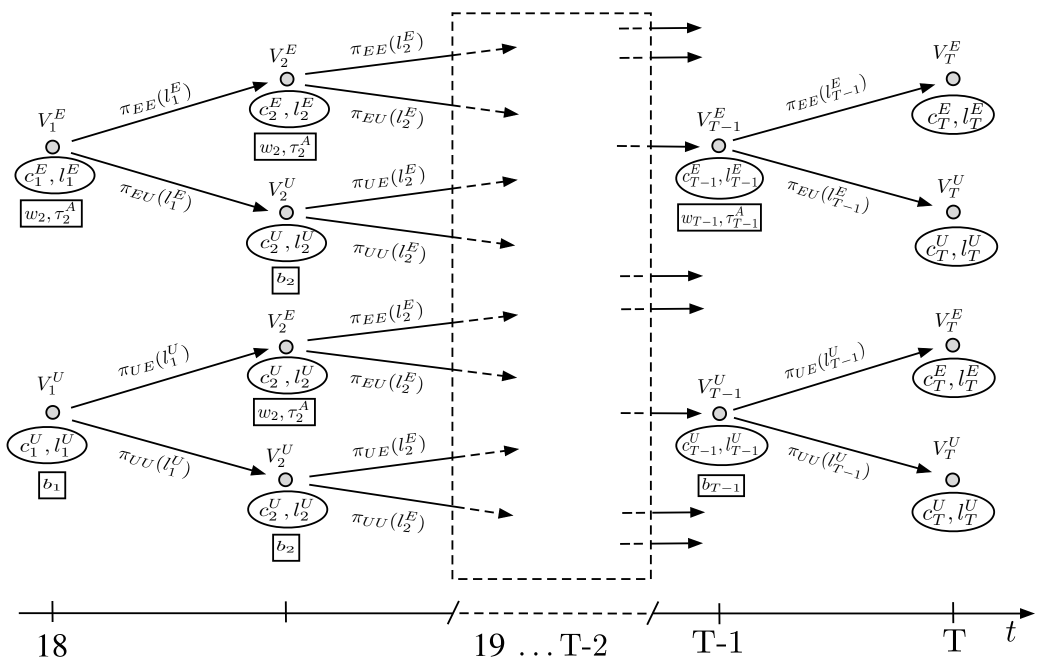

Figure 3.1: Stochastic model structure: Time runs from $1 - T$. Each time period, the welfare-maximizing individual faces an endowment of assets X and an unemployment account balance A on the continuous state space $X - A$. When employed, the individual receives wage w_t^E, net of τ_t^A, the contribution to the unemployment account. The optimal consumption c_t^E and leisure l_t^E policies conditional on the $X - A$ endowment determine the value function V_t^E. The same logic holds for the unemployed individual who receives unemployment benefits b_t^U. Given the employment status $S_t \in [E, U]$, the individual's leisure-dependent probability of moving to state $S_{t+1} \in [E, U]$ is given by $\pi_{S_t S_{t+1}}(l_t^{S_t})$. At time T, the individual faces a terminal value function. It is important to note, that given T time periods the model generates 2^T possible employment paths. The paths are not interlinked. Assuming $T = 48$, we obtain $2.81474977 \cdot 10^{14}$ possible employment paths. Since X and A are modeled as continuous-state variables, we are able to determine the optimal consumption and leisure decisions given the age and employment status for an infinite number of combination in the $X - A$ space.

3.2.2 The Dynamic Programming Framework

A solution to the dynamic optimization problem in (3.1) satisfies the Bellman equations for the employed (E) and unemployed (U) at each time period. We assume that the individual leaves the labor market at $t = T + 1$. As a consequence, the terminal value function is known and equal to the bequest value

$$V_{T+1}(X_{T+1}, A_{T+1}) = \Omega(X_{T+1}, A_{T+1}) \tag{3.3}$$

Given 3.3 we can recursively solve 3.1 for $t = T \dots 1$. In particular, we solve the Bellman equation for the individual when employed at t:

$$\begin{aligned} V_t^E &= \max_{c_t^E, l_t^E} u^E(c_t^E, l_t^E) \\ &+ \beta \cdot \left(\pi_{EE}(l_t^E) \cdot V_{t+1}^E(X_{t+1}^E, A_{t+1}^E) + \pi_{EU}(l_t^E) \cdot V_{t+1}^U(X_{t+1}^U, A_{t+1}^U)\right) \\ s.t. \qquad c_t^E &\geq 0 \\ 0 &\leq l_t^E \leq 1 \\ A_{t+1} &= \max\{0, (1+r)A_t^E + w_t \tau_t^A\} \\ X_t^E &\geq 0 \\ X_{t+1} &= (1+r)X_t^E + w_t(1-\tau_t^A) - c_t^E \end{aligned} \tag{3.4}$$

where X_1^E and A_1^E are given. Similarly, we solve the Bellman equation for the individual when unemployed at t:

$$\begin{aligned} V_t^U &= \max_{c_t^U, l_t^U} u^U(c_t^U, l_t^U) \\ &+ \beta \cdot \left(\pi_{UU}(l_t^U) \cdot V_{t+1}^U(X_{t+1}^U, A_{t+1}^U) + \pi_{UE}(l_t^U) \cdot V_{t+1}^E(X_{t+1}^E, A_{t+1}^E)\right) \\ s.t. \qquad c_t^U &\geq 0 \\ 0 &\leq l_t^U \leq 1 \\ A_{t+1} &= \max\{0, (1+r)A_t^U - b_t\} \\ X_t^U &\geq 0 \\ X_{t+1} &= (1+r) \cdot X_t^U + b_t - c_t^U \end{aligned} \tag{3.5}$$

where X_1^U and A_1^U are given.

In a next step we derive the optimality conditions for the optimal consumption and leisure policy. The first-order condition with respect to optimal consumption for the employed is given by:

$$\begin{aligned}\frac{\partial u_t^E}{\partial c_t^E} &= -\beta\Big(\pi_{EE}(l_t^E)\frac{\partial V_{t+1}^E}{\partial X_{t+1}}\frac{\partial X_{t+1}}{\partial c_t^E} + \pi_{EU}(l_t^E)\frac{\partial V_{t+1}^U}{\partial X_{t+1}}\frac{\partial X_{t+1}}{\partial c_t^E}\Big) \\ &= \beta\Big(\pi_{EE}(l_t^E)\frac{\partial V_{t+1}^E}{\partial X_{t+1}} + \pi_{EU}(l_t^E)\frac{\partial V_{t+1}^U}{\partial X_{t+1}}\Big)\end{aligned} \tag{3.6}$$

Thus, the employed consumes up to the point at which the marginal utility gain equals the expected present-discounted next period's marginal value function. Similarly, the Euler equation of the unemployed implies an inter-temporal consumption tradeoff. Todays additional utility obtained from consuming the marginal unit of assets comes at the costs of forgone utility reward from higher asset holdings tomorrow.

$$\begin{aligned}\frac{\partial u_t^U}{\partial c_t^U} &= -\beta\Big(\pi_{UU}(l_t^U)\frac{\partial V_{t+1}^U}{\partial X_{t+1}}\frac{\partial X_{t+1}}{\partial c_t^U} + \pi_{UE}(l_t^U)\frac{\partial V_{t+1}^E}{\partial X_{t+1}}\frac{\partial X_{t+1}}{\partial c_t^U}\Big) \\ &= \beta\Big(\pi_{UU}(l_t^U)\frac{\partial V_{t+1}^U}{\partial X_{t+1}} + \pi_{UE}(l_t^U)\frac{\partial V_{t+1}^E}{\partial X_{t+1}}\Big)\end{aligned} \tag{3.7}$$

Equations 3.8 and 3.9 specify the Euler equations for the optimal leisure choice. From Equation 3.8 we deduct that the optimal leisure choice for the employed is one that equates the marginal utility of leisure to the present-value additional reward of employment, weighted by the marginal firing rate[6].

$$\begin{aligned}\frac{\partial u_t^E}{\partial l_t^E} &= -\beta\Big(\overbrace{\underbrace{\frac{\partial \pi_{EE}}{\partial l_t^E}}_{<0} V_{t+1}^E + \underbrace{\frac{\partial \pi_{EU}}{\partial l_t^E}}_{>0} V_{t+1}^U}^{<0}\Big) \\ &= \beta\frac{\partial \pi_{EU}}{\partial l_t^E}(V_{t+1}^E - V_{t+1}^U)\end{aligned} \tag{3.8}$$

[6]Note, that because $\pi_{EE} = 1 - \pi_{EU}$, it holds that $\frac{\partial \pi_{EE}}{\partial l_t^E} = -\frac{\partial \pi_{EU}}{\partial l_t^E}$

A similar logic holds for the unemployed. Today, the unemployed will choose leisure up to that level for which today's marginal utility gains are offset by today's value of the expected additional reward from tomorrow's employment status.

$$\begin{aligned}\frac{\partial u_t^U}{\partial l_t^U} &= -\beta\Bigg(\overbrace{\underbrace{\frac{\partial \pi_{UU}}{\partial l_t^U}}_{>0} V_{t+1}^U + \underbrace{\frac{\partial \pi_{UE}}{\partial l_t^U}}_{<0} V_{t+1}^E}^{<0}\Bigg) \\ &= \beta \frac{\partial \pi_{UE}}{\partial l_t^U}(V_{t+1}^E - V_{t+1}^U)\end{aligned} \tag{3.9}$$

In general, the individual therefore must trade off the instantaneous benefits of leisure agains the discounted, uncertain future welfare from changes in the employment status. In the following we want to shed more light on those behavioral trade offs. Unfortunately, the multidimensional structure of our model does not allow for a closed form solution. We therefore use computational methods to numerically approximate a solution to the model.

3.2.3 The Numerical Solution Method

Our optimization problem is to solve a stochastic non-linear finite horizon model. We have two continuous states (assets and unemployment accounts) and a discrete employment state variable. We also have two continuous control variables (consumption and leisure choice). We solve this problem recursively, starting from the terminal period. In each period we compute the value function by maximizing over optimal consumption and leisure decisions for the individuals. We approximate the value function by a multidimensional polynomial over a finite interval of the state space. This is a standard approach in computational economics. We then iterate backwards up to the initial time period and proceed at each time step in the same manner. Furthermore, in many economic problems, the value function usually exhibits smoothness and sometimes monotonicity. When it is possible the modeler should exploit those properties to reduce the clock time of the optimization algorithm and increase accuracy of the model solution. In our case, given the properties of the utility function, it is natural to assume monotonicity and concavity of the value function with respect to the stock of wealth. Algorithm 2 below describes our numerical approach in more detail.

Algorithm 2 - Shape-Preserving Numerical Dynamic Programming Algorithm

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Numerical dynamic programming algorithm for solving the stochastic finite horizon optimization problem with value function iteration

(Initialization phase)

Step 1. *For both continuous state variables X_t and A_t, define a grid of approximation nodes, $X_t = \{x_{it} : 1 \leq i \leq m_t\}$ and $At = \{a_{jt} : 1 \leq j \leq n_t\}$ $\forall t < T$*

Step 2. *Express $\tilde{V}_t^s(X_t^s, A_t^s)$ as a sum of $(k-1)^{th}$ degree Chebyshev polynomials (P) over X^s and A^s, with k^2 coefficients, i.e.: $\tilde{V}_t^s(X_t^s, A_t^s) = \sum_{i=0}^{k} \sum_{j=0}^{k} \phi_{i,j} P_i(X^s) P_j(A^s)$. Let $\tilde{V}_{T+1}(X_{T+1}, A_{T+1}) = \Omega(X_{T+1}, A_{T+1})$.*

Step 3. *Recursively iterate from $t = T \ldots t = 1$ over steps 4 and 5.*

(Maximization phase)

Step 4 *Calculate the value function and optimal consumption and leisure policy functions for the employed (E) and unemployed (U) for each t and*

$$\begin{aligned}
\tilde{V}_t^E(X_t^E, A_t^E) &= \max_{c_t^E, l_t^E} u^E(c_t^E, l_t^E) \\
&+ \beta \cdot \left(\pi_{EE}(l_t^E)\tilde{V}_{t+1}^E(X_{t+1}^E, A_{t+1}^E) + \pi_{EU}(l_t^E)\tilde{V}_{t+1}^U(X_{t+1}^U, A_{t+1}^U)\right) \\
\tilde{V}_t^U(X_t^U, A_t^U) &= \max_{c_t^U, l_t^U} u^U(c_t^U, l_t^U) \\
&+ \beta \cdot \left(\pi_{UU}(l_t^U)\tilde{V}_{t+1}^U(X_{t+1}^U, A_{t+1}^U) + \pi_{UE}(l_t^U)\tilde{V}_{t+1}^E(X_{t+1}^E, A_{t+1}^E)\right)
\end{aligned}$$

(Shape-preserving approximation phase)

Step 5. *Given the maximization data from step 4 use the L^2 norm with shape preservation constraints on the value function to approximate the optimal value function.*

For the implementation of the algorithm we need to specify functional forms and parameters of our model. The following section provides more information on that task. We code the model and the algorithm in AMPL and use KNITRO as the nonlinear optimization solver. It takes about one minute to solve the model using a 2 GH, Intel Core i7 machine with 8GB RAM. The resulting relative errors of the approximation are all at most 10^{-6}.

3.3 Results of the Optimization Problem

The relatively simple structure of our model prevents extensive calibrations. Nevertheless, we calibrate our model in accordance with the relevant literature and to match to the German economy. More precisely, we perform a polynomial approximation to fit the life-cycle wage profile of the synthetic data from our empirical analysis of Chapter 2. In addition, we assume that $b_t = \bar{b} w_{t-1}$ with $\bar{b} = 0.6$, i.e. the individual's unemployment benefit amounts to 60% of the last period's wage. The utility function is given by $u(c_t, l_t) = (c_t^{\alpha} l^{1-\alpha})^{1-\gamma}/(1-\gamma)$. We assume $\alpha = 0.925$ and $\gamma = 1.5$. Furthermore, as already suggested in the previous section, we model the bequest function (i.e., the terminal value function) as $\Omega(X_{T+1}, A_{T+1}) = ((1+r)(X_{T+1} + A_{T+1}))^{\alpha(1-\gamma)}/(1-\gamma)$, assuming that all available assets are consumed and leisure is equal to 1. We assume that both, the market interest rate r and the annual discount rate β are 4%[7]. The individual's contribution to the unemployment account is 2% of the wage. Finally, our calibrated endogenous firing and hiring rate are given by $\pi_{EU} = (1 + e^{-\nu^E(l^E - \lambda^E))})^{-1}$ and by $\pi_{UE} = (1 + e^{-\nu^U(l^U - \lambda^U))})^{-1}$, with $\nu^E = 10$, $\lambda^E = 0.4$, $\nu^U = 6$ and $\lambda^U = 0.5$. Thus, our logistic firing and hiring functions are projected around the linear ones in Brown et al. (2007). Note, that λ^E and λ^U denote those leisure choices, which result in the highest marginal firing and hiring rates, respectively.

After implementing these functional forms and calibrated parameter choices, we apply Algorithm 2 to the equation system (3.4) and (3.5) to numerically compute the solution to the workers' optimization problem. After solving the optimization problem, we run 100,000 Monte Carlo runs to simulate the life cycles of the individuals. In the following we present the results of those simulations. First, we study the aggregate of all simulations. Second,

[7] van Huizen and Platenga (2011) note that the discount rate may be much higher, which implies a lower present value of the final payout and therefore a lower effect on incentives. Our assumption of exponential discounting also implies that all individuals have the same time-consistent preferences. As mentioned in van Huizen and Platenga (2011) the effect of the unemployment account system may be overestimated if this is not the case and some individuals are more myopic than others. Implementing (quasi-)hyperbolic preferences may be one way to address this issue in the future.

we focus on the individual's behavioral characteristics. Third, we modify the underlying model to allow for multiple payout periods. Finally, we perform a welfare analysis of the models.

3.3.1 Aggregate Features of the Model's Solution

We study the effects of replacing the traditional unemployment insurance system with individual unemployment accounts. We put special focus on the behavioral analysis of the individual's optimal consumption and leisure choices. However, in order to facilitate that analysis, we want to highlight how the model's calibration translates into the aggregate character of the simulated economy. Therefore, this section shows how the average unemployment account develops over time, and which level of payout can be expected by an individual upon retirement. Furthermore, we present the results on the consumption and saving behavior over the lifetime of the individuals under both systems.

Figure 3.2 shows some aggregate characteristics over the life cycle of individuals. First, note that (net) wage and unemployment benefits, as calibrated, are hump-shaped with a peak in the late forties of an individual. Next, consider the shaded area in Figure 3.2

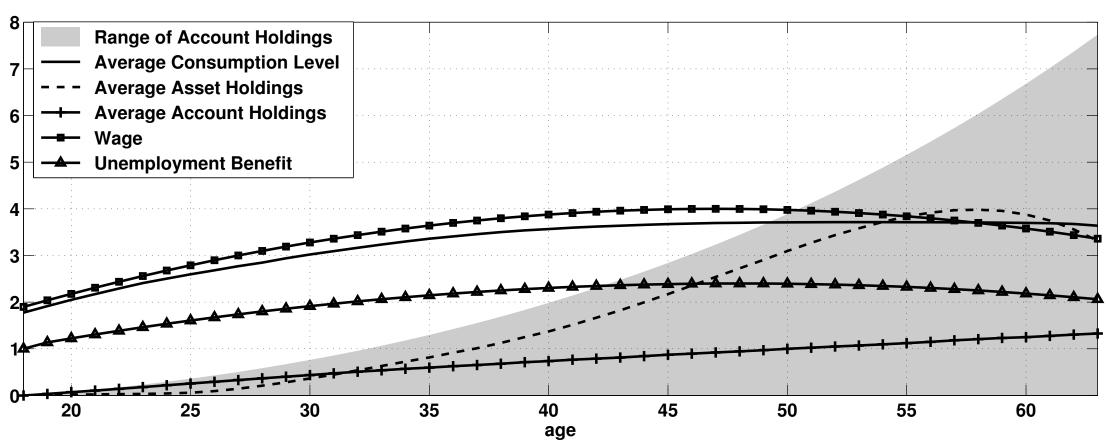

Figure 3.2: Aggregate Variables Under the UA System Over the Life Cycle: Results of 100.000 Simulated Individuals. One Unit of Vertical Axis = €10,000.

which represents the possible set of unemployment account holdings. Obviously, the lower envelope is zero, implying that out of the 100,000 simulated life cycles, there will always be someone in each age cohort having zero unemployment account holdings. The upper envelope represents the unemployment account of an individual, who is always employed. Naturally, the unemployment account for that individual will be convexly shaped due to compounding. We note, that the maximum unemployment account level upon retirement is about twice the corresponding wage level [8].

Also note, that a 43-year old individual, who has always been employed, will face an unemployment account level being equal to the expected unemployment benefit in case of unemployment. Similarly, a 51-year old individual, who has always been employed, will face an unemployment account level being roughly equal to the the wage. This is a direct consequence of the 2% mandatory contribution to the unemployment account and the 4% annual interest rate in our model. Consider next the evolution of the average individual's unemployment account level. Recall, that individuals start out with zero account holdings. Over the life cycle, only if employed, individuals transfer money to their unemployment accounts. The average account balance is increasing over the lifetime of the individual. Note however, that while the average account holdings are about 50% of the maximum possible level for a 33-year old, the average retiree can expect only about one sixth of the maximum possible account level. This is simply due to the fact that the probability of being unemployed at least once is increasing with age. Recall, that any individual who becomes unemployed before age 43 will face an unemployment account level dropping to zero. Nevertheless, the average payout upon retirement is about 40% of the last period's wage.

In a next step, we consider the optimal average consumption choice. The individual faces an inter-temporal consumption trade-off. On the one hand, discounting puts pressure on consuming more in early years. On the other hand, both, risk aversion and the inter-temporal elasticity of substitution induce the individual to consume more in later years, leading to consumption smoothing over the life cycle. Consequently, less consumption today (with higher asset holdings tomorrow) serves as an insurance against the state of unemployment and low income. In Figure 3.2 we see, that the average young individual consumes almost the entire disposable income (i.e. wage - UA contribution). Therefore, savings build up only slowly. Up to age 30, the stock of savings is still less than the average

[8] In accordance with our calibration, 1 unit = €10,000.

UA holdings. After age 30, savings continuously increase and peak at about age 58. Even upon retirement savings constitute a considerably high share of last period's wage. This is expected since the individual does not receive any labor income upon retirement and the risk of a low unemployment account level upon retirement induce the individual to accumulate this high level of savings. Furthermore, consumption smoothing preferences of the individual amplify this effect. The latter argument also explains why the average consumption path is more smooth than the wage path. In general, both average consumption and asset holdings

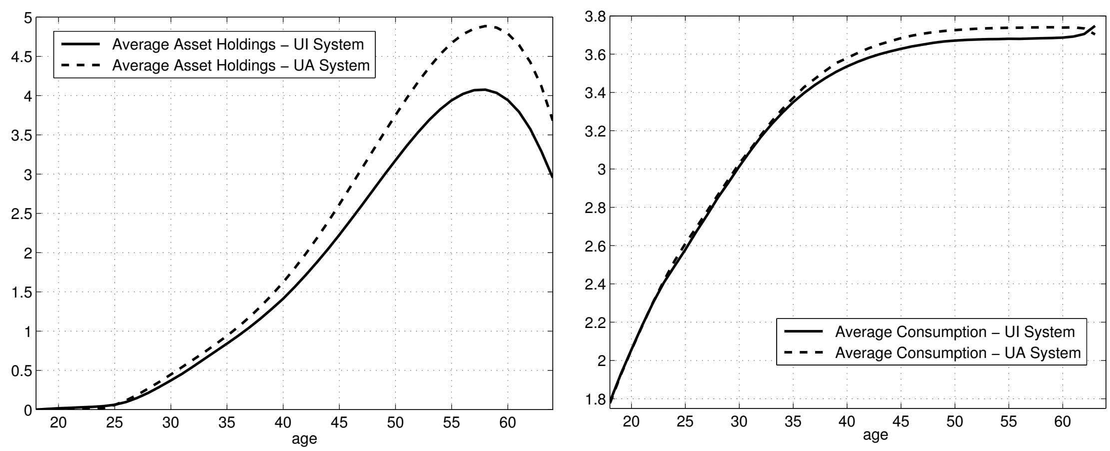

Figure 3.3: UA vs. UI - Asset Holdings (Total Savings) and Consumption. 100.000 Runs

exhibit intuitive profiles. Nevertheless, we can expect to observe some impact on the optimal consumption-saving decision when switching to the UA system. This is the focus of analysis in Figure 3.3. According to the left plot, the average savings (asset holdings) under the UA system are significantly higher compared to the UI system[9]. This effect amounts up to 15%-20% over almost the entire life cycle. At the same time, the average consumption level under the UA system is generally higher than under the UI system, as we show in the right plot. Thus, the UA system, despite leading to higher consumption for the average individual, does not crowd out aggregate savings. On the contrary, the savings behavior of the average individual is significantly enhanced. At first sight, higher consumption and higher savings appear counterintuitive. However, note that both plots represent the nominal

[9]Any comparison between these two systems in this chapter disregards any transition phase. Thus, the UA system results represent a situation in which all simulated individuals have always lived under the UA system. We will study transitional effects in the following chapter.

levels for the average individual. Thus, the only possible driver of this result must be a significantly higher degree of disposable income. That in turn can only be obtained by a significantly lower unemployment rate under the UA system. In order to shed more light at this finding, we consider next how the optimal leisure choice evolves over the life cycle and how that affects the prospects of employment. The left part of Figure 3.4 describes the

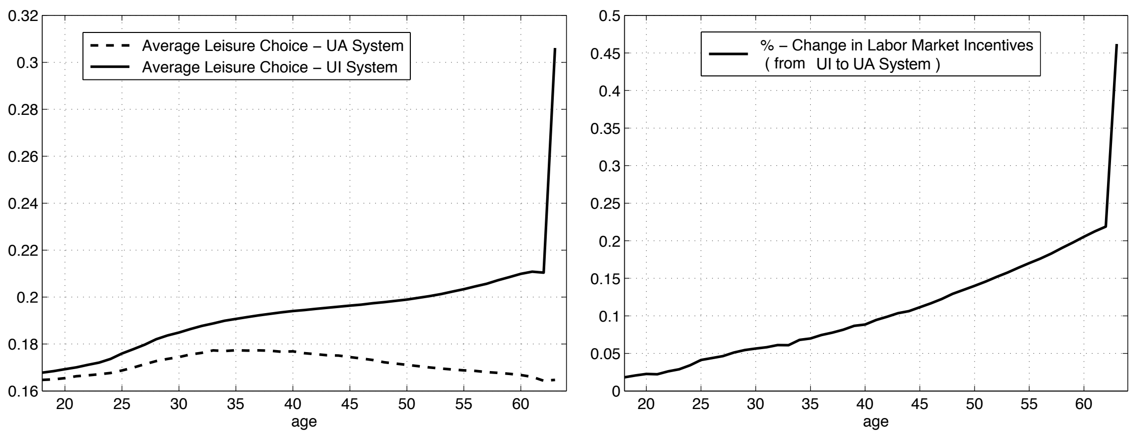

Figure 3.4: UA vs. UI - Labor Market Incentives. 100.000 Runs

optimal dynamics of leisure choice under the UA system in comparison to the UI system. In the traditional unemployment insurance model the optimal leisure choice is an increasing function of age. This mainly occurs for two reasons. On the one hand, wages rise constantly until the last third of the life cycle, which increases consumption and eventually the marginal utility of leisure. After about age 55 wages start to fall slowly. Nevertheless, leisure is still increasing. This is due to the reduced threat of unemployment persistence towards the end of the working life. On the other hand, the possible impacts of unemployment persistence on the individual's welfare fade with higher age of the individual. Furthermore, note that under the UI system, at age 63, there is a sudden sharp increase in leisure. While not shown here in more detail, this result arises because the rich 63-year old face much higher marginal welfare returns from increasing leisure than increasing consumption. Their leisure choice is very high while the poor 63-year old do not face such a strong rise in leisure. As a consequence, the average leisure choice exhibits some of the sharp rise.

This effect is mainly due to the fact that the rich employed face much higher marginal welfare returns from increasing leisure than increasing consumption[10]. In contrast, the unemployment account system induces the individuals to drastically change their leisure choice. While the leisure choice is always lower than in the UI system throughout their entire working life, the average optimal leisure choice is inversely U-shaped over the life cycle with a peak at age 33. This increasing part of the leisure path is most likely attributed to the wage level which is rising. Most interestingly, when considering that the wage profile peaks only after age 45 (see Figure 3.2), leisure decreases after age 33 - much earlier than the wage rate. Clearly the prospect of the payout from the unemployment account upon retirement drives this behavior. In anticipation of the significantly high payout upon retirement the average individual exhibits much stronger employment incentives than under the UI system. Those incentives are not only visible shortly before the retirement period but already some decades in advance.

The right plot in Figure 3.4 depicts how the UA system relatively affects aggregate labor market incentives. We find that the UA system clearly leads to higher aggregate working incentives over the entire life cycle. Furthermore, that difference increases monotonically as the individuals approach the retirement age and ultimately the unemployment account payout. Nevertheless, even entrants to the labor market (i.e. 18-years old) have on average about 2% higher labor market incentives.

We have argued before that higher consumption and higher savings can only be attained if the aggregate unemployment rate under the UA system is reduced. Recall that we model a direct relationship between labor market incentives and the unemployment rate, i.e., higher leisure increases the expected firing rate and decreases the expected hiring rate. Therefore, following our findings from Figure 3.4, we expect the unemployment rate to fall in the UA system. Figure 3.5 confirms our expectation. It shows that the unemployment rates in the two systems diverge significantly with the age of the cohorts. During the lifetime of the individuals in the UI system, the unemployment rate shows an upward trend, rising by more than 40% in total[11].

[10]Note, that we omit showing the leisure at age 64, which is the last decision stage in the model. At age 64 all individuals choose leisure of 1.

[11]In Figure 3.5 we aim at presenting a rough aggregate trend and therefore perform a third-order polynomial interpolation on the actual results to facilitate visualizing that trend.

This feature relates back to the increasing leisure path over the life cycle. In fact, both variables exhibit a direct proportional link. In particular, as we have explained above, workers in the UI system, who are close to the retirement age, value leisure relatively more than expected consumption flows. This effect is completely offset under the UA system.

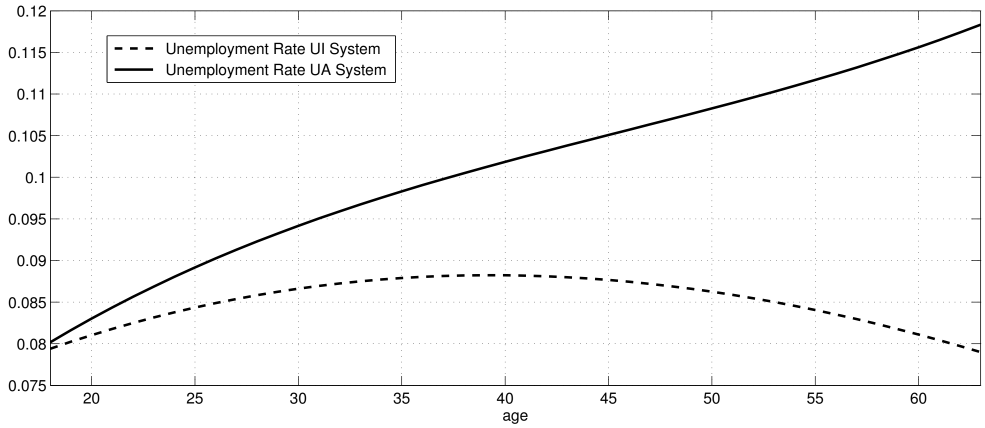

Figure 3.5: Average Unemployment Rate in Both Systems: Results of 10.000 Simulated Individuals.

Switching to the unemployment account system reduces the unemployment rate significantly for all age groups. We find that the unemployment rate roughly follows the wage profile over the life cycle (marginal utility of leisure rises with higher consumption). The average individual has much stronger incentives to work towards the retirement age. Clearly, the UA system is very effective in generating these incentives and, in particular, in reducing old-age unemployment. The unemployment rate of the entire working-age population is shown in Table 3.1[12].

UI System	UA System
10.46%	8.5%

Table 3.1: Demographically-Weighted Unemployment Rate of Working-Age Population

[12]We have computed the unemployment rates in Table 3.1 by aggregating the age-dependent unemployment rates and applying the 2004 demographic distribution in Germany.

First, as a result of our 100,000 simulated life cycles, the total unemployment rate under the UI system is 10.46%. This result matches very well the average unemployment rate for Germany between 1996-2004. We consider this match as validating our calibration of the wage profile and the hiring and firing rates. By contrast, a complete switch to the UA system drastically reduces the total unemployment rate. The nominal reduction is almost two percentage points and relatively, the unemployment rate is reduced by approximately 23%.

In general, the unemployment account system has a tremendous effect on the labor market prospects of all individuals. We attribute the increase in labor market incentives and the accompanying reduction in unemployment clearly to the expected payout upon retirement under the UA system. However, a payout at age 65 constitutes a stochastic cash flow of unknown size and it seems questionable if this stochastic cash flow can be that effective. Nevertheless, the risk of the expected return upon retirement is partly endogenous, since it can be altered by individual leisure choice. In the following, we shed more light on the payout of the individuals and highlight some statistical results for the level of unemployment accounts over the 100,000 simulations.

Table 3.2 provides details on the development of the account balances according to income deciles[13]. The unemployment account balance upon retirement as share of last period's wage differs enormously across the income distribution. It ranges from 14% in the lowest decile to 165% in the top decile. Obviously, individuals located in the upper part of the income distribution have been unemployed fewer times than the poor individuals. Accordingly, their accumulated account balance is much higher. Nevertheless, even the lowest decile, which primarily includes individuals who have been most frequently unemployed, can still - on average- expect an additional payout of about 14% of their wage before retirement.

Next, we consider the share of self-financed transfers over the life cycle. One of the motivations for reforming the unemployment system via introducing unemployment accounts is to take advantage of the high extent of intrapersonal income redistribution. Therefore, the share of self-financed transfers shows whether the model lives up to our primary motivation.

[13]We compute the deciles based on lifetime income, which we define as the the sum of wage and benefits. We disregard here the final payout that the individual receives upon retirement.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
UA Balance upon Retirement (as Share of Last Period's Wage)	0.14	0.18	0.21	0.26	0.27	0.34	0.40	0.64	0.79	1.65
Self-Financed Transfers (Share)	0.16	0.22	0.26	0.29	0.34	0.37	0.47	0.49	0.59	0.62
Positive Account Balances upon Retirement (Share)	0.86	0.89	0.91	0.93	0.93	0.95	0.97	1	1	1
Positive Account Balances during Lifetime (Share)	0.84	0.87	0.89	0.91	0.92	0.93	0.95	0.96	0.97	0.99
Positive Account Balances during Lifetime (Share of Average Transfer)	0.01	0.02	0.03	0.06	0.07	0.11	0.13	0.21	0.27	0.45

Table 3.2: Account Balances, Self-Financed Transfers and Positive Account Balances by Deciles of Lifetime Income.

Self-financed transfers are a measure of how effective unemployment accounts cover unemployment benefits. Obviously, frequently unemployed individuals who do not accumulate large stocks of unemployment accounts cannot cover their unemployment benefits entirely. Our results suggest that the share of self-financed transfers over the life cycle is about 16% for the poorest, and most frequently unemployed ones. It gradually rises up to 62% on average for the highest deciles. In addition, note that the extent to which the unemployment transfer is self-financed is also affected by the timing of the unemployment status. Unemployment at the beginning of the working life lowers the share of self-financing even further, as the individual has not yet accumulated enough to pay the benefit. We already pointed out above that some individuals - even if always employed - cannot self-finance one year of unemployment benefits until age 43. Those individuals have to rely on the government to co-finance the unemployment transfer, as they have not accumulated enough on their unemployment account. In contrast, a 54 year old individual who has always been unemployed has accumulated enough account holdings to self-finance two consecutive years of unemployment.

Table 3.2 reports also the share of positive account balances upon retirement. This share ranges from 86% to 100% across the income distribution. It reflects the low unemployment rate of the individuals in the last period of their working life. Here again, we observe older individuals striving to receive the final payout. As a result, the predominant majority has a positive account balance upon retirement. In order to reduce the weight of this final "effort-phase", we also look at the share of positive account balances during the entire lifetime.

This share is surprisingly high. Even in the lowest decile, individuals on average have a positive account balance in about 84% of their working life. This share is close to 100% in the last two deciles.

The previous two statistics do not provide information on the actual magnitude of the unemployment accounts. Therefore, we look at the average unemployment benefit over the life cycle and add the bottom row in Table 3.2 as a rough indicator for how often individuals can completely self-finance their unemployment benefits. More precisely, the question we ask is: If unemployed, in how many cases does an individual have enough account holdings to cover the entire unemployment benefit? Consider, e.g. the first decile. Our model suggests, that there is only a 1% chance that individuals will be able to completely self-finance all unemployment spells over their life cycle. Similarly, when considering the richest decile, we find that lifetime-rich individuals will be able to self-finance almost half of their unemployment spells.

The general message from Table 3.2 is, that the individuals manage to accumulate significantly large balances on their individual accounts. This is despite the fact, that they use a large share of it in order to finance the unemployment spells during their working life. In particular, the share of positive accounts over the lifetime and upon retirement are indicators for the significant rewards to employment, which individuals' can expect. These results from our simulated economy shows that the unemployment account system is able to generate large positive incentives to work and reduces the average unemployment rate for all age groups. In the next section, we want to identify the major behavioral drivers behind the individuals optimal decisions.

3.3.2 Behavioral Features of the Model's Solution

In this section we focus on the individual's decision making process. Recall that in our modeling framework, the optimal choice of leisure and consumption is a function of four state variables, the level of assets (continuous), the level of the unemployment account (continuous), the employment status (binary) and age (discrete). Given the stochastic dynamic programing approach, we can present the optimal individual choices as either static decision rules depending on the state space, or as the dynamic evolution of the individual's life cycle under rational decision making. The former type of presenting results is more general, answering questions like "given asset level X and account level A, how much leisure will a 45-year old choose if employed?" The latter type of presenting results allows us to look more closely at selected sample stochastic life cycle paths. In this section, we perform both types of analyses.

Analysis of Selected Sample Life Cycle Paths

First, we demonstrate the interplay of the various mechanisms, which are at work in the unemployment account system. In order to do this, we choose from our Monte Carlo simulation one sample path of an individual, who is unemployed three times during the working life (at age 27, 39 and age 61). We compare this individual to one who lives under the UI system, having exactly the same employment history. The lower part of Figure 3.6 shows the optimal leisure choice for both individuals. The upper part of that figure depicts the wage and benefits profiles, the evolution of the unemployment account under the UA system as well as optimal consumption and asset levels under both, the UI and UA system. The individual's age interval which we consider is 18-63[14].

Let us first consider the individual under the UI system (variables under the UI system are depicted as rectangles). Optimal consumption is quite high and the individual does not accumulate much assets up to age 26. Leisure between age 18 and 26 increases slightly due to higher income and consumption levels. In the first unemployment spell at age 27 the individual sharply increases leisure to offset the significant drop in consumption. The latter is still slightly above the unemployment benefit. Note, that this extra consumption in excess of the benefit comes from savings. The individual consumes all savings to smooth out the consumption path. As a consequence, savings at age 28 drop to zero. Furthermore, since the individual is employed again at age 28, leisure is drastically reduced, even below the former path since now the stock of asset holdings is much less. Finally, consumption is almost back to its old path.

With the next unemployment spell occurring at age 39, the individual again chooses much higher leisure and is forced to lower consumption once again. However, this time,

[14]Recall that the optimal leisure choice at age 64 is one. We do not show age-64 results to facilitate visualization. Besides, as both individuals are employed at age 64, the state variables (asset and account levels) can be inferred from the age-63 states and controls.

consumption is smoothed significantly better by using approximately 50% of the savings. Note, that the individual could afford the same constant consumption level as at age 38. However, since asset holdings also insure against lower consumption levels in case of future unemployment, the individual has to weigh much higher consumption at age 39 against the probability of being unemployed again in the next periods. The obvious choice is to hedge and not to decrease assets further.

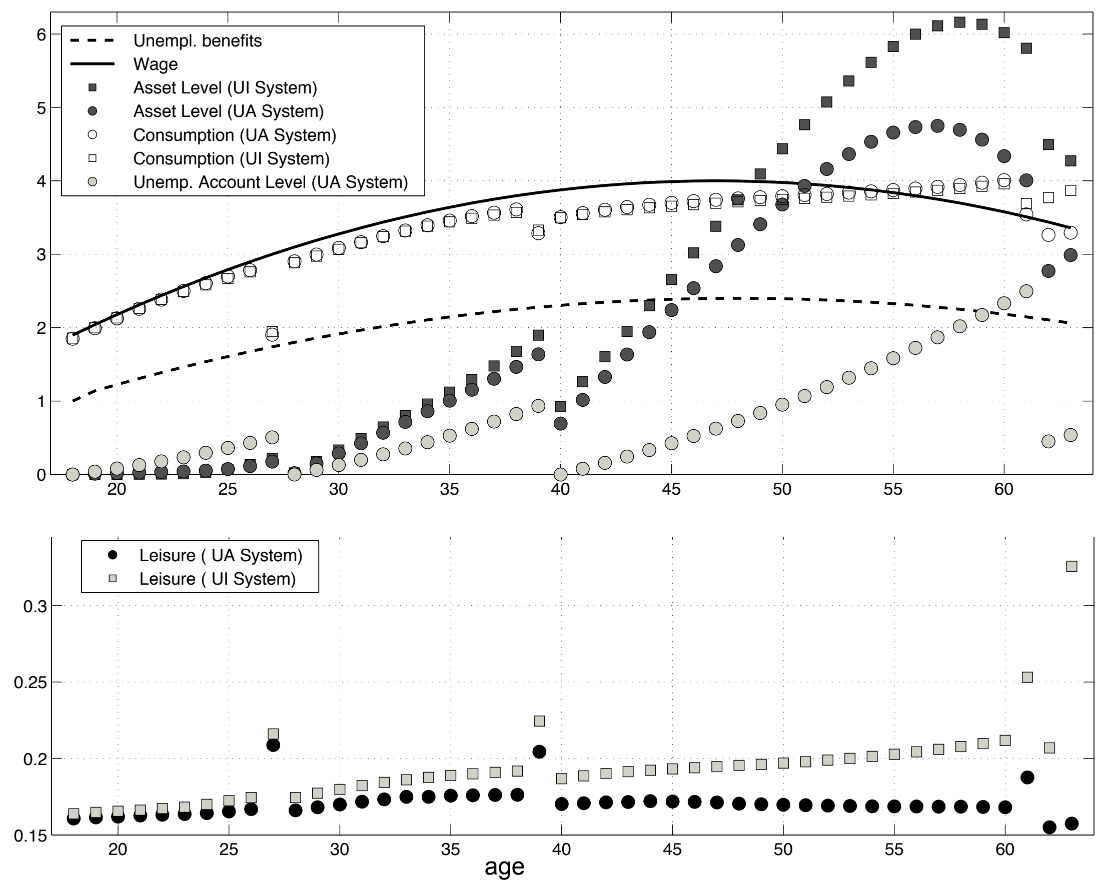

Figure 3.6: Two Sample Paths of Individuals With Same Employment Status over the Life Cycle (UA vs. UI System)

Recall, that savings are the individual's only source of income during retirement. Therefore, we observe a sharply increasing and hump-shaped level of assets. It has to provide enough income upon retirement and still insure against lower consumption if unemployed until then. The third unemployment spell occurs at age 61 and again, leisure is increased and consumption is only slightly reduced.

Next, let us compare the same individual (unemployed at age 27, 39 and 61) who lives under the UA system (variables under the UA system are depicted as circles) There is not much difference between these two systems early in the working life, e.g. until the first unemployment spell occurs at age 27. However, note that the unemployment account is accumulating and it seems as if consumption under the UA system is a bit higher and savings consequently a bit lower. At the same time leisure is slightly lower. At age 27 this trend does not change and both individuals adapt quite similarly to the state of unemployment. Furthermore, note that the unemployment account drops to zero since it does not suffice to cover the entire unemployment benefit.

At age 39, during the second unemployment spell, the unemployment account still does not suffice to cover the entire benefit and drops again to zero. The individual is now on the labor market for more than 20 years and has a zero account level. At that time, consumption and leisure follow similar trends as in the UI system although now, leisure increases much less under the UA system in order to offset the loss in utility arising from the drop in income. Note furthermore, that the stock of savings is visibly lower than under the UI system, which is due to the very low but constant increase in consumption in the past. Thus, we clearly observe that the UA system crowds out savings for this individual. This stands in contrast to our finding from the previous section. However, the previous section looked at the consumption-savings tradeoff of the aggregate economy whereas here we look at the individual's tradeoff. Clearly, the expectation of a positive unemployment account payout upon retirement lowers the pressure for building up a large stock of assets. Therefore, a crowding out of savings occurs. At the same time, individuals choose less leisure to increase their chances of eventually receiving a positive payout upon retirement. This lowers the aggregate rate of unemployment and translates to an average individual who experiences a higher total level of assets. It is important to separate these distinct effects.

With continuing employment in the next periods, the individual starts accumulating savings at a very steep rate. The crowding out of savings becomes therefore even more visible in the 50-60 age interval. We clearly observe the stock of assets accumulating much slower under the UA system than under the UI system. During this time interval the individual consumes slightly more than under the UI system, clearly driven by the expectation of additional income from the unemployment account upon retirement. Correspondingly, the individual chooses much less leisure to increase the probability of realizing that payout.

In our example however, this is not enough since the individual becomes unemployed at age 61. As in the previous two unemployment spells, leisure increases and assets are used to compensate for the loss of income. This time however, the level of unemployment account is sufficiently large to cover the entire unemployment benefit and the government does not need to co-finance the benefit. In fact, a positive amount (about 20% of last period's income) is left, which is being paid out upon retirement. Note however, that the sum of account and assets is lower under the UA system than under the UI system.

Next, we want to look at some interesting sample paths, concentrating solely on the UA system. Figure 3.7 depicts the optimal paths of consumption, leisure, assets and unemployment accounts for three individuals with different employment histories. We want

Figure 3.7: Sample Paths of Individuals with Different Employment Status over the Life Cycle

to analyze how unemployment at younger age affects the life cycle dynamics under the UA system. One individual is always employed, another individual is unemployed at age 20 and the third individual is unemployed at age 20 and 21. Both left-hand plots in Figure 3.7 suggest that consumption and asset holdings are hardly affected when unemployment occurs early in the life cycle. Only towards the end of the life cycle we can eyeball a small difference between these paths. In particular, we see that the individual with two unemployment spells has a slightly higher stock of assets. This is because this individual needs additional assets to compensate for the lower account level at retirement, when compared to the "always employed" individual. Note, that unemployment accounts start out from a zero level after unemployment at age 20 and 21 and compounding effects result in the visible difference in account sizes upon retirement. At the same time the individuals have different optimal leisure choices in the last decade of their working lives. Leisure is a bit higher for those with less unemployment spells because the associated account level is larger. What counts is the expected account level upon retirement, and this is determined by the size and the probability. It seems like the expected account level is similar in all three cases. Overall we find that the three different individuals exhibit quite similar life cycle characteristics.

In Figure 3.8 we perform a similar analysis as above, however now with three individuals who experience identical employment histories (always employed) up to age 59, at which age two of them become unemployed. While one of them immediately finds employment the other individual remains unemployed for one more period. Note, that in order to highlight the results, we just display the paths from age 54 onwards.

Let us first consider the "always employed" individual, who accumulates a very high balance on his unemployment account. Consequently this reduces the pressure of building up a high stock of assets for retirement. We therefore observe that this individual has a high, and even convex consumption pattern towards retirement age. At the same time, the "always employed" individual can retain a more or less constant degree of leisure.

In contrast, an individual who becomes unemployed, shortly before retirement obviously needs to update consumption and labor market incentives accordingly. We observe that a one-time unemployment at age 59 forces the individual to prematurely use up a large part of assets that were meant to be consumed upon retirement. Consequently consumption is reduced, and a low utility at that age will be partly offset by a higher leisure choice. However, already in the following year at age 60, the individual's behavior is driven by

Figure 3.8: Sample Paths of Individuals with Different Employment Status over the Life Cycle

higher labor market incentives to increase the expected payout from the unemployment account.

These effects become more pronounced when an individual faces unemployment at both, age 59 and 60. Note, that consumption is more than proportionally decreased when compared to the one-time unemployed. Similarly, the stock of assets is drastically reduced to dampen part of the consumption loss. Leisure is increased during the unemployment spell, but sharply reduced at age 61 and onwards.

Figure 3.8 again confirms our intuition that individual's decision making is based on the expected account payout. This time, with two unemployment spells, the expected payout is much lower, and therefore the stock of assets needs to be increased despite the general trend of reducing assets towards retirement.

Optimal Decision Rules & Heterogeneity

In the following, we want to concentrate on optimal consumption and leisure policies with a much stronger focus on the heterogeneity of the state space, i.e. asset, account level and employment status. Here, we do not show any dynamic evolution of the variables, but all control rules are inter-temporally optimal. First, we want to revisit the finding from Figure 3.4, namely the very rapid increase in leisure at age 63 under the UI system. For that purpose, we present Figure 3.9, which displays the optimal leisure choice of a 63-year-old employed as a function of asset wealth. The solid line marks the optimal leisure choice

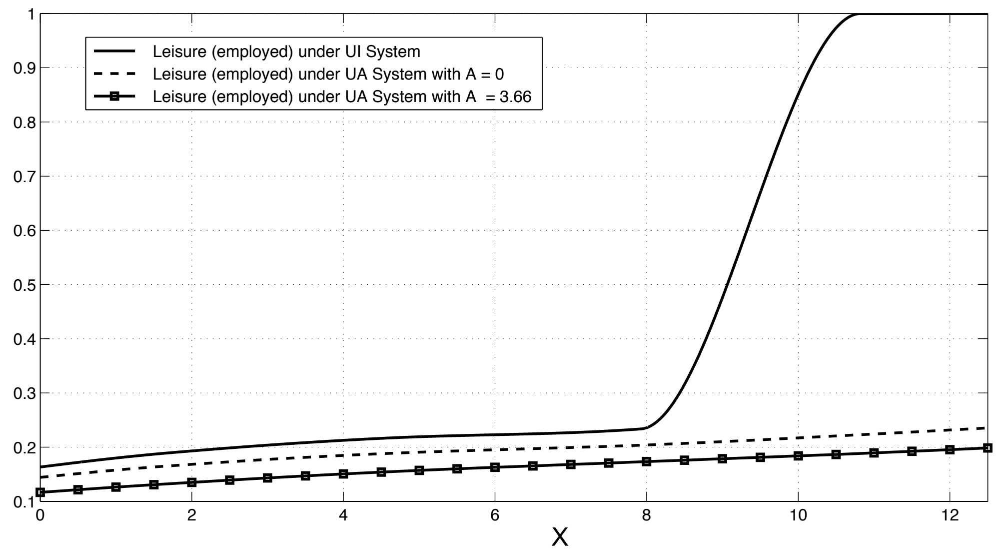

Figure 3.9: Optimal Leisure Choice for a 63-Year Old Employed as a Function of Asset (X) Holdings.

under the UI system. Note, that up to an asset level of about 8, the individual chooses more leisure with rising wealth level. This is intuitive, since a higher level of assets at age 63 decreases the prospects of low consumption upon retirement two years later. However, once the individual's asset level is larger than 8, leisure rises sharply with higher asset levels, eventually reaching one. The basic economic intuition behind this finding is as follows. The 63-year old individual is employed. There is only one more year of uncertain job status, which the individual can partly influence by choosing leisure. Certainly, a rich 63-year-old individual with only two more years of utility streams will also face a high consumption level at age 63, and consequently a lower marginal utility. It turns out to be the case that the individual can receive higher additional utility by increasing leisure. The latter choice has to take into account the possible reduction in expected consumption streams at age 64 and 65 because the probability of being fired is significantly increased.

This latter effect is completely offset under the UA system. Consider first the case in which the 63-year-old employed individual has an unemployment account level of about the same size as his wage (e.g. $A = 3.66$). With just two more years to consume, this individual hedges consumption by choosing a much higher consumption at age 63 and taking the risk of lower future consumption in case of unemployment at age 64. As a consequence, leisure is much lower for the rich individual compared to the UI system. The individual chooses less leisure because this increases the chances of obtaining the account level upon retirement while enjoying a current higher consumption level. Next, note that for the individual who has no funds in the unemployment account the situation is slightly different. This individual cannot expect a high payout upon retirement. However, the sharp increase in leisure as in the UI system does not occur. With two more years of anticipated contribution to the unemployment account, this individual can expect a payout of about 4% of the current wage at retirement. Given the high level of α (the consumption's share in the utility function), that extra 4% increase generates a higher expected utility than a drastic increase in leisure. Thus, overall the UA system generates much stronger labor market incentives for the old rich employed individuals. Finally, when comparing the two individuals under the UA system, we notice that a higher unemployment account balance results in a small parallel upward shift of the optimal leisure choice.

In the following, we want to extend the analysis of leisure and consumption choice for the elderly, in particular taking into account the interaction between different levels of assets and unemployment accounts. First, let us again consider the 63 year-old employed individual. Figure 3.10 displays the optimal leisure and consumption choices of that individual as contour plot in the asset and unemployment account space. The solid, vertical lines reflect the fact that under the UI system unemployment accounts do not exist and therefore do not influence the decision making process. We observe that both, optimal leisure and consumption choices increase with higher asset levels. This result is as expected. In fact, the equidistant contours for consumption indicate that optimal consumption is proportional to the stock of asset. The contours for the optimal leisure choices under the UI system are further away from each other with rising asset levels, indicating a concave relationship. This is due to the fact, that our calibrated firing rate is convex for that low range of leisure choices.

Next, we study how these optimal choices are affected by the UA system. When the level of unemployment accounts is zero, a 63-year-old employed individual chooses more consumption than compared to the UI system. Note that each vertical contour (isoquant) of the UI system is to the right of the corresponding isoquant of the UA system (E.g. at $X = 2$, optimal consumption under the UI system is 3 while under the UA system it is strictly larger (about 3.05). This is because even with a zero unemployment account level, the employed individual can expect a positive account balance upon retirement.   Furthermore, with

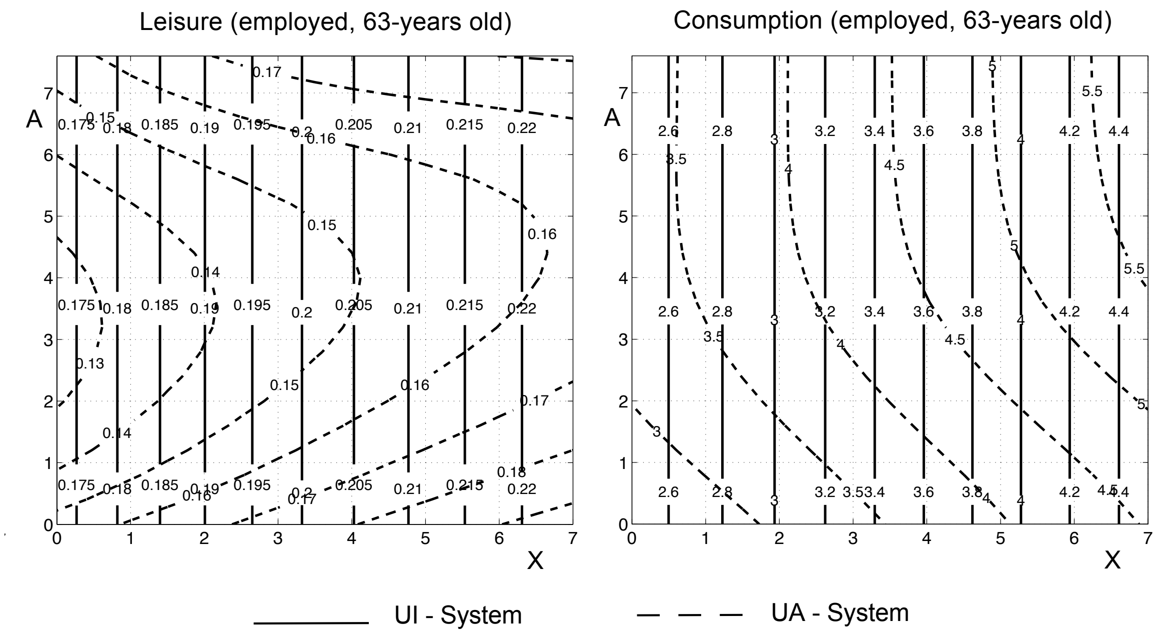

Figure 3.10: Optimal Leisure and Consumption Choice for a 63 Year-Old Employed as a Function of Asset and Account Holdings (X-A space).

higher levels of the unemployment account (keeping asset levels constant) that individual is constantly increasing the optimal consumption level. See for instance at asset level of 3, an optimal consumption rising from 3.53 to 4, with a corresponding account level of 0.5 and 2.75. This effect persists up to an unemployment account level of 4 after which it fades out. This fading-out effect occurs in part because of the decreasing marginal rate of substitution of leisure for consumption. The left plot for optimal leisure provides more intuition for this. We observe, that even in the case of zero unemployment accounts, the individual's leisure choice is about $10\% - 15\%$ less when compared to the UI system. This is a strong argument for the effectiveness of unemployment accounts in generating labor market incentives for the elderly, even for those with zero account balances, and irrespective of asset wealth.

Furthermore, with higher levels of unemployment accounts (keeping assets constant), the employed, 63-years old reduce their leisure choices even further. See for instance the leisure choice at asset level 4, which drops from 0.18 to 0.15 with a rise in the account balance up to 3.5. Recall, that at the same time consumption is increased. Thus, consumption is substituted for leisure, and this lower level of leisure in turn increases the probability of more consumption upon retirement. However, we also observe that there exists a threshold in the level of unemployment accounts, beyond which leisure is starting to rise again. This corresponds to the previously noted assumption that the marginal rate of substitution (leisure for consumption) is very low. One final observation is that the threshold in unemployment account levels beyond which leisure is rising increases with higher asset levels. This reflects the consumption smoothing preferences of wealthier individuals to maintain a high level of consumption.

Let us next study the optimal control rules for a 63-years old unemployed individual. From Figure 3.11, we note that in general at age 63, for any wealth level an unemployed chooses more leisure and less consumption than the employed. Also, the unemployed chooses more consumption and less leisure under the UA system. Broadly speaking, the optimal choices for consumption and leisure are driven by the same channels as already described for the employed. However, there is one major exception. Figure 3.11 shows that in both plots the optimal choice of leisure and consumption is invariant to unemployment account levels up to about 2. Recall, that the unemployed benefits are first covered by the stock of unemployment account and the remainder (if any) is covered by the government. This implies that the 63-year old unemployed today will, as a 64-year old, be endowed with unemployment account level of $\max\{0, (1+r)A_{63}^{U} - b_{63}\}$[15]. Consequently, the 63-year old unemployed knows that the unemployment account will be reduced with certainty. It turns out, that the unemployment benefit is about 2 and therefore the observed kink in Figure 3.11 also occurs at that level. In fact, since this result is a direct consequence of our modeling assumptions, we consider it as validating our numerical solution algorithm.

[15]where we denote A as a beginning-of-period and b as an end-of-period variable.

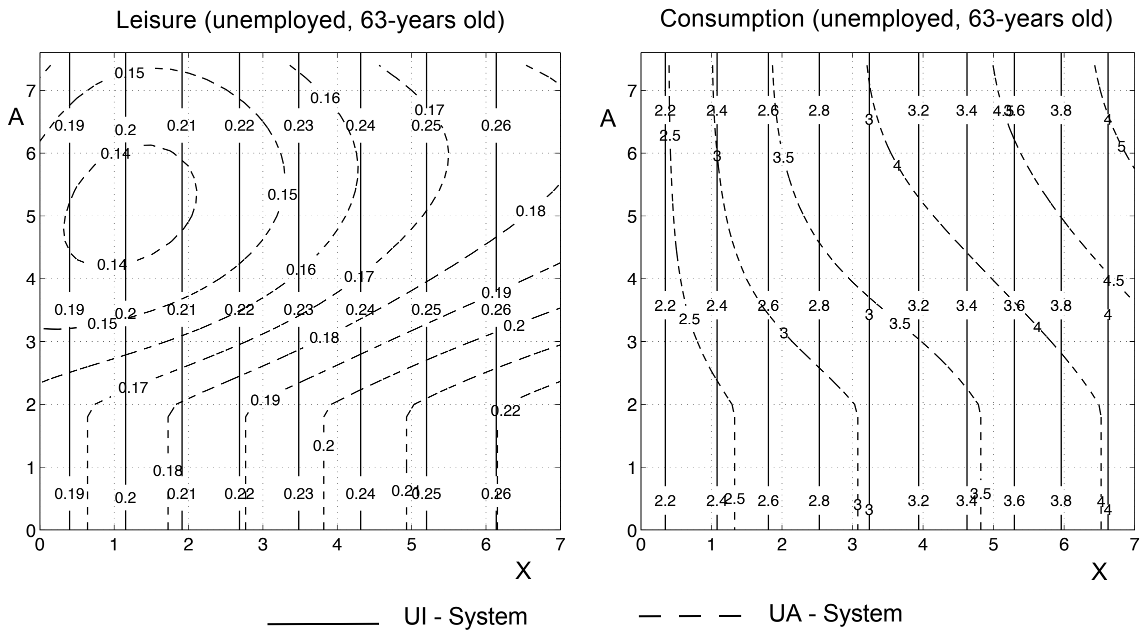

Figure 3.11: Optimal Leisure and Consumption Choice for a 63-Year Old Unemployed as a Function in Asset and Account Holdings (X-A space).

Next, we consider the optimal consumption and leisure choices for employed and unemployed individuals in different age groups, taking into account the heterogeneity in their wealth status. Table 3.3 reports the leisure and consumption choice of the UA system relative to the UI system. Regarding the leisure choice, we see that the drop in leisure when switching to the UA system is more pronounced with increasing age, confirming our findings of the last section. This is valid for both, the unemployed as well as the employed, and also irrespective of the wealth status of the individual. Independent of their age, wealthier individuals react more strongly to the introduction of accounts, meaning that their leisure choice drops more. They have the financial power to consume more while at the same time reducing leisure to increase the probability of receiving their unemployment account. This effect is most valid for the very young. Focusing on the distinction in the behavior of unemployed and employed individuals, Table 3.3 shows, that young unemployed individuals (aged 18) reduce their leisure more than the employed in the account system. In contrast, middle-aged individuals reduce their leisure more strongly when they are employed, and at age 62, the reduction in leisure is more or less the same for both, employed and unemployed individuals.

Regarding the optimal consumption choice, Table 3.3 shows that the consumption level

Control Variable:		leisure		consumption	
Employment Status:		*unemployed*	*employed*	*unemployed*	*employed*
Age = 18	**poor**	-0.014	-0.012	+0.004	+0.005
	rich	-0.025	-0.019	+0.009	+0.011
Age = 40	**poor**	-0.054	-0.089	+0.012	+0.022
	rich	-0.058	-0.092	+0.027	+0.032
Age = 62	**poor**	-0.282	-0.268	+0.172	+0.282
	rich	-0.285	-0.288	+0.076	+0.191

Table 3.3: Optimal Consumption and Leisure Choices under the UA system, Relative to the UI System

is much higher under the UA system for all individuals, irrespective of their age, wealth or employment status. However, as in the case of the optimal leisure decision, the impact on consumption is more pronounced, the older the individuals. To give an example, a rich 62 year-old employed individual increases his consumption level by 19.1%, while a rich young individual increase his consumption only by 1.1%. Moreover, we see that when moving to the UA system, employed individuals enjoy a higher increase in consumption levels than unemployed individuals. This holds even when we take their wealth status into account. For instance, poor middle-aged individuals will increase their consumption nearly twice as much in the UA system as poor middle-aged unemployed. The wealth level affects the difference in optimal consumption choices positively, with the exception of older individuals. In the latter case, wealthier individuals increase their consumption less than poorer individuals, which is simply due to the fact, that old rich individuals choose to have much leisure which increases the marginal utility of consumption.

3.4 Extension - Multiple Payout Periods

The previous section discussed the results for the basic model, in which one single payout of the unemployment account occurs upon retirement. The results showed that the incentives to work increased over the whole lifetime of all individuals. Comparing the incentives to work for different age groups we found, that this effect was not uniformly distributed over all age groups. Instead, the incentives to work - depicted by the leisure decision - increased particularly for the older individuals. Consequently, the question arises whether there is an alternative mechanism to increase the incentives to work of the younger generations, without at the same time compromising the beneficial effect for the elderly. We explore this question by implementing an earlier payout timing in the model. In particular, our objective in this section is to investigate how the duration until the payout period affects the incentives to work of different age groups.

We study two cases, in which we allow for additional payouts. In both cases these payouts occur earlier, that is they occur during the working life of the individuals. We compare those cases to our baseline scenario with one single payout upon retirement (case 1). In case 2, we allow for two payouts: one occurs upon retirement with age 65 (as in the previous section), the other payout occurs already after 20 years in the job market (at age 37). In case 3, we allow for 5 payouts, which roughly occur every ten years (with age 27, 37, 47, 57, 65). We compare both cases with the results from the previous section, in which the only payout occurred upon retirement.

There are many different ways in which such a payout can be designed. In addition to the timing of the payouts, it is necessary to make some assumptions about the share of the account balance that is withdrawn by the individuals. In order to clearly identify the new impact of the additional payout periods, we assume that the individuals receive the full account balance at each payout period, that has been accumulated up to date. Furthermore, we assume that all individuals (who have money on their accounts) receive the payout. If they had the choice whether or not to receive the payout, all individuals would choose the certain payout, instead of leaving the money on the account. Otherwise, the money on the account could be "lost" in case of unemployment.

In the following we describe the adjusted optimization problem for both cases. The dynamic stochastic optimization model for an individual under the UA system with multiple payout periods is similar to that of the previous section. Nevertheless, we have to make some substantial changes. In particular, we use an indicator function $\max\{0, 1-\prod_n^N |t-n|\}$ which for $n \in [1, 2, 3, ...47]$ denotes the possible intermediate payout periods. The indicator function is 1 if there is a payout and 0 if there is no payout. Furthermore, we need to take into account that the unemployment accounts at $n+1$ (i.e. one period after the payout) are down to zero for the unemployed, and $t_t^A w_n$ for the employed. The new objective problem of the individual can be expressed by:

$$
\begin{aligned}
V_t(X_t, A_t, S_t, t) &= \max_{c_t^{S_t}, l_t^{S_t}} \ \mathbb{E}\left\{\sum_t^T \beta^{t-1} u^{S_t}(c_t^{S_t}, l_t^{S_t}) + \beta^{T+1}\Omega(X_{T+1}, A_{T+1})\right\} \qquad (3.10) \\
X_{t+1} &= \begin{cases} (1+r)X_t + w_t(1-\tau_t^A) + A_t \cdot \max\{0, 1-\prod_n^N |t-n|\} - c_t^E \\ \quad \text{for } S_t = E \quad \text{and} \quad n \in [1,2,3,...47] \\ (1+r)X_t + b_t - c_t^U + \max\{0, A_t - b_t\}\max\{0, 1-\prod_n^N |t-n|\} \\ \quad \text{for } S_t = U \quad \text{and} \quad n \in [1,2,3,...47] \end{cases} \\
A_{t+1} &= \begin{cases} (1+r)A_t \cdot (1-\max\{0, 1-\prod_n^N |t-n|\}) + w_t\tau_t^A \\ \quad \text{for } S_t = E \quad \text{and} \quad n \in [1,2,3,...47] \\ \max\{0, (1+r)A_t - b_t\} \cdot (1-\max\{0, 1-\prod_n^N |t-n|\}) \\ \quad \text{for } S_t = U \quad \text{and} \quad n \in [1,2,3,...47] \end{cases} \\
S_{t+1} &= \Pi_t(S_t, l_t^{S_t}) \\
\Pi_t &= \begin{bmatrix} \pi_{EE}(l_t^E) & \pi_{EU}(l_t^E) \\ \pi_{UE}(l_t^U) & \pi_{UU}(l_t^U) \end{bmatrix} \\
X_t, A_t &\geq 0 \qquad c_t^{S_t} \geq 0 \qquad 0 \leq l_t^{S_t} \leq 1
\end{aligned}
$$

In contrast to the baseline case, our second case features one additional payout at age 37 (i.e. $n = 20$) and in the third case there will be four additional payouts at age 27, 37, 47, 57. In the following we discuss the impact of additional payouts on the development of the account level of an individual who is always employed. The left part of Figure 3.12 depicts how the account balance develops over the lifetime of the individual in the three scenarios. The solid line depicts the account level with one payout upon retirement. As discussed in the previous section the account level of the employed rises with age due to the continuing payment to the account and due to interest. In case 2 (with one additional payout at age 37) the account balance follows the same pattern until age 37, after which it drops to zero due to the payout. Thereafter the account balance rises again.

Recall from the previous section that the maximum payout is about twice the last period's wage, in the case with only one single payout occurring upon retirement. Here, in the case with one additional payout at age 37, the individual who has always been employed can still expect a final payout upon retirement that equals slightly more than the last period's wage.

Note, that at age 37 the individual, who has always been employed, has not even accumulated enough on his account to finance one period of unemployment. At each age up to 37 the account balance is always lower than the corresponding benefit level. We saw that in the case of only one payout (upon retirement) the employed would be able to finance an unemployment benefit only at age 42. Now, the individual will only be able to finance an unemployment benefit from his account at about age 56. The account balance in case 3 (with 5 payouts) exhibits a similar pattern as case 2. The account balance of the employed rises after each drop. However, in this case the individual will always be able to finance only a share of an unemployment benefit.

Next, we move from the maximum UA level to the that of the average individual. More precisely, the right hand plot in Figure 3.12 depicts the dynamic pattern of the average UA level as a share of the maximum UA level. Here again we have performed 100.000 simulations so that the average statistic can also be regarded as the expected path[16]. When there is only one payout upon retirement (depicted by the solid line), the individual can expect on average to receive a payout of 20% of the maximum possible payout. In contrast,

[16]The highest shares in the right hand plot are slightly higher than 90% which reflects the unemployment rates of this particular age group.

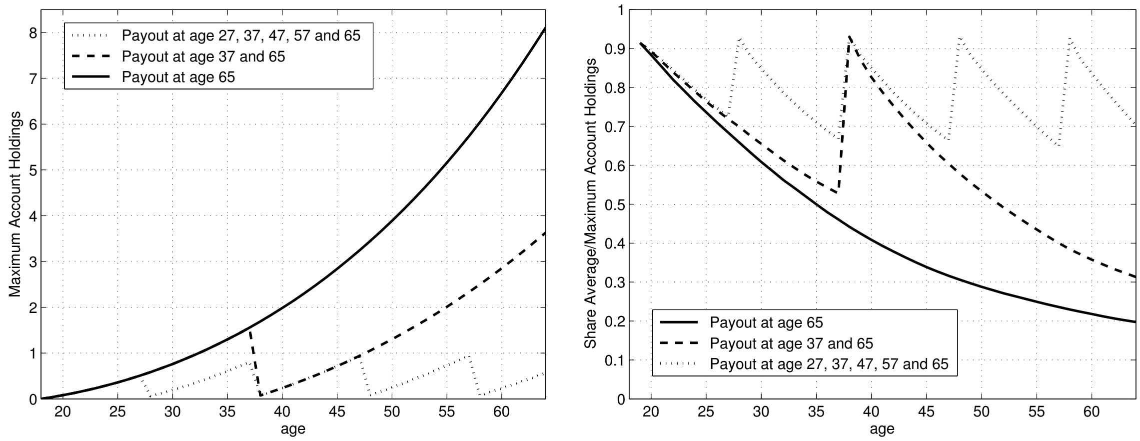

Figure 3.12: Left: Maximum Possible UA Level under Three Different UA Regimes. Right: Average UA Level as Share of the Maximum Possible UA Level.

an individual who also receives a payout at age 37 can anticipate this early payout to be about 53% of the maximum possible payout. At age 65 this share will still be more than 32%, thus much higher than in the case of only one payout [17]. With four additional payout periods the average payout is each time roughly about 70% of the maximum possible payout. Note, that also the final payout has increased to 70%. The reason for this difference clearly seems to be that a shortened *waiting* time for the payout reduces the variance of payouts. However, the additional payouts might as well have a significant impact on labor market incentives. In order to shed more light on the dynamic decision-making process of the individual in face of these additional payout periods, we again consider in the following an individual who is always employed. Figure 3.13 depicts his decisions with regard to leisure and consumption, as well as the asset and account levels. Please note, that the upper two graphs show the asset and account levels until age 65, while the lower two graphs depict the consumption and leisure choice up to the last relevant decision period, which is age 64.

The most interesting fact to note, is that the individual reacts to the additional payouts well in advance and adjusts his behavior accordingly. The upper left graph shows the asset level. At age 37, when the individual receives the payout from his account there is an obvious jump in his asset level. However, the asset line diverges, from the one with only

[17] Obviously, the nominal payout is lower.

one single payout upon retirement, well before age 37. The asset level of the individual

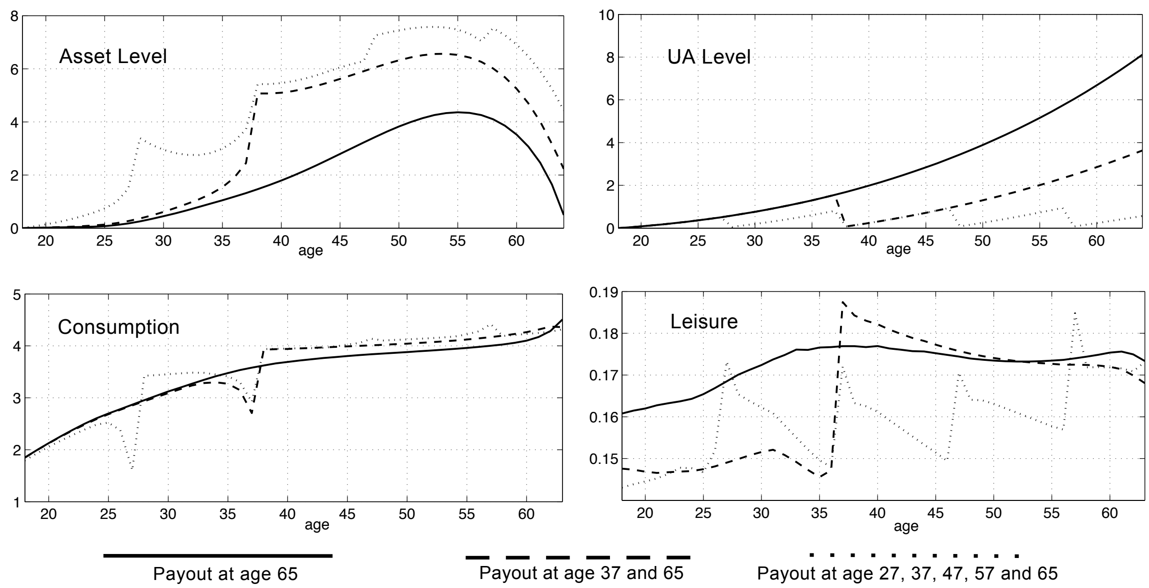

Figure 3.13: *Always Employed* Individuals under the UI and the UA Systems (1, 2 or 5 Payout Periods) (The horizontal axis denotes age)

starts to accumulate faster roughly six years before. Overall, introducing an additional payout period at age 37 increases savings throughout his working life. While decreased consumption explains the increase in savings up to age 37, consumption rises thereafter as well. From the payout period onwards, the individual enjoys more consumption throughout his working life, than someone who receives only one single payout upon retirement. The reason is, that an individual, who anticipates a payout at the age 37, adjusts his leisure choice right from the beginning of his working life. The lower right graph shows that the leisure choice is much lower than a leisure choice of someone who anticipates his only payout at age 65. Past age 31 the individual has even more labor market incentives in order to make sure that he will accumulate a high account balance until payout time. Once he receives the accumulated balance, his leisure level jumps upwards. In the next ten years, his leisure level remains above the leisure of an individual in the single payout case at a diminishing rate. Eventually around age 52 it even drops below the leisure level of the single payout case. Overall, Figure 3.13 shows that it is optimal for the individual to shift his utility over time. He accepts less utility in the first years (with less consumption and less leisure), in order to trigger more utility in later years. Both, consumption and the asset level are well above the solid line after the payout period. Higher assets serve as a mechanism to dampen potential future shocks of unemployment. Therefore the individual is able to enjoy a rather long period of 15 years, in which his leisure is much higher than with one single payout. Towards the end of the working life, the level of leisure decreases in anticipation of the second payout, which occurs upon retirement. Consumption converges to the consumption level in the single payout case. Finally, the savings are gradually consumed towards the end of the working life.

In case 3 (with 5 payouts) a similar pattern can be observed. Savings accumulate stronger over the lifetime. Overall, they are continuously higher than in the previous two cases. This might be due to the lower marginal utility of consumption due to decreasing leisure choices. Individuals anticipate a potential payout at age 27 and therefore reduce their consumption slightly and increase their labor market efforts significantly. The same pattern is observed for the following payout periods. Towards the end of the working life the individual gradually consumes his savings. The consumption choice of the individual resembles the one in the two-payout case. It decreases in the years before the payout, and jumps to a higher level thereafter. After the first payout it remains at a higher level than in the two-period case. One possible explanation for this is, that it is optimal for the individual to choose a lower leisure level than in the single payout case. After each payout the leisure level jumps upwards, but it only overshoots the leisure choice in the single payout case after two (out of five) payout periods. The last jump occurs at age 57 and is certainly due to the rather high level of assets at this point. Recall that assets serve as a cushion against potential unemployment. Therefore, the individual can afford a higher leisure choice.

Overall we observe a very significant labor market incentives effect of additional payout periods. Take for example the additional payout at age 37 only (case 2). Such a payout has an enormous wealth effect for the individual who is in turn willing to reduce leisure and consumption in face of the payout period. In the following section we show how the incentive effects of single and multiple payout periods translate into a lower unemployment rate. Moreover, we investigate whether it is financially feasible to replace the unemployment insurance system by individual unemployment accounts and determine its impact on welfare.

3.5 Implications for Welfare and the Government Budget

In this study, we do not model any strategic behavior of the government. For instance, we do not assume, that the government endogenously determines the welfare-maximizing contribution to the UA. Instead, we are primarily interested in the effects of the UA system on labor market incentives and aggregate welfare. Nevertheless, we aim at providing an analysis of how the UA affects the budgetary balance of the policy maker. That analysis should also be comparable with the current design of the unemployment insurance system. Therefore, we use the our dynamic programming approach to shed some light on the implications of the UA system on welfare. Our approach goes as follows. First, we compare the implications of both regimes on the government budget. In the second step we compute the consumption equivalent of entrants to the labor market, which is a valid measure of welfare. Obviously, a system of UA, which reduces unemployment, improves welfare and has a positive effect on government budget clearly constitutes a Pareto improvement over the current UI system.

3.5.1 Unemployment Rate and Government Budget

Table 3.4 provides a summary of the unemployment rates and the government's budget positions in the different payout regimes. The interesting thing to note is, that the unemployment rate is lower, the more payout options are available in the unemployment account system. As discussed in Section 3.3.1 the unemployment rate is 18.7% lower in the unemployment account system with a single payout than in the UI system. With more payout periods included, the unemployment rate drops even further. Relative to the UI system it can be reduced by more than 26%.

Looking at the development of the unemployment rates more closely, Figure 3.14 depicts a clear pattern with respect to the payout periods. The unemployment rate is depicted for the three payout regimes in the UA system over the life cycle of the individuals. Including an additional payout at age 37 drives the unemployment rate up immediately after the payout. This is due to the increased leisure shown in Figure 3.13. The unemployment rate even overshoots the level of unemployment in the single payout regime, but converges slowly thereafter. In the case with 5 payout periods, this pattern is replicated. With respect to the government budget we assume that employers pay an additional 3% contribution to the

	Total unemployment rate *(absolute change to UI regime)*	**Government's Budget Position** *(Euros per individual, per year)*
UI Regime	10.46%	0
UA Regime Payout in $t \in \{65\}$	8.50% *(-18.7%)*	+458
UA Regime Payout in $t \in \{37, 65\}$	8.08% *(-22.8%)*	+364
UA Regime Payout in $t \in \{27, 37, 47, 57, 65\}$	7.70% *(-26.4%)*	+240

Table 3.4: Unemployment Rate and Government Budget for Different Regimes

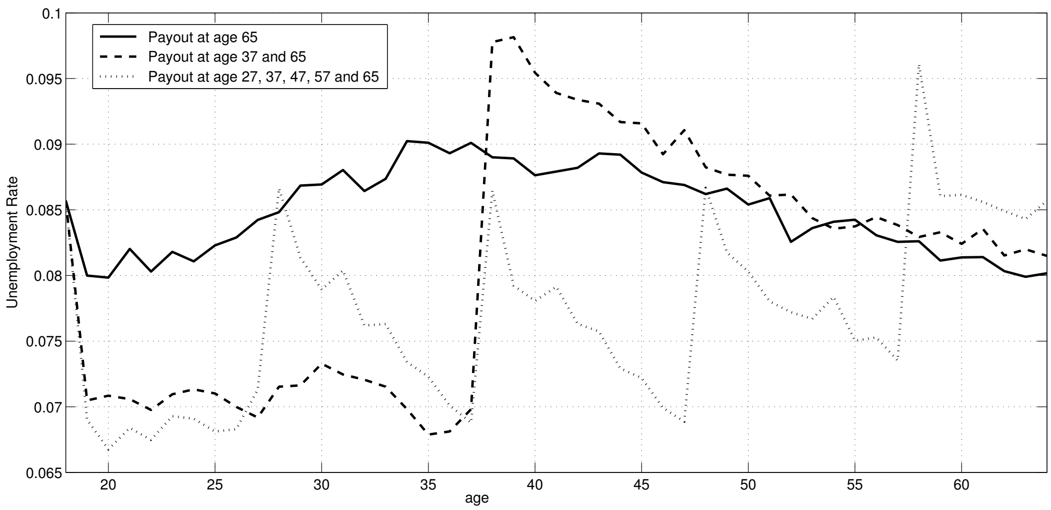

Figure 3.14: Unemployment Rate for Three Different UA Regimes

common fund in order to achieve financial balance of the government budget. Overall, the total unemployment contribution rate (of individuals and their employers) is slightly too high for the prevailing unemployment rate of 10.4%. However, in our model all unemployed individuals receive the same level of unemployment benefits. In reality, however, there is a bias towards individuals in the lower income deciles. Among the unemployed the percentage of low-income individuals is disproportionately high. In consequence there will be a larger percentage of unemployment benefits that are below the average.

Figure 3.15 shows the details with respect to the government budget. In particular, we see the changes in the government budget position (relative to the UI system) caused by different age cohorts. In the case of one single payout at age 65, the government budget position starts worse off in the account system (than in the UI system), and improves with an increasing age of the population. The reason is, that due to the low accumulated account balances, the young generation depends on the co-financing of the unemployment benefits by the government. As can be seen in the right part of Figure 3.15, the government's share of the unemployment benefit is 100% for the labor market entrants and falls to nearly 50% on average for the old. Thus, on average, the government contributes about 2/3 of the unemployment benefits. Comparing the UI system with the UA system, the government receives less revenue from taxes, since the individuals pay a direct contribution to their account instead. At the same time, only the older individuals can afford to pay the unemployment benefits from their account without relying on co-financing by the government. Consequently, when shifting from from the UI system to the UA system, the government "looses" for the youngest third of the labor force and "gains" from the older two-third of the labor force. The gains from the older age cohorts are further amplified through higher working incentives. Overall, the government budget is improved significantly when shifting

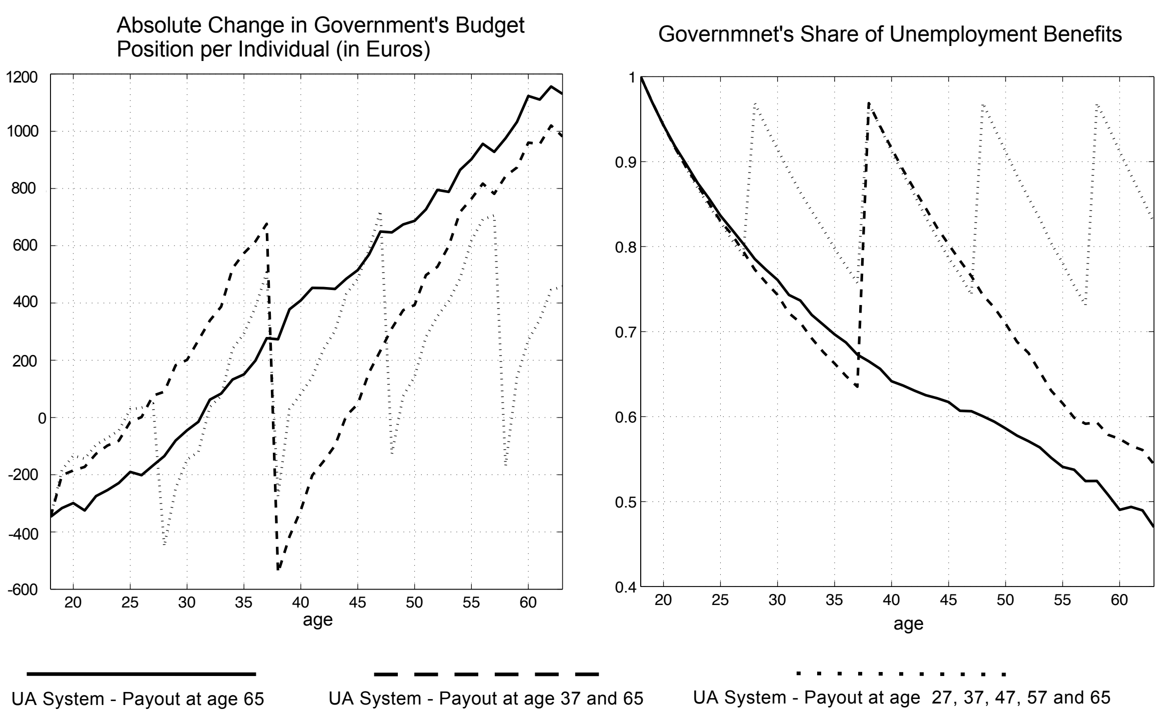

Figure 3.15: Left: Change in the Government Budget Position under Three Different UA Regimes. Right: Governments' Share of Unemployment Benefits

from the UI to UA system. The government now gains 458 € per year per individual, in contrast to the balanced budget position in the UI system. This huge improvement in the government budget indicates the potential of lowering the distortionary tax rate. This in turn might set in motion another round of positive labour market incentives, followed by lower unemployment.

When we include an additional payout at age 37, the government still ’looses” for the younger generations, but far less, than in the case of a single payout. However, this improvement in the budget is more than offset by the adverse impact on the budget for the older generations. Due to lower incentives to work, the government earns less taxes than in the single-payout UA system. Overall, the government budget in the account system with two payouts is therefore worse than in the account system with one payout. Note, however, that the government budget is improved compared to the situation in the UI system. The government still gains 364 € per individual per year. The positive budgetary impact even occurs in the case when the account system features five payouts.

3.5.2 Welfare Effects: Income Distribution

We have already shown that UA systems with either no or several additional payout periods will induce individuals to participate more actively in the labor market. As a consequence, we have observed a much lower unemployment rate over the entire life cycle. Inevitably, this translates to higher income prospects due to more employment periods within each life cycle on average. In the following we want to report the distributional consequences of our simulations for the different UA regimes. For the calculation of the total life cycle income we consider two measures. One measure simply represents total income from labor and unemployment benefits. The second measure also adds the various payments from the unemployment accounts at all payout periods. In that way we can disentangle the effect of unemployment account payouts on life-cycle income from the changes in life-cycle income purely due to different labor market incentives. Figure 3.16 displays the lifetime income distribution for the three different UA regimes.

The grey-shaded histograms represent the lifetime income distribution under the UI system. The solid black histogram denotes the case without considering additional payouts from unemployment accounts while the dashed black histogram takes these payouts into account.

The left plot in Figure 3.16 compares the UI regime to the standard UA system with no additional payout periods. We first note that the plain UA system clearly shifts the mean of the distribution to the right. This is an expected result since less individuals are unemployed. Also, as expected, when taking into account the final payout into the calculation of life time income, the distribution shifts out even further to the right. Furthermore, the center and right plots show that increasing the number of payout periods has a significantly positive effect on life-cycle income. However, this does not necessarily imply that all individuals

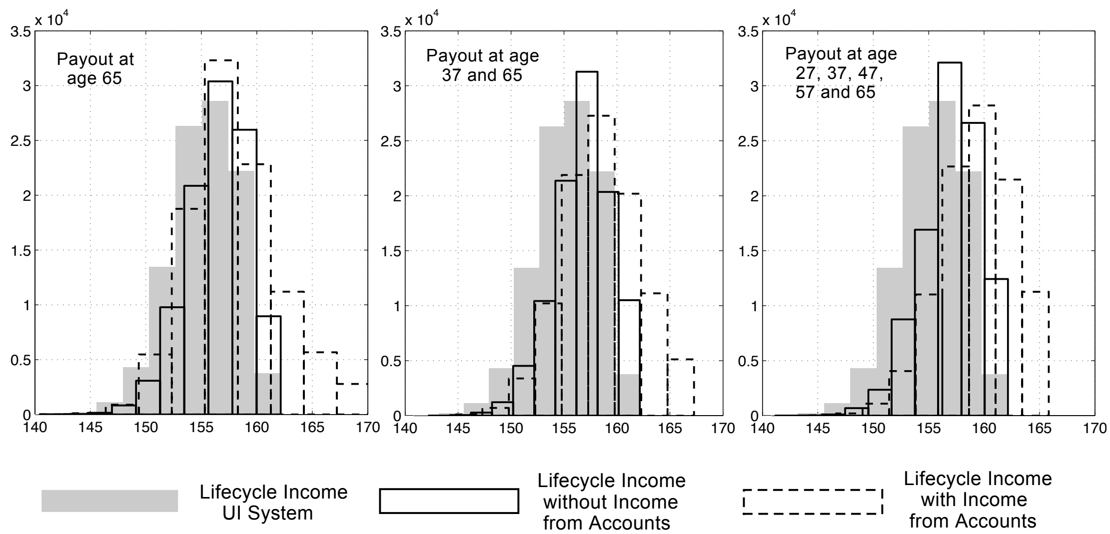

Figure 3.16: Distribution of Lifetime Income: Comparison of Three UA Regimes to the UI System.

will perceive improved welfare. We have previously discussed that the introduction of unemployment accounts will lead to a lower leisure choice of all individuals. This implies that individuals will experience disutility from increased labor market participation. In fact, it might turn out to be the case that the this disutility dominates the extra utility gained from higher consumption. In the following we therefore study the welfare implications of unemployment accounts by studying consumption equivalents.

3.5.3 Welfare Effects: Consumption Equivalent

Recall from the previous section, that at age 64 the value function of an individual with employment status i is obtained by maximizing the sum of age 64 utility and the discounted, expected utility at age 65. This is given by

$$
\begin{aligned}
V^i_{64} &= \max_{c^i_{64} l^i_{64}} u^i(c^i_{64}, l^i_{64}) \qquad (3.11)\\
&+ \beta \cdot \left(\pi_{ii}(l^i_{64}) \cdot \Omega^i(X_{65}, A_{65}) + \pi_{ij}(l^j_t) \cdot \Omega^j(X_{65}, A_{65})\right)\\
s.t. \qquad c^i_{64} &\geq 0\\
0 &\leq l^i_{64} \leq 1
\end{aligned}
$$

Given that the value function at age 65 is the terminal value function, which we assume to be represented by $\Omega(X_{65}, A_{65}) = \frac{((1+r)(X_{65}+A_{65}))^{\alpha(1-\gamma)}}{1-\gamma}$. Note, that we set $C_{65} = (X_{65}, A_{65})$, assuming that all assets and account holdings are consumed upon requirement. Consequently, a consumption equivalence representation of the age 64 value function, ceteris paribus can be written as:

$$
V^i_{64}\_CE = u^i((1+CE)c^i_{64}, l^i_{64}) + \beta \cdot \Omega((1+CE)(X_{65}, A_{65})) \qquad (3.12)
$$

where we assume $V^i_{65}(X^i_{65}, A^i_{65}) = V^j_{65}(X^j_{65}, A^j_{65})$ Furthermore, we assume that consumption and leisure choices are optimal. Following this notation, we can write the recursive formula for the consumption equivalence adjusted value function of an individual with employment status i as

$$
\begin{aligned}
V^i_t\_CE &= u^i((1+CE)c^i_t, l^i_t) \qquad (3.13)\\
&+ \beta \cdot \left(\pi_{ii}(l^i_t) \cdot u^i((1+CE^i)c^i_{t+1}, l^i_{t+1}) + \pi_{ij}(l^i_t) \cdot u^j((1+CE^i)c^j_{t+1}, l^j_{t+1})\right)
\end{aligned}
$$

Next, we assume that the utiity function is multiplicative in its arguments, allowing us to write $u(c,l) = v(c)w(l)$. We also assume, that $v(c)$ is homogenous of degree λ. With these assumptions, we can rewrite the recursive formulation of the value function as:

$$
\begin{aligned}
V^i_t\_CE &= (1+CE^i)^{\lambda} \cdot u^i(c^i_t, l^i_t) + \beta \cdot \left(\pi_{ii}(l^i_t) \cdot u^i(c^i_{t+1}, l^i_{t+1}) + \pi_{ij}(l^i_t) \cdot u^j(c^j_{t+1}, l^j_{t+1})\right)\\
&= (1+CE^i)^{\lambda} \cdot V^i_t \qquad (3.14)
\end{aligned}
$$

Since we are interested in the consumption equivalent adjustment of moving from the UI system to the UA system, we can formulate the relationship for a labor market entrant as $V^i_{18}\_UA = (1+CE^i)^\lambda \cdot V^i_{18}\_UI$, which we can solve for the consumption equivalent measure. The latter is given by

$$CE^i = \left(\frac{V^i_{18}\_UA}{V^i_{18}\_UI}\right)^{\frac{1}{\lambda}} - 1 \tag{3.15}$$

With this formula above we are able to study what constant and perpetual additional share (CE) in consumption would equalize welfare under both unemployment systems. Note, that this formula holds for both, the employed entrants as well as the unemployed ones. Also, note that since wealth (X) is a state variable in the value function, we can represent the consumption equivalent also as a function of the wealth level of the labor market entrant. Finally, our CE calculations take into account the varying optimal leisure choices. We have shown in our discussion above that the UA system will induce the individuals to reduce their leisure choice and thus strenghten labor market incentives. This is an important fact to consider for any welfare analysis, since higher labor market incentives are a cost in the model and the utility from consumption needs to be sufficiently large relative to the disutility of reduced leisure for welfare to have gone up. Table 3.5 summarizes our results for the consumption equivalent for both, our basic version of the UA system, and also for the additional variants of the UA system with multiple payout periods. In general,

Employment Status:		**unemployed**			**employed**	
Wealth Level:	*poor*	*average*	*rich*	*poor*	*average*	*rich*
Consumption Equivalence (in %) Payout in $t \in \{65\}$	0.96	0.92	0.88	0.97	0.93	0.89
Consumption Equivalence (in %) Payout in $t \in \{37, 65\}$	0.93	0.81	0.68	0.96	0.84	0.70
Consumption Equivalence (in %) Payout in $t \in \{27, 37, 47, 57, 65\}$	0.85	0.62	0.34	0.89	0.65	0.38

Table 3.5: Consumption Equivalence (CE) for a Labor Market Entrant (18-Years Old). CE Defined as Constant Percentage Increase in Consumption over the Life Cycle

Table 3.5 shows that giving individuals a perpetual increase of nearly 1% in consumption would equalize the welfare under both unemployment systems. However, distinguishing the different groups of individuals and different types of account systems, we see clear differences in the consumption equivalents. The welfare gain (CE) for an employed labour market entrant is always a bit higher than for the unemployed labour market entrant, independent of his asset level. The reason is, that his individual account will already start to accumulate in the next period, in contrast to the account of the unemployed. Moreover, the persistence effect of unemployment reduces the prospects of payouts even further. This effect is stronger when the *waiting time* for payouts is reduced since the employment status of an entrant weighs in more: The shorter the waiting time for payouts, the more likely is the receipt of the payout, and the larger is the welfare gain of being in the unemployment account system. However, overall the effect of employment status of an entrant on the consumption equivalent is very low, reflecting the potential reward that an unemployed labor market entrant may still earn.

Regarding the heterogeneity in asset levels, Table 3.5 shows that poor individuals experience a larger welfare gain in the unemployment account system than rich individuals. This is an intuitive result since the same expected payout upon retirement has a much stronger weight for the poor individuals. At the same time, as already explained by Table 3.3, wealthier individuals reduce leisure more strongly than poorer individuals leading to higher disutility. This effect partially offsets the overall welfare increase of the UA system. When increasing the number of payout periods, our results show that the welfare gains drop significantly. This effect is particularly pronounced for wealthy individuals. The reason is, that asset holdings tend to dampen the consumption pattern volatility occurring due to changes in the employment status. A wealthier labor market entrant therefore has a higher ability to smooth consumption in the stochastic labor market irrespective of the type of unemployment system. Furthermore, note that the CE difference between the poor and rich individuals becomes more pronounced when there are more payout periods. Recall, that with additional payout periods, optimal leisure choices are much lower. This has, as already explained, a negative partial effect on welfare. However, total CE still remains positive.

Thus, upon entering the labor market all individuals, whether initially employed or unemployed, rich or poor can expect higher total welfare under any UA regime compared to the traditional UI regime.

3.6 Conclusion

We have studied the effects of introducing unemployment accounts within a stochastic life-cycle framework. Individual unemployment accounts let individuals internalize the cost of their unemployment, while at the same time enabling them to receive a considerable payout at the end of their working life. We find that this induces the individuals to adjust their behavior considerably. Labour market incentives are strengthened, and the average unemployment rate is thereby reduced for all age groups. Even individuals with zero account balances reduce their leisure choice considerably. Moreover, this result is also independent of asset wealth. Our analysis of the individual behavior also shows, that the expectation of a positive unemployment account payout upon retirement lowers the pressure for building up a large stock of assets. Therefore, a crowding out of savings occurs. At the same time, individuals choose less leisure to increase their chances of eventually receiving a positive payout upon retirement. This lowers the aggregate rate of unemployment and translates to an average individual who experiences a higher total level of assets (and consumption).

Strengthened labour market incentives hold particularly for the older individuals, who are particularly sensitive to the expected payout upon retirement. In order to stimulate the labour market incentives of the younger individuals we have introduced multiple payout regimes, in which individuals can receive their account balance at an earlier time during their working life. Overall, we observe a very significant labor market incentives effect of additional payout periods. The individuals anticipate additional payouts well in advance and adjust their behavior accordingly. Financially, the government budget improves with single and with multiple payout periods. Compared with the situation under the UI system, the government "looses" for the youngest third of the labor force and "gains" from the older two-third of the labor force. The gains from the older age cohorts are further amplified through higher working incentives. Overall, a reform that replaces the unemployment insurance system with individual unemployment accounts is financially feasible. Finally, our welfare analysis suggests that upon entering the labor market all individuals, whether initially employed or unemployed, rich or poor, can expect higher total welfare under any UA regime compared to the traditional UI regime.

Chapter 4

The Transition from the Unemployment Insurance System to the Unemployment Accounts System

4.1 Introduction

In the previous chapter we have shown, that the account system clearly generates higher working incentives for individuals of all ages and irrespective of their employment status. This in turn, also reduces the overall unemployment rate and consequently improves the government budget compared to the UI system. We have therefore concluded, that it is financially feasible (and desirable) to replace the traditional UI system with the UA system. Our analysis has so far compared the UI system to the long-run state of the UA system. Once the UA system is well-established (e.g. after 47 years), all individuals in the economy start contributing to their individual unemployment accounts in the first year of their working life.

However, from this previous discussion it remains unclear how the economy behaves during the years of the transition. Is the switch from the traditional UI system to the UA system financially feasible or how much does the switch cost and when do the long-run positive working incentives set in?

We know from the previous chapter that the unemployment account system is mainly driven by the incentives of the older individuals. This is because they are closest to their payout period. During the transition, however, the accumulated account balance at the end of the working life will be much lower for the older individuals, as they have mainly lived and worked under the UI system. Therefore, one might expect that their incentives to remain employed (in order to secure their accumulated account balance) are significantly lower than in the well-established UA system. Therefore, we investigate in detail how the employment incentives of different age cohorts are affected throughout the transition period. Moreover, immediately upon introduction of the UA system, the revenues of the government are substantially reduced, as a fair share of the tax revenues is now reallocated to the individuals' accounts. At the same time, the positive long-run effects of the account system might not yet have been materialized.

In this chapter, we revisit the analysis of labor market incentives under the UA system but at the same time we investigate - from a government's point of view - the financial feasibility of the UA system putting a strong focus on the financial dynamics in the transition period. Our goal is to assert whether enough employment incentives are generated during the transition such that switching from the insurance to the account system is financially feasible. Finally, we analyze how the altered incentives to work translate into the unemployment rate during the transition period.

The UI system which we have considered in Chapter 3 and which we also consider here has been modeled as a pay-as-you-go (PAYG) system. We assume that the government adjusts the unemployment insurance tax in order to finance the unemployment benefits, which is how the current unemployment system in Germany is organized. The inherent risk pooling in the PAYG system extends over generations. For easier comparison, in particular during the transition period, we keep this PAYG structure and apply it to the unemployment account system. This does not imply, that we regard one or the other system as superior, but we rather aim to make the incentive effects in the account system easier tractable[1].

In principle, an unemployment account system could also be run as a fully-funded system system (Orszag and Snower (2002)). In a fully-funded system the account balance is invested and earns interest. The cross-subsidization is limited to each age cohort and does not

[1]The risk pooling over generations is one major criticism of the current system as demographic factors, such as the advancing aging of the population put pressure on the pay-as-you-go system. In principle therefore replacing the traditional UI system could be the right moment to consider replacing the pay-as-you-go system with a fully-funded account system.

extend across generations. In consequence, this necessitates a higher contribution rate than an individual account system that incorporates a cross-generational redistributive element (Robalino et al. (2009)). In a PAYG system, on the other hand, the accounts are so-called notional accounts and the contributions are not invested. However, as mentioned by Brown et al. (2007) and Robalino et al. (2009) contributions to the individual accounts may be borrowed by the government at interest in order to finance the unemployment benefits, thus creating more financial flexibility for the governement.

The amount of money, which is needed to finance unemployment benefits under an unemployment account system, is less than under the unemployment insurance system. We saw in Chapter 3 that, assuming the same unemployment insurance contributions and benefits as under the UI system, the account system generates a surplus for the government budget. With the PAYG system, we therefore seek a new unemployment account contribution rate, which balances the government budget. In the first part of this chapter, we refine our stochastic life-cycle optimization model by incorporating a PAYG system. Our resulting long-run unemployment contribution rate is 1.565% and therefore lower than the insurance tax under the UI system. Applying this lower contribution rate, the individuals consequently experience what we call the *wealth effect*, as their disposable income rises. In our analysis, we distinguish the *pure incentive effect* (which results exclusively from the expectation of the potential payout) from this *wealth effect* and find that the *incentive effect* clearly dominates the *wealth effect* for all individuals, irrespective of age and wealth status. This implies that the main driver of the account system are the changed leisure choices due to the expected payout upon retirement. The reduced contribution rate, which results from the larger tax base that needs to finance fewer unemployment benefits, plays only a minor role. Taking into account the heterogeneity with respect to age and the wealth status, we further find, that although most individuals reduce their leisure as a result of the *wealth effect*, some individuals in fact raise their optimal leisure level. This has implications for the aggregate unemployment rate, which in turn even rises for the older age cohorts when compared to Chapter 3. Moreover, we find that when compared to the UI system the long-run UA system improves welfare on the aggregate. However, this is not the case for all individuals, as in particular the old rich unemployed individuals may loose welfare (in terms of consumption equivalents) when switching from the UI to the long-run UA system.

The results of the first part of this chapter refer to a situation in which the UA system has been in place for a long time. Thus, they compare individuals' behavior in a long-run UA system (in which no individuals in the economy have ever experienced the UI system) to the UI system. Therefore, we use the second part of this chapter to investigate the transition to a system of unemployment accounts.

In modeling the switch from the traditional unemployment insurance system to the unemployment account system, we have to make certain assumptions on how this transition proceeds. The main question is who will switch to the new account system. Is the new system mandatory for everyone, is it voluntary or is it introduced at a different speed for different age groups? In this respect 'real-world' experience, such as the introduction of the accounts program in Chile, does not provide enough guidelines on how to set up the economic model for Germany, as the system of traditional unemployment insurance was basically non-existent before the unemployment account reform (Reyes Hartley et al. (2011)). In their economic model Pallage and Zimmermann (2011) discuss the willingness to shift from an insurance to a new account system and find that in an economy with a low extent of moral hazard, the individuals prefer the UA system over the UI system [2]. In our model set-up we accordingly assume that everyone switches to the account system at the same conditions regardless of the age or other personal characteristics. This means that also the older individuals, who have a much shorter time horizon to accumulate large balances on their accounts, face the same contribution rates as young individuals. The assumption of an immediate switch enables us to decipher the exact impact of the transition on each age cohort.

We find, that in order to achieve a fully-balanced budget in the first year of the transition, the government needs to raise the optimal contribution rate to such a level, that it (together with the amount paid to the common fund) exceeds the 4% unemployment insurance tax which prevails under the UI system. However, even despite this initially high contribution rate, the UA system generates enough working incentives in the transition period, such that the government can afford to lower the contribution rate in each following year. Already in year 5 of the transition, the contribution rate (together with the contribution rate to the

[2] This result is further amplified when the extent of moral hazard rises.

common fund) is lower than the traditional unemployment insurance tax. Surprisingly, the incentives to work converge very quickly to their high long-run level. The leisure choice of all age groups drops significantly after the introduction of the accounts, with the old individuals having the largest increase in labor market incentives.

At the same time, we also perform a transitional welfare analysis distinguishing between the individuals' heterogenous characteristics. We infer that during the transition period the consumption equivalent is significantly positive for the vast majority of individuals. We conclude that overall, the UA system - at any stage of implementation - is associated with remarkable welfare implications.

This chapter is organized as follows. Section 4.2 describes the optimization problem, which determines the optimal long-run tax rate in the UA system and discusses the long-run *wealth effect*. Section 4.3 outlines our approach to modeling the transition period. It describes the extended optimization problem, which determines the optimal tax rate in the transition period and subsequently discusses the results on incentives to work and welfare during the transition. Section 4.4 concludes.

4.2 Incentive Effects in the Long Run

In the previous chapter, we set our major focus on the incentives that arise entirely from the introduction of individual unemployment accounts and the resulting potential payouts. We observed significantly strong effects on the labor market incentives. For simplicity we assumed, that the after-tax income of each individual is the same under both, the UA and the UI system. In practice however, this will not necessarily be the case. Under the current pay-as-you-go (PAYG) funding system in Germany, the unemployment insurance contributions by the employee as well as the employer are endogenously determined, taking into account the bill of the total unemployment benefits in a given year. Thus, obviously a system of unemployment accounts, which affects the unemployment rate via altering labor market incentives, would necessarily induce an adjustment in the tax rate, which would then eventually change the after-tax income of the individuals. Depending on the sign of the tax adjustment, this process could either reinforce additional incentives or lead to effects which reduce them. Our results in Chapter 3 suggest, that the equilibrating tax under the UA system will be lower than under the UI system. In this section we want to revisit the optimization problem of the individual with the extension of a social planner seeking for the optimal PAYG tax rate. In a first step, we analyze an economy with a running UA system (long-run UA system) and compare the necessary tax adjustment to the unemployment insurance tax. Thereafter, we show how the optimally adjusted tax evolves in the transition period between those two systems.

4.2.1 Structure of the Long-Run Model

We now reformulate the adjusted optimization model. This time the social planner in a PAYG system, who has full information about the individuals' preferences and characteristics is optimally setting the unemployment insurance tax, such as to equilibrate total unemployment insurance contributions and total unemployment benefits in each given period. For clarification, recall that τ_t^A denotes the unemployment account contribution of the individual under the UA system. Let τ_t^I denote the unemployment insurance contribution, which each employed individual is paying to the common unemployment fund. Consequently, the total contribution of the individual (employee) is $\tau_t^{employee} = \tau_t^A + \tau_t^I$[3]. Similarly, let $\tau_t^{employer}$ denote the employer's contribution to the common fund. For the UI system, we have set the ratio of $\tau_t^{employer}$ to $\tau_t^{employee}$ as constant[4] and obtained $\tau_t^{employee} = 4\%$. For the UA system analysis in Chapter 3, we assumed that $\tau_t^A = \tau_t^I = 2\%$ and $\tau_t^{employer} = 3\%$ in order to apply the same parameter values as in the financially balanced UI system. The focus of the following analysis is the re-optimization of the contribution rate to the unemployment account. The government commits to a PAYG financing system with unemployment accounts and sets the optimal employer's tax, $\tau_t^{employer}$, the optimal contribution rate to the account of the employee, τ_t^A, and the optimal unemployment insurance contribution to the common fund (paid by the employee), τ_t^I, taking into account the individuals' welfare maximization problem. For simplicity, we assume that $\tau_t^A = \tau_t^I$, so that by using the above mentioned constraints the objective eventually becomes to determine the optimal unemployment account contribution τ_t^A.

We decompose the problem into an outer and inner optimization problem. The outer

[3]Obviously, under the UI system $\tau_t^A = 0$. Note, that in the government budget analysis in Chapter 3 we assumed that $\tau_t^A = 2\%$ and that $\tau_t^I = 2\%$ in the UA system and $\tau_t^{employee} = 4\%$ in the UI system
[4]which is a reasonable assumption for the German UI system in the investigated time period.

optimization problem refers to finding the optimal tax rate (or the optimal contribution rate to the account in the case of the UA system), which balances total tax receipts and total benefits. The inner optimization problem constitutes the individuals' welfare maximization problem.

Outer optimization problem under the UA system: Let N denote the size of the working-age population in the economy at any period, with $N = N^E + N^U$, where N^E and N^U denote the total number of employed and unemployed individuals in that period. The total amount of unemployment contributions received by the government from worker i's labor contract is given by $w_t^i \tau^A(1+2/\sigma)$, where σ denotes the constant share between the employer's and employee's contributions. Similarly, the amount of benefits which the government provides for each unemployed i is given by $max\{b_t^i - (1+r)A_t^i, 0\}$. Considering the entire working-age population, the government seeks the level of τ_t^A which solves the following equation:

$$0 = \sum_{i=1}^{N^E} w_t^i \tau^A (1 + 2/\sigma) - \sum_{i=1}^{N^U} max\{b_t^i - (1+r)A_t^i, 0\} \tag{4.1}$$

Note, that by increasing N, the number of simulated individuals, τ^A converges to the true optimum level, and for N being sufficiently large (we choose N=100,000) the approximation will be accurate.

Inner optimization problem under the UA system: The N individuals, of age t are endowed with asset holdings X_t and unemployment account balance A_t. Given the employment status S_t, each individual chooses consumption c and leisure l to maximize the expected present discounted life-time utility stream up to $t = T$. Utility in state S is given by $U^{S_t}(c_t^{S_t}, l_t^{S_t})$ We specify t $\in$ [18, 19, 20, $\ldots$64] as the age of an individual participating in the labor market, where age 65 corresponds to the retirement period. Thus, we have 47 periods with annual time steps. The objective function of the individuals can be expressed by:

$$
\begin{aligned}
V_t(X_t, A_t, S_t, t) &= \max_{c_t^{S_t}, l_t^{S_t}} \quad \mathbb{E}\left\{\sum_t^T \beta^{t-1} u^{S_t}(c_t^{S_t}, l_t^{S_t}) + \beta^{T+1}\Omega(X_{T+1}, A_{T+1})\right\} \\
\text{s.t.} \quad X_{t+1} &= \begin{cases} (1+r)X_t + w_t(1-\tau^A) - c_t^E & \text{for } S_t = E \\ (1+r)X_t + b_t - c_t^U & \text{for } S_t = U \end{cases} \\
A_{t+1} &= \begin{cases} (1+r)A_t + w_t\tau^A & \text{for } S_t = E \\ \max\{0, (1+r)A_t - b_t\} & \text{for } S_t = U \end{cases} \\
S_{t+1} &= \Pi_t(S_t, l_t^{S_t}) \\
\Pi_t &= \begin{bmatrix} \pi_{EE}(l_t^E) & \pi_{EU}(l_t^E) \\ \pi_{UE}(l_t^U) & \pi_{UU}(l_t^U) \end{bmatrix} \\
X_t, A_t &\geq 0 \qquad c_t^{S_t} \geq 0 \qquad 0 \leq l_t^{S_t} \leq 1
\end{aligned} \tag{4.2}
$$

By analogy, the government's optimization problem under the UI system is a reduced version of the one under the UA system. It can be expressed by eliminating the unemployment account state variable A_t and replacing the unemployment account contribution τ_t^A by the contribution to the unemployment insurance.

Outer optimization problem under the UI system: Let N denote the size of working age population in the economy at any period, with $N = N^E + N^U$, where N^E and N^U denote the total number of employed and unemployed individuals in that period. The total amount of unemployment insurance contributions received by the government from worker's i labor contract is given by $w_t^i\tau^I(1+1/\sigma)$, where σ again denotes the constant share between the employer's and employee's contributions. Similarly, the amount of benefits which the government provides for each unemployed individual i is given by b_t^i. Considering the entire working-age population, the government seeks the level of τ_t^I which solves the following equation:

$$0 = \sum_{i=1}^{N^E} w_t^i \tau^I (1 + 1/\sigma) - \sum_{i=1}^{N^U} b_t^i \tag{4.3}$$

Inner optimization problem under UI system: The N individuals, of age t are endowed with asset holdings X_t. Given the employment status S_t, the individuals each choose consumption c and leisure l to maximize the expected present discounted life-time utility stream up to $t = T$. Utility in state S is given by $U^{S_t}(c_t^{S_t}, l_t^{S_t})$ We specify t $\in$ [18, 19, 20, ... 64] as the age of an individual participating in the labor market, where age 65 corresponds to the retirement period. Thus, we have 47 with annual time steps. The objective function of an individual can be expressed by:

$$\begin{aligned}
V_t(X_t, S_t, t) &= \max_{c_t^{S_t}, l_t^{S_t}} \quad \mathbb{E}\left\{\sum_{t}^{T} \beta^{t-1} u^{S_t}(c_t^{S_t}, l_t^{S_t}) + \beta^{T+1}\Omega(X_{T+1})\right\} \\
\text{s.t.} \quad X_{t+1} &= \begin{cases} (1+r)X_t + w_t(1-\tau^I) - c_t^E & \text{for } S_t = E \\ (1+r)X_t + b_t - c_t^U & \text{for } S_t = U \end{cases} \\
S_{t+1} &= \Pi_t(S_t, l_t^{S_t}) \\
\Pi_t &= \begin{bmatrix} \pi_{EE}(l_t^E) & \pi_{EU}(l_t^E) \\ \pi_{UE}(l_t^U) & \pi_{UU}(l_t^U) \end{bmatrix} \\
X_t &\geq 0 \qquad c_t^{S_t} \geq 0 \qquad 0 \leq l_t^{S_t} \leq 1
\end{aligned} \tag{4.4}$$

While the inner maximization problem under both, UA and UI systems is done by dynamic programming with value function iteration as explained in Chapter 3, the outer optimization problem can be done by a simple root-finding procedure. However, since we assume a monotonic relationship between the optimal tax level and the budgetary position, the outer optimization problem can also be solved by a simple guess and verify procedure, checking a finite set of possible levels.

In order to achieve a balanced budget in the UI system we assumed an insurance tax rate of τ^I=4% (to be paid by the employee) and $\tau^{employer} = 3.05\%$. Applying the same values to the UA system (with a contribution rate to the account, τ^A, of 2%, and 2% for the common fund), the government experiences an improvement in the budget. Recall, that with one single payout upon retirement, the UA system will generate 458 € per individual per year, as described in Chapter 3 in Table 3.14. Using the new optimization problem the long-run UA system is financially balanced with a τ^A=1.565%, τ^I=1.565% and $\tau^{employer} = 2.387\%$. Thus, as expected the optimal long-run contribution of the employees to the account system is substantially lower. Furthermore, note that since the employer's contribution is reduced, the demand side of labor is positively affected and more jobs might be created.

4.2.2 Disentangling Long-Run Effects

We have already seen that the UA system generally induces changes in workers' labor market incentives. Chapter 3 demonstrated that these incentives are improved for all individuals in the long run. In the previous section, we discussed that the lower long run unemployment rate will bring about a significant reduction in the tax rate on labor. Most likely, individuals will also react to that as well. In the following we would like to investigate the impacts of this second-order effect on labor market incentives. It helps to define two different mechanisms by which the optimal leisure choice is affected. One is what we call the *pure incentive effect* and refers to the direct impact from the unemployment accounts. The individuals pay a contribution rate into their individual accounts, and accordingly alter their leisure choices as they expect a certain future payout. (This effect has been discussed at length in the previous chapter). The second mechanism describes the impact arising from the so-called *wealth effect*. As described in Chapter 3 the government would actually make a surplus in the unemployment account system, if it were to keep the same insurance taxes. The reason for this was the reduced leisure choice, which resulted in higher hiring and lower firing rates. Consequently, fewer individuals were unemployed and at the same time, the tax base increased due to more employed individuals. As a result a reduction in the overall tax rate would be possible in order to keep the government budget financially balanced. This reduction in the tax rate lowers the overall contribution rate, leading to a higher disposable income for the individuals. This *wealth effect* will consequently affect their leisure choices further. In principle, its direction is ambiguous. On the one hand, a lower overall tax rate stimulates even higher working incentives of the individuals, as the opportunity cost of the status of employment rise and working becomes more profitable. On the other hand, higher disposable income may induce individuals to raise their leisure choices, as the increased disposable income enables them to enjoy a higher leisure level while affording the same consumption level.

In the following we decompose the change in leisure in its two components; the *wealth effect* (due to the higher disposable income) and the *pure incentive effect* (due to the expected payout upon retirement). We investigate in detail if these effects work against each other or complement each other, both in the long-run, as well as in the transition period which we discuss in later sections.

Figure 4.1 disentangles the *pure incentive effect* from the *wealth effect* with respect to leisure for the employed as well as for the unemployed individual. It shows that the reduction in leisure that occurs in the long-run UA system is mainly caused by the *pure incentive effect* and only a small part of the overall reduction is due to the reduction of the contribution rate (and the accordingly higher disposable income). The *incentive effect* clearly dominates the *wealth effect* irrespective of the employment status. For an 18-year old individual it is around 70% of the overall effect, and rises with increasing age up to 100% for the very old. Obviously, with increasing age, the *wealth effect* becomes less prevailing since individuals accumulate assets over their lifetime and older individuals therefore rather prefer to use the additional disposable income for consumption.

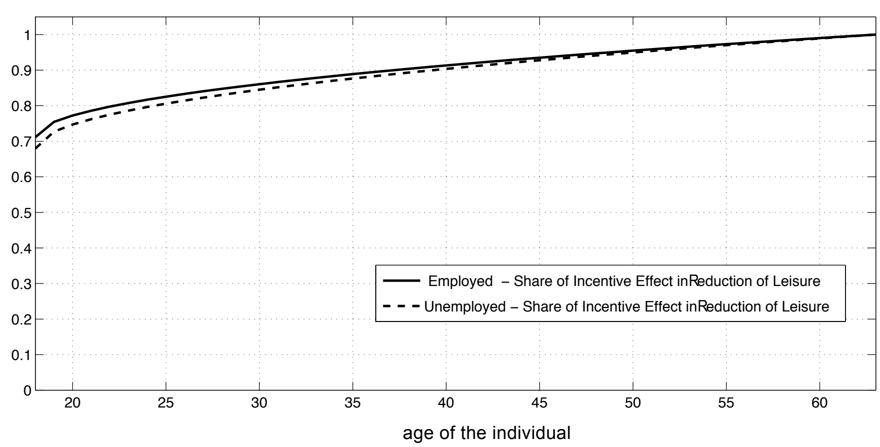

Figure 4.1: Share of *Pure Incentive Effect* of Total Long-Run Effect

We take a more detailed look at the reduction in leisure in Table 4.1. It decomposes the *incentive* and *wealth effect* taking into account the heterogeneity of the individuals with respect to age, the employment status, wealth status and the account balance. Table 4.1 shows the overall optimal reduction in leisure, which is associated with the long-run UA system (compared to the UI system). The numbers in brackets show the reduction in leisure, which results purely from the *incentive effect*.

One result that immediately becomes obvious, is that the *incentive effect* dominates the *wealth effect* for all groups of individuals. The *wealth effect* is strongest for the youngest age cohort, but even here it reaches maximally 32% of the total effect. Overall, older individuals reduce their leisure much stronger than younger individuals and at the same time, the share of the *incentive effect* in this reduction also grows stronger with rising age. This confirms our previously noted findings from Figure 4.1. The other main message is that there is no clear pattern visible with respect to the wealth status, nor with respect to the level of the unemployment account balance, or the employment status. Differentiating the leisure

Employment Status:	**U**		**E**	
Wealth Level:	*poor*	*rich*	*poor*	*rich*
Age = 18	1.42 (1.01)	2.17(1.68)	1.27 (0.86)	1.81 (1.46)
Age = 40 Low$A$	5.08 (4.61)	6.13 (5.63)	4.78 (4.46)	5.05(4.72)
Age = 40 High$A$	9.82 (9.28)	5.95 (5.39)	11.61(10.99)	9.30 (8.87)
Age = 62 Low$A$	11.03 (10.97)	14.93 (14.16)	**10.62 (10.78)**	**12.40 (12.48)**
Age = 62 High$A$	21.00(20.99)	13.30 (13.22)	27.11 (27.02)	**20.92 (21.05)**

Table 4.1: Reduction in Leisure Choice in %. Number in Brackets: % Reduction in Leisure - *Incentive Effect*

reduction with respect to heterogenous individuals nevertheless exposes three interesting cases. In Figure 4.1 we see that overall the *wealth effect* contributes to the reduction in leisure, that occurs when comparing the UI system to the long-run UA system. Figure 4.1

further shows that the *incentive effect* dominates both for the employed as well as for the unemployed and that it reaches 100% for the very old. However, what is disguised in this aggregate picture is that the additional income generated by the long-run tax reduction induces certain groups of individuals to raise their leisure choice, instead of reducing it like all the others. Consequently, the *incentive effect* is larger than the total effect for the three individuals highlighted in the lower right corner of Table 4.1. Rich[5] old employed individuals increase their leisure choice as a response to the long-run tax reduction[6]. Apparently, rich old employed individuals retrieve higher utility from additional leisure, instead of further improving their hiring/firing probabilities by reducing leisure. This behavior is consistent irrespective of the level of their account balances. The next interesting case concerns the poor old employed individuals with a low balance on their individual account. These individuals do not expect a (high) payout, since they retire already 3 years later and will not have accumulated much until then. However, the additional increase in leisure appears to give them a utility boost, which is superior to the additional money that they may (or may not) earn by improving his employment prospects and therefore his account balance. One would think that the poor old employed with a high balance on his individual account behaves similarly. However, he does not increase but rather decreases his optimal leisure choice in response to the tax cut. The reason is that, this individual wants to make sure that he indeed receives this payout. In order to ensure this, he will take no extra risk and reduces his leisure accordingly.

As our results show, the aggregate *wealth effect* is clearly positive despite the three special cases just mentioned, so that overall the higher disposable income induces the individuals to lower their leisure choices.

In the following we discuss how the changed leisure choices induced by the lower tax rate translate into the unemployment rate. There are two mechanisms through which the unemployment rate is affected. One is that the *wealth effect* (generated by the lower contribution rate) is more important for younger individuals. They react much more strongly to the lower contribution rate. Second, while young individuals reduce their leisure in response to

[5]In general, we assume a poor individual to have less than half of the average individual's assets, while we define a rich individual to have more than twice the average amount of assets.

[6]Note, that overall their optimal leisure choice is reduced when comparing the UA and the UI system.

the tax, the older individuals exhibit lower incentives to work. Consequently, the long-run tax reduction should decrease the unemployment rate primarily for young individuals. This

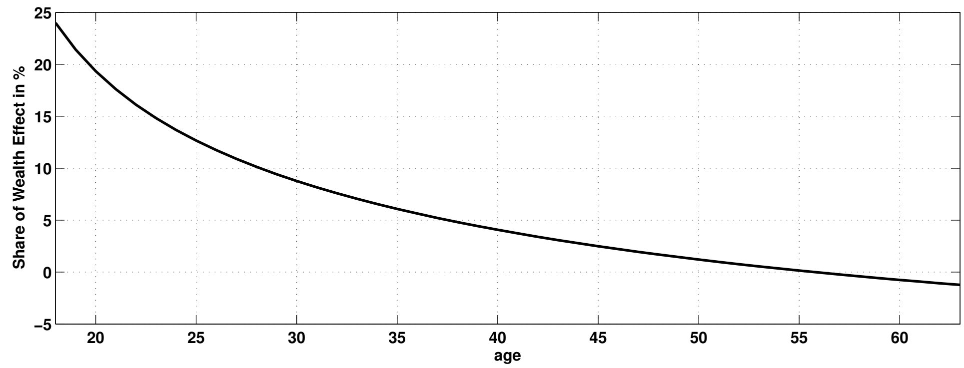

Figure 4.2: Long-Run Share of Wealth Effect as % of the Total Unemployment Reduction when Switching from the UI to the Long-Run UA System

is exactly what we can see in Figure 4.2, which visualizes the impact of the *wealth effect* on the unemployment rates of the different age cohorts.

Accordingly, we can see that the unemployment rate of the very young labour market entrants is reduced by 25%. This falls at a diminishing rate up to age 58 at which the unemployment rate is actually increased. Thus, for the individuals aged 58 or older the unemployment rate rises slightly in consequence of the higher disposable income generated by the long-run tax reduction. Overall, this translates into an improved aggregate unemployment rate of 8.35%, which compares to 10.46% in the UI system.

In the following we investigate which constant and perpetual increase in consumption equalizes the welfare under the UI and the UA system. This takes into account that an additional reduction in leisure (as experienced by most individuals here) is a cost in the model and utility from consumption needs to be sufficiently large relative to the disutility of the reduced leisure to increase welfare. More specifically, Figure 4.3 shows the details with respect to the consumption equivalents of heterogenous individuals taking into account the long-run effect of the tax reduction. Figure 4.3 compares the consumption equivalents of individuals with different employment status and different wealth status [7]. Moreover, it shows the consumption equivalents pertaining to different age cohorts.

[7]For a detailed mathematical derivation of the consumption equivalents, please refer to Section 3.5.3

Distinguishing the different groups of individuals, we see clear differences in the consumption equivalents. One major difference refers to the wealth status. The consumption equivalent of poor individuals is higher than the consumption equivalent of rich individuals. This finding holds irrespective of the employment status or the age of the individuals. One reason why poor individuals experience a larger welfare gain in the unemployment account system than rich individuals, is the additional income from the expected payout, which raises their utility more than that of rich individuals, as rich individuals have a lower marginal utility from the additional payout upon retirement. The interplay of the consump-

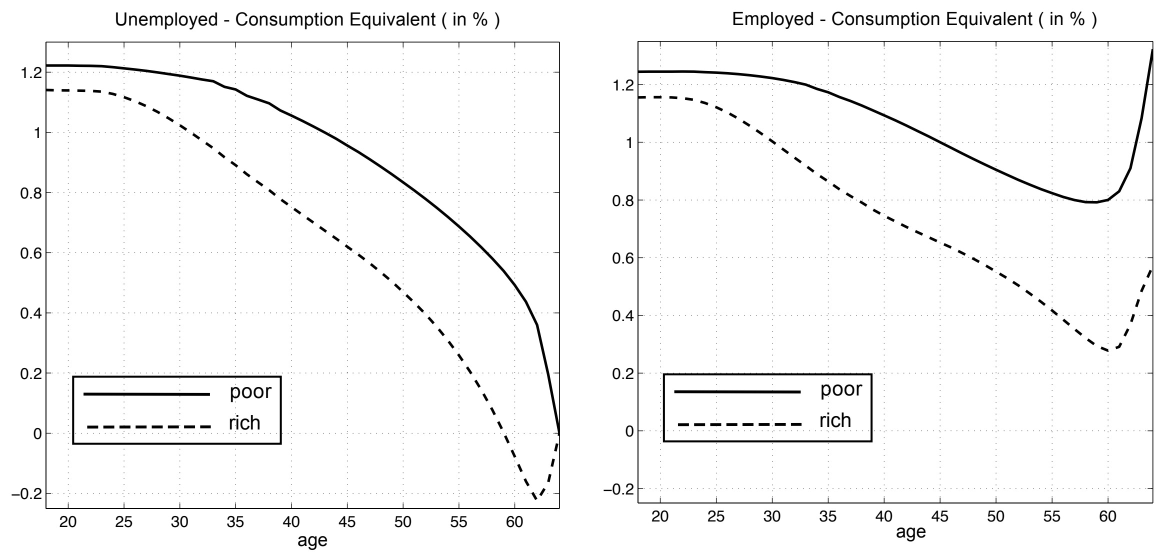

Figure 4.3: CE for Different Age-Cohorts When Switching to the UA System - Left (Unemployed) and Right (Employed), Rich and Poor Individuals

tion equivalent and the wealth status of the individuals also changes with the individuals' age. The welfare gain of the UA system for labour market entrants is about 1.2%, and it is basically the same for the unemployed and employed and independent of their asset levels. For 40-year-old individuals, the consumption equivalent is still quite high: slightly above 1% for the rich and slightly below 0.8% for the poor. One year before the retirement period (age 64), the unemployed (rich and poor) face a consumption equivalent of 0%. This is quite an obvious result, since those individuals are not contributing any payments to their unemployment accounts and will receive no payout upon retirement[8]. In contrast,

[8]Recall, that we assume a zero account level in the consumption equivalent calculations.

the employed have a positive consumption equivalent. While it is about 0.6% for the rich, the consumption equivalent for the poor is more than twice as high, almost 1.3%. Rich employed 64 year-old workers are facing a much lower marginal utility of additional consumption upon retirement. Recall, that the major driving mechanism of the unemployment account system is that individuals are not forced to accumulate a high stock of savings in anticipation of the payout upon retirement. This leads them to consume higher amounts over their lifetime, while at the same time increasing their labor efforts in order to secure that final payout. However, if, e.g. a 50- year old poor individual is facing an empty unemployment account balance, this individual has to sacrifice much more leisure (and most probably) consumption to guarantee some level of consumption in the retirement period.

Next, we turn to the effect of the employment status on the consumption equivalent. It is important to recall, that unemployed individuals receive only 60% of the regular wage, and therefore must use their savings to sustain the usual consumption levels. Given their depleting stock of savings, the unemployed face increasing pressure to find employment. This feature is important in understanding Figure 4.3. In general, the consumption equivalent for the employed is higher than for the unemployed as the associated expected account balance is much higher. Also, for most individuals, the introduction of the UA system constituted a positive consumption equivalent. Nevertheless, note that the consumption equivalent is decreasing with the individuals' age until age 58. Clearly the possible compounding of a positive unemployment account plays a role in that. Most likely however, the decreasing relative level of leisure under the UA system, as explained in Figure 3.4 is the major driving force behind this development. For the employed at age 59, the consumption equivalent seems do become dominated by the effect of employment persistence, indicating a high probability of receiving a positive payout from the unemployment account upon retirement. In contrast when considering the 59-63-year old rich unemployed, we see that a switch to the UA system will have a slightly negative welfare effect. The order of magnitude is about -0.2%. Obviously those individuals sharply reduce their leisure to find employment which will might guarantee a positive unemployment account upon retirement. This disutility from lower leisure seems to offset the potential welfare gains from higher consumption levels upon retirement.

The general finding from Figure 4.3 is that the consumption equivalent is always positive, except for the very old rich unemployed. This implies that, with exception for the latter group of individuals, the unemployment account system in the long-run is superior in welfare terms to the unemployment insurance system.

4.3 The Unemployment Account System in the Transition Period

In this section we investigate the optimal PAYG contribution rate to the account for the transition period. Furthermore, we also look at the corresponding incentive effects in the transition. Suppose first, that the government does not adjust the UA tax rate during each year of the transition phase when switching from the UI to the UA system. Figure 4.4 shows the evolution of the government budget, applying three different contribution rates, which are fixed over the entire transition period. As examples, we choose 2% (the UI system PAYG rate), 1.565% (the long run optimal PAYG UA rate) and 2.75% (which we later show to be the PAYG UA rate in the first period of the transition). Figure 4.4 shows

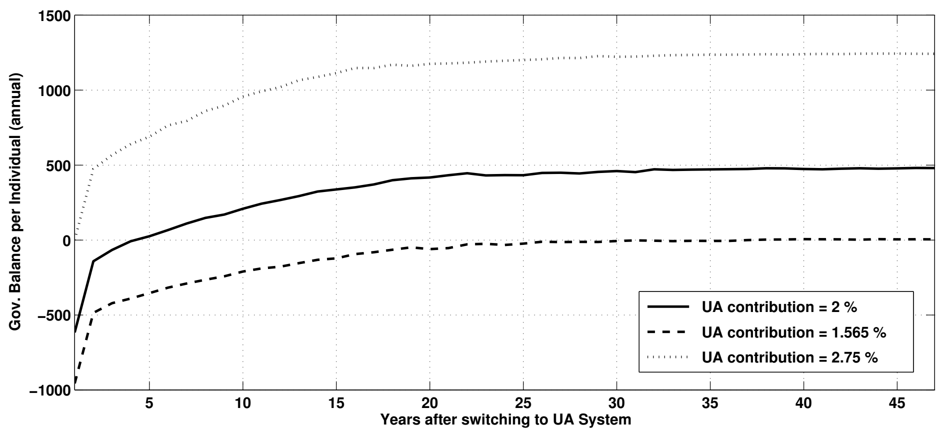

Figure 4.4: Government Budget Balance (Annual) per Individual (in Euros) for Three Fixed Rates of UA Contribution

that even if the government would simply adopt the 2% contribution rate [9], the government would only make a loss in the first 4 years of the transition period. The government budget

[9] This 2% contribution rate is comparable to the traditional UI system, as it implies keeping the same tax level as in the UI system.

balance deteriorates upon the introduction of the UA system, as individuals have not yet accumulated much on their accounts, and therefore still rely on government support. At the same time, the revenues of the government fall by half, as 2% are paid into the individual account. In the following years the budget continuously improves. The UA system becomes self-financing after 4 years, after which the government continuously earns more revenue than it needs to finance the unemployment benefits. Furthermore, it takes about 5 additional years for the government to cover the loss which has been accumulated in the first 4 years. After about 20 years the full budgetary impact of the UA system has been almost reached. The perpetual long-run gain amounts to 458 € per individual per year.

In order to already achieve a financial balance in the first year of the transition, a tax rate of 2.75% is needed as shown by the dotted line in Figure 4.4 [10]. Consequently, workers experience a 1.5% reduction in disposable income, since they are obliged to pay an equal share to the common fund in addition to their contribution to the individual account. Applying the optimal long-run tax rate of 1.565% to the whole transition period, we see that it takes only 23 years until the system is financially balanced.

Figure 4.4 motivates the need for determining the optimal tax rate in the transition period through a new optimization problem. While in principle the government could use revenues from the later years to compensate the first 4 years in which it makes a loss (in the 2% contribution case), we illustrate in the following how the optimal tax rate needs to adjust to achieve financial balance in each year during the transition period. This takes into account, that individuals pay less taxes, as part of their overall contribution is now paid into their private account. At the same time these lower tax revenues need to finance the same level of unemployment benefits in the first years of the transition period. We ask, which tax rate is needed in order to finance this smooth introduction of the accounts. In order to compensate the lower revenues in the first years, the government will have to charge a tax which is higher than the 2%. In fact, Figure 4.4 shows that the optimal tax rate in the transition period, which balances the government budget, will decrease very rapidly from 2.75%, to 2% in the fourth year of the transition period, to the long-run tax rate of 1.565%. In turn, we also discuss whether this initial higher tax rate (of 2.75%) may put too much

[10] We show in the next section how to obtain this number.

pressure on the incentives to work and whether it is possible to achieve financial balance under these circumstances.

4.3.1 An Extended Optimization Problem for the Transition

As in Chapter 3, we solve a stochastic life-cycle model of consumption, leisure and savings choices with intrinsic uncertainty about the employment status of the individual. However, this time the individuals are faced with the introduction of the UA system s years after having entered the labor market. (where $s \in [1, 47]$). Thus, we investigate explicitly how the economy develops in each of the 47 years of the transition. We explicitly model that the contribution rate to the unemployment accounts now differs with the year of transition. At the same time we assume that within each period of the transition all individuals, independent of their age, pay the same contribution rate to their account. The latter assumption implies that older individuals pay the same rate as younger individuals, even though they only face the UA system for a few years and might not benefit as much from it. We assume that there are no payouts within the life cycle. Upon retirement, all individuals receive 100% of their accumulated account balance, which is left over at the end of their working life. Accordingly, in the first years of the transition, the final payout to old individuals upon retirement will be low since they have spent only a few years under the UA system.

Before the government introduces the UA system, the government's and individual's optimization problem is equal to that of the UI system, as explained in the previous section. We assume that the individuals do not anticipate the change in the government's policy to introduce the UA system. More specifically, since one time period in our model equals one year, we assume that the switch to the UA system is communicated to the public in less than a year prior to that switch. After the switch, in principle, one can use the optimization problem of the UA system, as explained before. This time however, the expected size of the individuals' unemployment accounts will differ as the economy transits towards the long-run. A 50-year-old individual one year after the switch is expected to have a much lower level of the unemployment account compared to a 50-year-old individual e.g. 20 years after the switch. Therefore, a government which commits to the PAYG system, must re-optimize the tax in each period of the transition. In the following we describe the adjusted problem.

Outer optimization problem during the transition: Let N^s denote the size of the working-age population in the economy at year s of the transition phase, with $N_s = N_s^E + N_s^U$, where N_s^E and N_s^U denote the total number of employed and unemployed individuals at period s of the transition. The total amount of unemployment insurance contributions received by the government from worker's i labor contract is given by $w_t^i \tau_s^A (1 + 2/\sigma)$. Similarly, the amount of benefits, which the government provides for each unemployed individual i is given by $max\{b_t^i - (1+r)A_t^i, 0\}$. Considering the entire working-age population, the government seeks the level of τ_s^A, which solves the following equation:

$$0 = \sum_{i=1}^{N_s^E} w_t^i \tau_s^A (1 + 2/\sigma) - \sum_{i=1}^{N_s^U} max\{b_t^i - (1+r)A_t^i, 0\} \tag{4.5}$$

Inner optimization problem during the transition: The N individuals, of age t are endowed with asset holdings X_t and unemployment account balance A_t. Given the employment status S_t, the individuals each choose consumption c and leisure l to maximize the expected present discounted lifetime utility stream up to $t = T$. Utility in state S is given by $U^{S_t}(c_t^{S_t}, l_t^{S_t})$ We specify t $\in$ [18, 19, 20, $\ldots$64] as the age of an individual participating in the labor market, where age 65 corresponds to the retirement period. Thus, we have 47 periods with annual time steps. The objective function of the individuals can be expressed by:

$$
\begin{aligned}
V_t(X_t, A_t, S_t, t) &= \max_{c_t^{S_t}, l_t^{S_t}} \quad \mathbb{E}\left\{\sum_t^T \beta^{t-1} u^{S_t}(c_t^{S_t}, l_t^{S_t}) + \beta^{T+1}\Omega(X_{T+1}, A_{T+1})\right\} \\
\text{s.t.} \quad X_{t+1} &= \begin{cases} (1+r)X_t + w_t(1-\tau_s^A) - c_t^E & \text{for } S_t = E \\ (1+r)X_t + b_t - c_t^U & \text{for } S_t = U \end{cases} \\
A_{t+1} &= \begin{cases} (1+r)A_t + w_t\tau_s^A & \text{for } S_t = E \\ \max\{0, (1+r)A_t - b_t\} & \text{for } S_t = U \end{cases} \\
S_{t+1} &= \Pi_t(S_t, l_t^{S_t}) \\
\Pi_t &= \begin{bmatrix} \pi_{EE}(l_t^E) & \pi_{EU}(l_t^E) \\ \pi_{UE}(l_t^U) & \pi_{UU}(l_t^U) \end{bmatrix} \\
X_t, A_t &\geq 0 \qquad c_t^{S_t} \geq 0 \qquad 0 \leq l_t^{S_t} \leq 1
\end{aligned} \tag{4.6}
$$

where now, τ_s^A denotes the unemployment account contribution in year s of the transition phase.

4.3.2 The Optimal Account Contribution Rate in the Transition

Figure 4.5 shows the optimal account contribution rate in each year of the transition period[11]. As mentioned in the previous section, the optimal contribution rate, which is needed to achieve financial balance in the first year, is about 2.75%, and therefore higher than the long-run contribution rate. The reason is, that the government still needs to finance the unemployment benefits as the individuals have not yet accumulated anything on their accounts. Nevertheless, the total unemployment insurance contributions which the government receives[12] is now 6.94% instead of the 7.05% under the UI system. This implies that

[11] The optimal contribution rate to the unemployment accounts in the transition can be approximated by $\tau_s^A = a_0 + a_1 s^{-1} + a_2 s^2 + a_3 ln(s)$, where $a_0 = 2.1312253$, $a_1 = 0.6274944$, $a_2 = 0.0000574$ and $a_3 = -0.1828895$.

[12] As discussed earlier, this is measured as the sum of τ^I and the employer's contribution.

already one year after the switch to the UA system, the labor market incentive effects of the UA system are notably in place. Consequently, the overall tax is roughly 0.1 percentage points lower.

During the transition period individuals accumulate higher unemployment account balances. This increases the share of self-financed benefits and lowers the need for government co-financing. At the same time, the individuals reduce their leisure choices and thereby reduce the probability of being fired. Thus, overall fewer unemployment benefits need to be

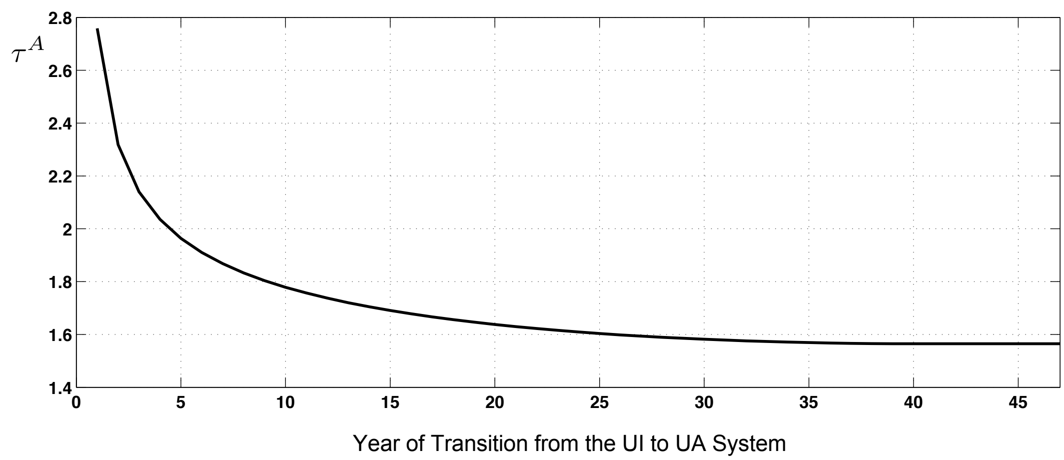

Figure 4.5: The Optimal Account Contribution Rate During the Transition Phase

financed by a larger tax base. The optimal contribution rate to the unemployment account decreases rapidly in the first years of the transition. After about 10 years, it continues to decrease at a diminishing rate until approaching the long-run optimal account contribution rate of 1.565%. Note, that after about 25 years after the switch to the UA system, the optimal contribution rate is about 1.6%, which is almost the long-run level. The overall contribution rate received by the government is now equal to 4.04% instead of the 7.05% under the traditional UI system.

In the following we investigate how the incentives to work are affected throughout the transition, and in particular how they are affected by the relatively high contribution rate in the first year. Figure 4.6 shows the optimal leisure choices in the transition period for young, middle-aged and old individuals differentiating further according to wealth and employment status[13].

While the leisure choices of unemployed individuals are always higher than the optimal leisure choices of employed individuals, the difference is much more apparent for rich individuals, who have more financial means to allow for lower working incentives. We also see, that the optimal leisure choice falls with rising age, except for the 40 and 60 year-old employed individuals, who choose more or less the same leisure. This is consistent with our results from Chapter 3, which showed that individuals reduce their leisure in anticipation of the payout. It implies that older individuals (e.g. the 60-year-old), who are much closer to the payout period (upon retirement) than the 20-year-old, react more strongly by adjusting their leisure choice. The transition period itself (e.g. 47 years until the long-run UA system

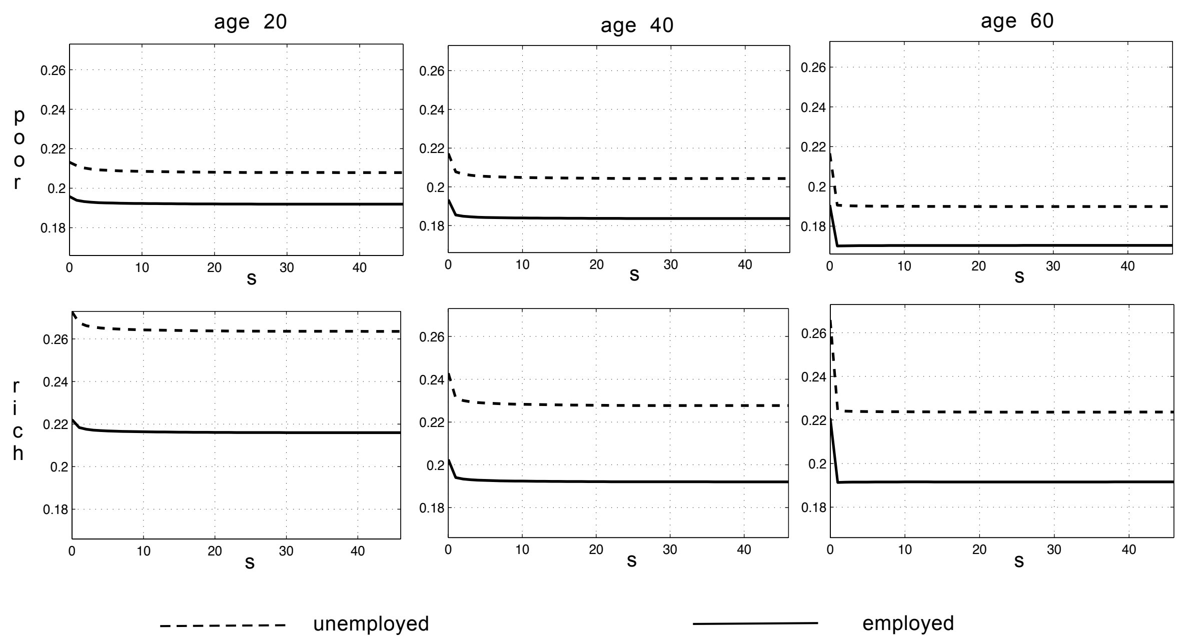

Figure 4.6: Leisure in the Transition Period for Heterogenous Individuals

is reached) does not affect the working incentives much. Leisure drops most in the first year of the transition right after the switch from the UI to the UA system. However, after the initial drop, the optimal leisure choices approach their long-run values pretty quickly. The initial drop is quite surprising, as the overall obligatory provisions for unemployment

[13]Note, that in order to facilitate comparison to the UI system, we are assuming an account level of zero. Obviously though, a 40-year old individual is expected to have a significantly high unemployment account balance if the UA system has already been running for 20 years.

to be paid by the employed are higher in the first year (2.75% contribution rate to the account in addition to the 2.75% for the common unemployment fund) than in the traditional unemployment insurance system (where the employed paid 'only' 4% insurance tax). Nevertheless, the individuals reduce their leisure significantly. This may be explained by their long-run expectation on receiving a payout in the future. This prospect enhances their working incentives from the first period onward. What further supports this explanation, is that the drop of leisure in the first year of the transition is more extreme for the older individuals, e.g. in the most extreme case (for 60-year-old employed individuals) leisure drops by 4 percentage points. Their waiting time until the payout is the shortest, e.g. 4 years in contrast to 44 years waiting time of the 20-year-old. Moreover, young individuals' employment paths risk getting heavily influenced by the persistence effect, in case they become unemployed in the first years of their working life. Older individuals, who have only 4 more years to go, will be less affected by this persistence. This raises their prospects compared to the ones of young individuals. In consequence their working incentives are affected more strongly. The main result from this discussion on optimal leisure choices is, that overall, individuals adjust their leisure choices surprisingly fast, instead of a slow adjustment path during the 47 years of the transition.

The same can be said about the evolvement of the aggregate unemployment rate during the transition period, depicted in Figure 4.7. Just like the optimal leisure choices, the unemployment rate also reaches its long-run level pretty quickly. It only takes about 2-3 years during which unemployment remains at a significantly higher level than in the long-run UA system. Note, however, that the unemployment rate improves already in the first year of the transition period compared to the traditional UI system. This is a remarkable result, as it implies that on the aggregate the unemployment rate improves in all periods even with a balanced budget assumption, and thus despite the relatively high account contribution rate which is necessary in the first years of the transition. While overall improved working incentives and an improved unemployment rate (under a balanced budget assumption) are desirable from the government's point of view, this does not necessarily hold for the individuals themselves. As argued before, lower levels of leisure are a cost in the model and affect the utility of individuals negatively. Overall, it is therefore uncertain whether the welfare implications during the transition phase are positive for the individuals. In the

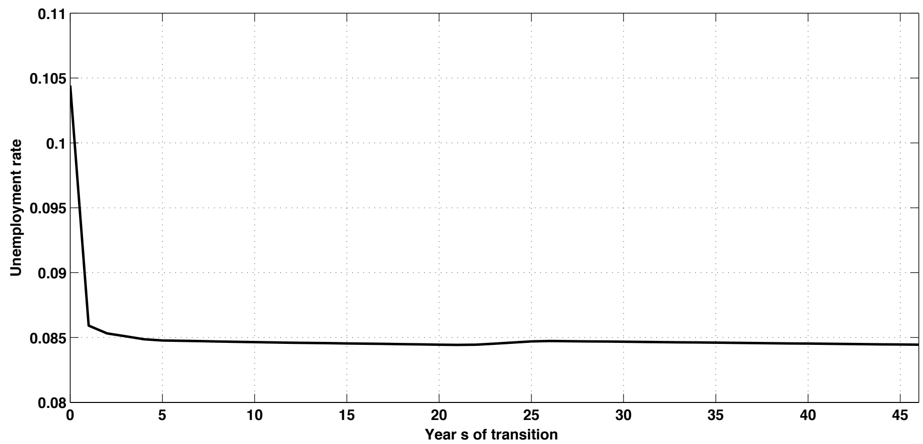

Figure 4.7: Unemployment Rate in the Transition Period

following, we intent to investigate that matter.

Figure 4.8 depicts the consumption equivalents for different age cohorts taking into account the heterogeneity of the individuals with respect to their employment status and wealth status[14]. Figure 4.8 presents an upper and lower limit of the consumption equivalent. The upper limit refers to the consumption equivalent associated with the long-run tax rate of 1.565% (depicted by the solid line). The lower limit refers to the consumption equivalent associated with the optimal maximal tax rate of 2.75% (depicted by the dotted line). This is the optimal tax rate in the first year of the transition. The dashed line depicts the 2% tax rate, which is comparable to the UI system [15]. Thus, the *wealth effect* (the impact from the increase in disposable income generated by the lower long-run tax rate) is visualized in the difference between the solid and the dashed lines. Note, that while Figure 4.8 does not depict the evolvement of the CE over the years of the transition period, it gives us a range of possible values for the consumption equivalents, which would occur if the low, middle and high tax case were applied to the UA system, essentially allowing us to infer the welfare impact during the transition period.

We have already discussed the age-dependent consumption equivalent for the long-run unemployment account contribution rate of 1.565%. Our analysis suggests that overall the

[14]To facilitate the comparison, the individuals depicted in Figure 4.8 all have a zero account balance.
[15]Actually, this tax rate is also the optimal one between the fourth and fifth year of the transition.

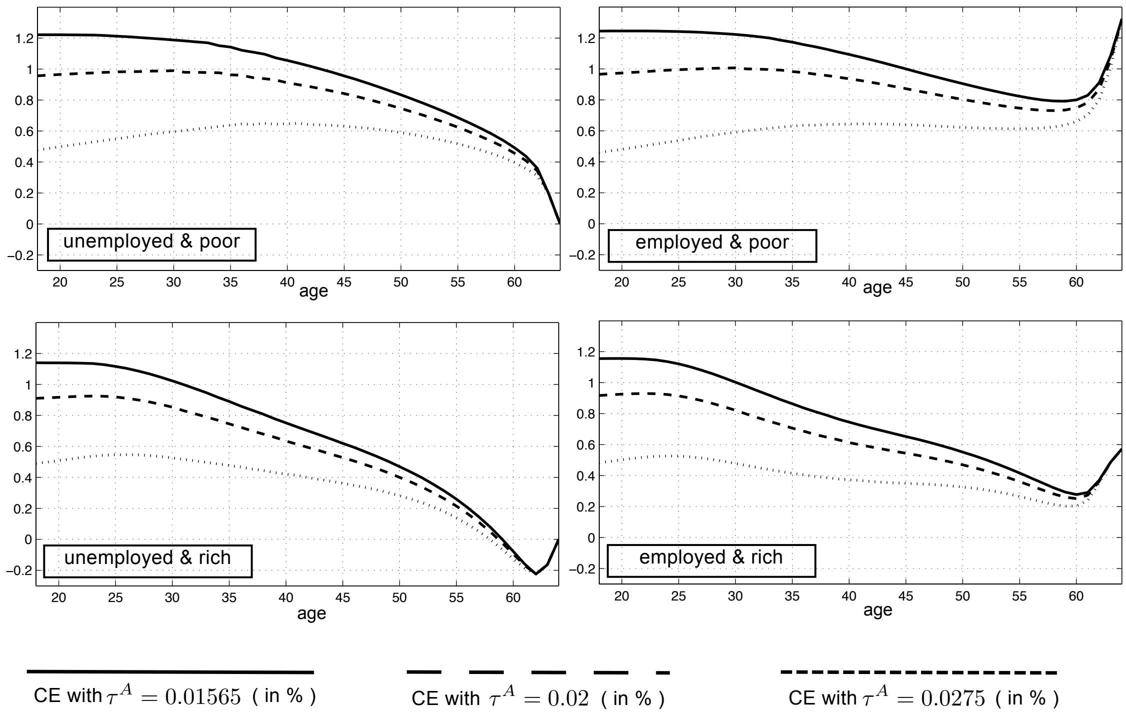

Figure 4.8: CE for Different Age-Cohorts and Contributions to the UA When Switching to the UA System

long-run UA system is clearly welfare-improving. However, upon introduction and also during the transition the optimal account contribution rate is substantially higher. When comparing the long-run rate to those of 2.75% and 2%, Figure 4.8 shows that the consumption equivalents are highest in the long-run tax case (i.e.: $\tau^A = 1.565\%$). Individuals have more disposable income available than in the other tax cases, and this translates to higher welfare regardless of whether the individual is employed, unemployed, poor or rich. One could think that a higher contribution rate will eventually lead to a much higher possible level of unemployment account upon retirement, thus increasing the potential welfare gains of the UA system. However, at the same time, the higher contribution to the unemployment account significantly lowers disposable income. While the former effect - the payout - is uncertain, the reduction in disposable income occurs instantly, and with certainty.

We also see from Figure 4.8 that the spread of the consumption equivalents between the upper and lower tax rate envelopes is much larger for the young age cohorts. The spread diminishes as people get older and have higher incomes. The consumption equivalents basically converge for the older age cohorts. This implies, that the prevalent tax rate makes a big difference in welfare terms for the young individuals, in contrast to the older individuals, who experience more or less the same consumption equivalents regardless of the underlying tax regime.

We discussed in Section 4.2 for the long-run tax case, that there is a trend for the CE to decrease with rising age. This does not hold anymore when we consider the tax rate of the first year (2.75%). Here, in particular visible for the poor employed, the consumption equivalents increase with rising age. The reason is that, while young employed individuals will tend to accumulate large balances on their individual accounts, they also experience a loss in their disposable income due to the high contribution rate. The probability to obtain this high payout upon retirement will vary with the employment paths during their working lives, and is therefore highly uncertain. In contrast, the loss in disposable income due to the high contribution rate, is certain in each year. Therefore, younger individuals tend to experience lower welfare gains in this tax case as compared to individuals, who are older when the UA system is introduced.

The overall message from Figure 4.8 is that the transition to the long-run UA system is welfare improving for almost the entire working-age population. Despite a relatively high contribution rate of 2.75%, which is needed for balanced-budget financing, the system generates much higher welfare already in the first year of the transition by creating enough additional utility for the individuals to compensate the loss from lower leisure levels.

4.4 Conclusion

In this chapter we have studied the financial feasibility of the UA system by implementing a PAYG structure. This way the government can achieve a balanced budget in the account system by relying on cross-subsidization across generations, which is inherent in the design of the current German unemployment insurance system. We have adjusted the optimization problem accordingly in order to determine the optimal long-run contribution rate of the UA system. As a result we find a long-run account contribution rate of only 1.565%, which implies an overall burden for the employed of 3.13%. This compares to a 4% tax burden in the traditional UI system. As a consequence, the individuals benefit from the account system in two ways. First, they can potentially receive a large payout from their accumulated unemployment account upon retirement. Second, in each period during their working life they have more disposable income available. Paying closer attention to the heterogeneity of the individuals, we see that the individuals do not react to these different effects in the same way. We find, that while the first effect, the *incentive effect*, reduces the optimal leisure choices of all individuals, this is not the case for the latter, the *wealth effect*. It induces certain groups of individuals (namely the rich old employed, and the poor old employed with low account balances) to lower their incentives to work as a response to the tax cut. Overall, however, the extent of the *incentive effect* dominates the *wealth effect* for all individuals. As a result, the individuals significantly reduce their optimal leisure choices in the long-run UA system, when compared to the UI system.

The opposed impact of the *incentive* and *wealth effects* also has implications for the unemployment rate. Comparing it with a situation in which the budget is not balanced (but positive), the unemployment rate now decreases for young and middle-aged age cohorts, but increases for the older age cohorts. Comparing with the current UI system, the aggregate unemployment rate is nevertheless reduced by roughly 2 percentage points.

Next to the positive stimulus for the supply side, the new long-run solution also turns out to be favorable for the employer as his contributions drop to 2.387%. This may eventually also stimulate labor demand.

Next, we have investigated how the economy behaves during the years of the transition from the traditional UI system to the UA system. In particular, whether the switch from the traditional UI system to the UA system is financially feasible and how employment incentives of different age cohorts (and in turn the unemployment rate) are affected throughout the transition period.

Our results suggest, that the switch from the UI to the UA system is self-financing and it is possible to introduce the unemployment account system at the same conditions for everyone without risking financial imbalance. This is an astonishing result, as the switch (with a financially balanced budget) necessitates a high initial account contribution rate.

Although the individuals have less disposable income available in the first years, the vast majority of the individuals experiences a positive consumption equivalent. This indicates that most individuals are not only better off in the long-run UA system, but also improve their welfare (in terms of consumption equivalents) in the transition period from the traditional UI system to the new account system.

Chapter 5

General Conclusion

In this thesis we have aimed at investigating how employment incentives can be improved by introducing a new mechanism of providing unemployment benefits. We have stressed in particular the role of the underlying tax-transfer system in generating employment incentives, while at the same time maintaining the redistributional characteristics, which transfer income from the lifetime rich to the lifetime poor. In this respect we have focused on the implementation and transition to an unemployment accounts system. We have been able to show the resulting implications for individual savings, consumption and leisure choices over the entire life cycle, as well as during the entire transition period from the current UI system to the new long-run UA system.

We have employed a dynamic optimization model for our analysis and found that introducing individual unemployment accounts in Germany provides a very promising alternative to the current design of unemployment benefits. Our results show that the unemployment account system is very efficient in improving employment incentives. Both, the expectation of receiving a payout upon retirement and lower taxes during times of employment trigger significant changes in the individuals' labour market behavior. (Individuals reduce their optimal leisure choices). Overall, this leads to a much lower unemployment rate for all age cohorts.

Due to our model design employment incentives are particularly improved for the older age cohorts. However, we have shown that it is possible to also stimulate the employment incentives of the young and middle-aged generations, by introducing multiple payout periods (which occur before retirement) without generating costs that are prohibitively high.

A further advantage of the account system is that after its implementation there is a very rapid transition to the long-run. Individuals' behavior, in particular their optimal leisure choices, adjust very quickly to the new system. In turn, the account system is also feasible from a financial perspective without straining the public budget. On the contrary, the government budget is significantly improved. Overall, the tax burden for the individual is significantly reduced, as individuals pay contributions to their individual accounts. This money is not 'lost' but can potentially be received at the end of the working life. Furthermore, due to a reduced unemployment rate, less unemployment benefits need to be financed overall. This in turn reduces the tax rate even further.

Our results show that the current characteristics of the German tax-benefit system suggest that the implementation of a German unemployment account system would rest on a solid foundation. The reason is, that in Germany the intrapersonal redistribution of income is very high. This holds in particular for the unemployment benefits, of which more than half are currently self-financed. Even the lowest income decile reports a remarkably high extent of self-financing.

This is not the case for all transfers. Instead, we have seen that the intrapersonal redistribution of income differs enormously across transfers. This points to further possible variants of the individual accounts system, as it could be applied to other transfers, which also feature a high extent of self-financing. Future research should focus on the feasibility of incorporating those transfers to the individual account system. Furthermore, it may be possible to combine certain transfers in the account system. In this particular case, old-age pensions and unemployment benefits are already linked to some extent. Elaborating on this further should giver more insights on such a possible combination.

With respect to the details of the unemployment account system, future research should be directed at refining the precise characteristics of the design. One major focus should lie on the effect of the payout period on activating employment incentives of the younger generations. In this respect, it will be important to analyze different specifications of the unemployment account model with multiple payouts, which vary in the amount that is paid out, or which for instance individualize the timing of the payout period (instead of fixing this for everyone).

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Eidesstattliche Erklärung

Ich erkläre hiermit an Eides Statt, dass ich meine Doktorarbeit "Unemployment Accounts and Employment Incentives over the Life Cycle" selbstständig und ohne fremde Hilfe angefertigt habe und dass ich alle von anderen Autoren wörtlich übernommenen Stellen, wie auch die sich an die Gedanken anderer Autoren eng anlehnenden Ausführungen meiner Arbeit, besonders gekennzeichnet und die Quellen nach den mir angegebenen Richtlinien zitiert habe.

Zürich, 20. April 2013

(Laura Lontzek, geb. Krische)