Abstract

Unemployment in Austria has been considerably low in the past decades compared to other European countries. Nevertheless, recent increases in the past five years started a controversial discussion about the generous unemployment insurance system in place. The current government, therefore, argues to change the insurance system similar to the German HARTZ IV reform, although the effects on unemployment have proven to be ambiguous in Germany. I introduce a discrete time life-cycle model with endogenous job-search effort to inquire the potential effects of such a reform on long- and short-term unemployment, as well as individuals’ job-search incentives. Individuals are ex-ante heterogeneous in their labour income possibilities and are subject to exogenous layoffs throughout their life. The model suggests that the proposed reform would reduce long-term unemployment substantially, however, to the cost of a larger amount of short-term unemployment spells and decreased overall welfare. Job-search effort over the whole life-cycle appears to increase, with the largest differences at the end of the life-cycle.

Keywords: Life-cycle, unemployment insurance, job-search, effort, unemployment benefits, labour market reform
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1 Introduction

Unemployment in Europe is well known for its persistence, especially over the last five decades, with large peaks during the Great Recession. Contrary to this Austrian unemployment appeared to be low for most of the of the aforementioned time span. Recently, however, Austria experienced unusual rises in the unemployment rate as well (OECD, 2018b). Economists seem to agree nowadays that a combination of institutions and shocks is responsible for the stable and higher levels of unemployment in Europe compared to the United States (Launov and Wälde, 2013). Even though Austria appears to be a special case within Europe, with it is strong connections to Germany on the one hand and nevertheless different unemployment level on the other hand. Following Launov and Wälde (2013), we argue that shocks will endure and the institutional setting should, therefore, be the target of interest.

Similar to the already existing German HARTZ reforms, Austria’s current government, consisting of the Austrian People’s Party (ÖVP) and the Austrian Freedom Party (FPÖ), proposed to decrease unemployment benefit generosity for long-term unemployed individuals. Although it seems to appear simple, that less generous unemployment benefits reduce the overall unemployment in an economy, insurance effects are by far more complex and affect many aspects of individual behaviour, which are worth taking into consideration, when introducing such a far-reaching reform.

This paper, therefore, tries to investigate the effects and mechanisms of a change in the second leg of the tier-two unemployment insurance scheme in Austria. By developing a discrete time life-cycle model with endogenous job-search effort calibrated to the current environment of the Austrian labour market, I aim to explain the effect of changing from a wage-dependent replacement rate to a flat rate, on the outcomes employment, individual job-search intensities and the length of unemployment spells. Additionally, the article will discuss welfare and public expenditure implications of the reform.

The article is structured as follows. Section two provides information about the current institutional setting of the unemployment insurance system in Austria and will provide insight about the proposed reform currently discussed by the Austrian government. Section three will then continue to relate the research question to the relevant literature, which will include both microeconomic evidence as well similar macroeconomic research. The fourth section will then cover basic theoretical concepts of unemployment insurance schemes and potential mechanisms that have to be considered when modelling individuals in an imperfect labour market. Section five builds on the theory part of section four and introduces the reader to the model used in order to inquire the effects of changes in unemployment generosity on job-search effort and employment. A special focus will be put on the dynamic programming approach of the model.
Calibration will be covered in section six of the article. Section seven then continues with the methodological aspect of the dynamic programming approach. Following, section eight will present the simulation results of the reform and their effect on several model outcomes. Section nine adds some discussion on general equilibrium effects, which are not covered in the partial equilibrium analysis of the model at hand. Section ten then completes by summarising the main findings and implications of the research article.

2 Institutional setting

From the 1970s onwards the Austrian economy experienced a steady increase in unemployment currently peaking at around six percent (OECD, 2018b). Even though there has been a recent increase in the unemployment rate, Austria for most of the time showed lower levels of unemployment than most other European countries, which usually show rates well above the unemployment rate of the United States. The unemployment rate, as well as the incentive structure of the Austrian unemployment benefits system, therefore have been a controversially discussed topic during the 2016 campaign for the parliamentary elections. The Austrian People’s Party (ÖVP), a Christian democratic conservative party, introduced the proposition of altering the current unemployment benefits system in order to incentivise job-search and hence reducing unemployment.

The Austrian unemployment system, similar to most OECD countries, consists of both active and passive measures with the aim of reintegrating individuals back into the labour market. Implementation of these measures is undertaken by the Austrian Public Employment Agency (Arbeitsmarktservice-AMS), which provides educational programmes and other active reintegration arrangements on the one hand. On the other hand, the AMS is responsible for assessing eligibility for unemployment benefits and administering the payments of the replacement rates.

Comparable to other industrialised countries, Austria has a tier-two unemployment system in place, consisting of regular unemployment benefits system and an extension programme for long-term unemployed individuals. Individuals who worked for at least 52 weeks in the last two years and contributed to the Austrian Social Security System are eligible for unemployment benefits (Arbeitslosengeld). The usual replacement rate amounts to approximately 55 percent of the annual average net labour income. During the time of unemployment, individuals have to be on active job-search in order to receive unemployment benefits (UB) for up to 20 weeks or up to 30 weeks in case of more than 156 weeks of previous employment. After the expiration of UBs unemployed persons are eligible to apply for unemployment assistance (Notstandshilfe), which gets granted for a maximum of 52 weeks. Although UA is only granted for 52 weeks, it is possible to reapply as many times as needed and therefore it is basically possible to receive
UA until retirement. The replacement rates of UA amount to approximately 95 percent of the previously provided UB and can, in general, be obtained until retirement age. Due to the generosity of the UA individuals with low wages might be strongly disincentivised to increase job-search effort in order to reintegrate into the labour market again, as has been shown by Lalive et al. (2006), Lalive (2007) and Card et al. (2007).

The increasing fraction of unemployed workers, as well as the generosity of the UB system, encouraged conservative politicians to start debating a reform similar to the HARTZ reforms in Germany. The key element of the discussion focussed on the abolishment of the UA. Individuals generally not eligible to UB and UA are entitled to minimum benefits (Mindestsicherung). The generosity of the minimum benefits (MB) varies across the eight federal states, however single persons and parents received on average 844 Euros per month (Bundeskanzleramt, 2018). One additional difference between the UA and the MBs is the treatment of private savings. The UA usually neglects private savings and assets and therefore has no effect on the wealth of individuals. When receiving MBs, assets and savings have to be reduced to approximately 4,200 Euros before being eligible to MBs. The wealth diminishing aspect of the MBs is a crucial part when looking at the incentive structure of benefit systems, nevertheless, this dimension will be neglected in the analysis presented in this paper.

The idea of the conservative party was to cancel the UA and only rely on UB, which would mean that after 30 weeks of unemployment individuals would automatically drop into the MB system. Due to the uniform replacement rates of the MB, individuals with a previously higher average net labour income would probably lose some of their benefits. The next section will now focus on the previous literature on unemployment benefits and their effect on individuals’ behaviour.

3 Literature review

There has been a vast amount of studies with the aim of investigating effects of changes in the UB generosity on hazard rates and unemployment in general. Several microeconomic studies have identified causal effects of UB generosity on time spent in unemployment, mostly using exogenous variation from natural experiments. Some of these studies will be presented in more detail in the following section. Evidence from macroeconomic life-cycle models is rather scarce for Austria, however, life-cycle modelling was used in order to evaluate the effects of the German HARTZ reforms, which are very similar in nature to the proposition currently discussed by the Austrian government. In this section, some evidence from the microeconomic literature on UBs will be presented first and will be followed by relevant macroeconomic studies with endogenous job-search.
3.1 Microeconomic literature

Besides the pioneering theoretical research on UBs and their relation to job-search by McCall (1970), Mortensen (1977) and Mortensen (1986) there is a vast amount of empirical literature available studying the effect of UB generosity on the time spent in unemployment. Katz and Meyer (1990) use maximum likelihood estimation in combination with US register data to identify the effect of benefit duration and replacement rates on the hazard rate of exit and find evidence supporting prolonging effects on unemployment. Card and Levine (2000) evaluated the implications of the New Jersey Extended Benefit Programme and found only marginal effects of increased benefit duration on the unemployment length. Evidence from Germany is provided by Caliendo et al. (2013), who use a sharp regression discontinuity approach in order to find strong effects of extended unemployment duration on the unemployment hazard rates. Research by Carling et al. (1996) suggests that for Sweden disincentivising effects of UBs are rather small, although they show that benefit exhaustion is present. A cut in UBs proved to decrease unemployment lengths in Slovenia significantly and spikes at benefit exhaustion were observed in a study by Van Ours and Vodopivec (2006). Lalive et al. (2006), Card et al. (2007) and Lalive (2008) provide evidence from Austrian Social Security Data, with different estimation methods they exploit natural experiments caused by changes in benefit generosity. Because the results these research articles provide are in particular relevant to the potential research presented here, I want to explain their results more thoroughly in the next paragraphs.

A change of the Austrian Unemployment Insurance Law in the year 1989 was topic of a study conducted by Lalive et al. (2006). They used the exogenous variation of this natural experiment to investigate the effect of a change in the replacement rate and the benefit duration on time spent in unemployment. In order to identify the true causal effect, they estimate a difference-in-difference model with three different control groups. The underlying policy change affected certain age and income groups differently, which enabled them to create three different treatment groups and compare them to an unaffected control group. Specifically, the first treatment group was entitled to longer benefit duration, the second benefited from increased replacement rates and the third treatment group experienced an increase in both replacement rate and benefit duration. The results indicated a stronger effect of an increased benefit duration compared to an increase in the replacement rate, especially for older workers. An increase in benefit duration by a week resulted in a 0.35-day increase for prime-age workers, whereas for older workers (40 and older) the effect was twice as large. Because the predictions from theory hold for their research, with stronger effects for older workers, it seems appropriate to examine this subgroup in more detail.

Additional evidence from Austria was provided by Lalive (2008) who exploited the Regional
Extended Benefit Programme which targeted workers older than 50 years in former steel industry regions. The change in UB duration was relatively large for those entitled individuals. Workers fulfilling all necessary criteria experienced an increase from 39 weeks to 209 weeks of entitlement to UBs. This natural experiment was then used to apply a sharp regression discontinuity design with two different running variables. Age defined the first treatment group, where age 50 was used as cut-off. The second treatment group was created by using distance to the border. This procedure was possible due to a regional limitation of the programme. The estimation results in this study indicate strong increases in unemployment duration for the group of workers with longer UB duration. However, for women, the estimates were larger than for men who are argued to be caused by women’s lower early retirement age. Lalive (2008) argues that due to proximity to early retirement women have even more incentive to exhaust benefits compared to men.

Card et al. (2007) show in a summary of the pre-existing literature, that the way unemployment duration is measured has a crucial impact on the results obtained. They argue that spikes appear to be extremely large when it is measured by duration in registered unemployment. In order to compare potential results from the different policy changes, it is therefore important to remind these measurement differences. Besides their summary of existing literature, they investigate unemployment duration on the Austrian labour market as well. By using a subsample of involuntary job seekers gained from Austrian Social Security Data they find substantial spikes at benefit exhaustion when defining unemployment duration as registered unemployment duration. Hazard rates of re-employment are much smaller in that case and prove the importance of variable definition in such settings.

3.2 Macroeconomic literature

So far most of the microeconomic evidence suggests that longer UB duration, as well as higher replacement rates, would lead to extended unemployment duration and vice versa. Even though the estimates obtained from these studies seem to work very well with economic theory, the effect on unemployment in the economy is not completely unambiguous. In order to get predictions about the behaviour of the unemployed individuals, macroeconomists use life-cycle models calibrated to a specific institutional setting, to investigate how different institutions affect the optimal choice of individuals. In the following paragraphs, evidence from macroeconomic models of job-search will be presented. The main goal of this strand of literature is to explain how differences in unemployment can be explained by taking into account the incentives created by social policy. The advantage of these search models lies in their ability to explain movements of workers from unemployment into employment and vice versa (Rogerson and Shimer 2011).
A large part of this literature in macroeconomic labour economics is built on the 'common shocks - different institutions' hypothesis, which is a potential explanation for differences in unemployment between Europe and the United States (Rogerson and Shimer 2011). The basic concept behind the hypothesis is that Europe and the United States are usually hit by common shocks like new information technologies, increased internationalisation or competition from newly industrialised countries (Ljungqvist and Sargent 1998). Even though these shocks are supposed to be similar in a globalised and interconnected world, their transmission on the economy can vary between economies. This is where the second part of the hypothesis comes into play. Different institutions appear to be a crucial factor in transmitting these common shocks and can explain a large part of the differences in unemployment between Europe and the United States.

Pioneering research in the 'common shocks - different institutions' literature has been conducted by Ljungqvist and Sargent. They investigate the difference between European and US unemployment rates by accounting for so-called common turbulences and different institutional settings between Europe and the US. Ljungqvist and Sargent (1998) argue that these turbulences affect the depreciation of human capital of laid-off workers. Turbulences can be seen as permanent shocks to the economy, resulting in a permanent loss of employment in certain sectors. They argue that these permanent changes in employment affect the depreciation of laid-off workers’ human capital negatively, compared to short-term unemployment spells, where no long-term income decrease is noticed and therefore the human capital loss is rather marginal. The large shocks have in their eyes a stronger and more permanent effect in Europe due to the generous UBs in most European countries (Ljungqvist and Sargent 1998). This is mainly driven by the smaller incentives for individuals to get into employment again, where they would need to accumulate human capital once again. By design of most UB schemes in developed welfare states, unemployed individuals are entitled to generous UBs, which are calculated based on previous employment. According to Ljungqvist and Sargent (1998) this leads to low search intensities and high reservation wages, which makes long-term unemployment spells much more common in Europe compared to the US. Ljungqvist and Sargent test their hypothesis in several follow-up papers, where they alter the underlying model with respect to the heterogeneity of agents, the search or matching mechanism and the transmission of the human capital depreciation.

Compared to Ljungqvist and Sargent (1998), where they use endogenous search effort in combination with a probability distribution of wage offers, Ljungqvist and Sargent (2004) apply a matching model with a Nash-bargaining mechanism. The main finding that high UBs discourage individuals from re-entering the labour market is confirmed again. One additional insight shows that the inflow into unemployment seems to stay constant in this framework, however,
the increase in equilibrium unemployment appears to prolong the duration of unemployment for laid-off workers (Ljungqvist and Sargent 2004).

Even though the research of Ljungqvist and Sargent aims to explain the differences in unemployment rates between Europe and the US, it is highly relevant with respect to the proposed change in the Austrian UB system. If one considers the current Austrian UB system as the generous welfare state and the proposal of the government as the laissez-faire state then it is possible to use a similar framework to investigate expected changes in equilibrium unemployment and the unemployment duration. This strategy has been used in macroeconomic research for the German HARTZ reforms, enforced in the early 2000s. Launov and Wälde (2013) argue that shocks will not be absent in the future and therefore it is necessary to focus on the institutional setting within countries in order to address developments in unemployment. By using a matching model with spell-dependent UBs, they are able to investigate the effect of the HARTZ IV reform on the German unemployment rate and welfare (Launov and Wälde 2013). The main findings include decreased search incentives for low-skilled workers and increased search incentives for medium- and high-skilled workers, which results from the abolishment of wage dependencies of the UA benefits. In their model, the overall unemployment rate just fell marginally, mainly driven by low-skilled workers participating in the labour market again (Launov and Wälde 2013). A negative impact of the HARTZ IV reform was found with respect to average social welfare, again resulting from the heterogeneous effects among different income groups and their entitlement to pre-reform UA (Launov and Wälde 2013).

Studying the effects of the HARTZ reforms with a special focus on increases in the effectiveness of the German public employment agency (PEA), Launov and Wälde (2016) show that the improved matching effectiveness of the PEA had a negative effect on short-term unemployment, due to the strong focus on long-term unemployed individuals and the anticipation of improved treatment when short-term unemployed. By using a Mortensen-Pissarides matching model, ex-ante skill heterogeneous agents and unobserved search productivities, the authors investigate the impact of the HARTZ III and IV reforms on equilibrium unemployment. With their model they show that the impact of the UA reduction, which was part of the HARTZ IV reform, had a small overall effect on unemployment, only explaining 2.1 % of the unemployment decline (Launov and Wälde 2016). On the other hand, the increased matching effectiveness, which resulted from the HARTZ III package, was able to explain 22.5 % of the steady-state unemployment decline. First, Launov and Wälde (2016) argue that the reform had been more effective if the focus on long-term unemployed had been absent and, second, the impact of the benefit reduction only accounted for a small part of the unemployment reduction.

The idea that unemployment insurance systems do not only distort the behaviour of economic agents through the effects of moral hazard and adverse selection is investigated in Acemoglu
Life-cycle job-search model

and Shimer (2000). By using a dynamic infinitely lived agents model with risk-averse individuals they are able to show that unemployment insurance increases labour productivity by encouraging unemployed individuals to apply for higher productivity jobs on the one hand and encouraging firms to create jobs with a higher productivity profile on the other hand (Acemoglu and Shimer, 2000). In their model calibrated to the US labour market, the authors show that more generous unemployment insurance systems lead to slight increases in output and welfare, which results from the willingness of better-insured workers to apply for higher wage jobs (Acemoglu and Shimer, 2000). Due to the higher difficulty of finding a high-productivity job, risk-averse individuals would tend to obtain low-productivity jobs as they mitigate the risk of being unemployed. According to Acemoglu and Shimer (2000), unemployment insurance can increase the effectiveness of the matching process when risk-averse individuals are encouraged to take on higher levels of risk in the job-search process.

The fact that unemployment insurance might increase the efficiency of matches between employees and employers is also part of the investigation in Marimon and Zilibotti (1999). In contrast to Ljungqvist and Sargent (1998), they argue that by improving the safety net of laid-off workers it is possible for them to find jobs which are socially optimal and increase overall welfare (Marimon and Zilibotti, 1999). In their heterogeneous agent model they find substantially longer unemployment spells for individuals entitled to more generous UBs, however, the longer unemployment duration is accompanied by a higher productivity growth. Even though these positive effects of unemployment insurance systems can be shown to be of eminent importance in the discussion, Marimon and Zilibotti (1999) emphasise the trade-off between increased matching efficiencies on the one hand and moral hazard on the other hand. Nevertheless, their research adds important insights in explaining differences between European and US unemployment.

4 Theory

Economic models which try to explain the mechanisms behind perfect and imperfect labour markets with incorporated UB systems are available in a vast amount. In the following section, I will describe the most important theoretical concepts of such benefits according to Boeri and Van Ours (2008) and will then proceed to pay special attention to the incorporation of these microeconomic foundations into the macroeconomic literature on unemployment. In a next step, I will then try to provide the most relevant theoretical predictions of life-cycle models and show how different institutional settings can explain differences in unemployment across countries.

The case where UBs are considered under the circumstances of an imperfect labour market
Life-cycle job-search model predicts that people who are entitled to UBs have less incentive to look for new employment, compared to people who cannot rely on such payments. Due to UBs, entitled individuals have less incentive to actively look for jobs and therefore search less intensively for new employment possibilities. This prediction is based on the increased reservation wage of entitled persons. Higher reservation wages are assumed to make workers more choosy regarding potential job offers and reduce job-search intensity (Boeri and Van Ours, 2008). UBs have other important channels such as the effect on equilibrium wages. Through the Nash-bargaining rule individuals entitled to UBs might demand higher wages now due to increased reservation wages (Boeri and Van Ours, 2008). Another transmission channel works through the lower participation of unemployed workers in the labour market. Some individuals might not even consider working at all if the non-labour income is higher than their reservation wage. This would lead to a general reduction in labour supply and should be considered when talking about the generosity of UBs.

Usually, UBs have two main dimensions of generosity, the amount of the actual replacement rate and the UB duration. In the case of the proposed reform, the duration of the UB and UA is in general negligible, because there is no change to the UB generosity planned. For the UA, the duration is not considerably important within this analysis either, because both UA and MBs can basically be received until retirement age. Therefore, the dimension of most importance for the analysis is the amount of the replacement rate, which is proposed to change from a proportional rate (in case of the UA) to a fixed rate (in case of the MBs).

In order to assess the effects of the proposed reform to the Austrian UB system, it is necessary however to build a model, which is able to capture the decision-making of individuals. One of the first frameworks developed to model the dynamics of job-search and UBs is presented in McCall (1970). In this partial equilibrium model individuals, each period draw wage offers from the same wage distribution and have then the option to either refuse or accept the offer. In case of accepting the worker will receive the previously agreed upon wage until the end of his working life. Should the individual decide to refuse the wage offer, he only receives unemployment compensation and is going to draw a new offer in the next period. It is straightforward that the optimal strategy within this framework depends on a certain reservation wage. If the offer drawn from the wage distribution lies above the reservation wage, the individual will decide to work again, otherwise, he will stay unemployed. Ljungqvist and Sargent (2012) show that the level of the reservation wage and the level of the UBs indirectly imply a certain search cost which increases with a higher reservation wage and decreases with more generous replacement rates.
5 Model

So far economic theory and microeconomic evidence suggest that by decreasing generosity of a UB system individuals should get faster into employment. This results from an increased job-search effort and lower wage claims when getting a job offer (Boeri and Van Ours 2008). However, the effects of the proposed reform in Austria are ambiguous due to the fact that the current UA is dependent on previous wages and the MB is not. Similar to the ambiguity of the HARTZ reform in Germany investigated in Launov and Wälde (2013) the proposal would affect high-income earners differently compared to low-income earners.

In order to get insight into potential effects of the proposed reform, it is necessary to show predictions of individuals’ behaviour resulting from a change in the generosity of the UB system. I, therefore, develop a discrete time life cycle model to evaluate the incentive change of the proposed reform. A discrete time life cycle model populated by prime-age workers between the age 25 and 55 should be used to investigate the behaviour of unemployed workers in presence of a certain unemployment insurance system. By virtue of different incentives, the model does not capture educational decisions and therefore model age zero corresponds to age 25. Similar reasoning applies to the end of the life cycle where usually retirement decisions impede the analysis of such reforms, accordingly the last period in the model corresponds to age 55. One model period represents half a year of life of each individual. This is necessary in order to capture the duration of the different benefit schemes. It is assumed that individuals ex-ante only differ with respect to the wage group they find themselves in. Ex-post heterogeneity results from stochastic employment and unemployment shocks throughout the individuals’ lives.

Individuals in the model have the following sequence of preferences regarding consumption (c), labour supply (h) and job-search effort (e):

\[ U = \sum_{t=0}^{61} \beta^t \cdot \left[ \ln(c_t) - \alpha h_t - e_t \right] \] (1)

Utility is assumed to be separable and consistent with balanced growth, which is why the \( \ln(c) \) specification was chosen. Here \( \beta \) represents the discount factor and \( \alpha \) is the disutility weight of labour. Labour supply enters discretely, meaning that the individual either works full time or not at all \( h_t \in [0, \frac{1}{3}] \). Full-time employment is set to one-third to mirror the standard eight-hour working days in Austria. Job-search effort enters the utility function negatively because searching for jobs is costly for individuals. However, with increasing effort the individual’s probability of finding a job increases and therefore the probability is given as a function of search effort:

\[ p_t(e_t) = 1 - e^{-\theta e_t} \] (2)
Following Hopenhayn and Nicolini (1997), \( p_t \) is an increasing, strictly concave and twice differentiable function of job-search effort. This setup guarantees on the one hand that individuals are to a certain extent reluctant in putting too much effort on job-search due to the disutility arising from search effort and on the other hand that their incentive of searching increases the probability of getting into employment. The functional form of the above equation guarantees a value between zero and one which converges to one when \( e_t \) tends towards positive infinity. The parameter theta represents the job-finding rate of the economy. Additionally, individuals need to take into account a sequence of budget constraints given by:

\[
ct + k_{t+1} = (1 + r)k_t + wt \cdot ht + B_t
\]  

(3)

Depending on the employment or unemployment status the individual is in, he or she maximises utility with respect to consumption (c), capital (k) and labour supply taking into account wage (w) and the benefit replacement rate (B) he receives. In order to guarantee young individuals have to work even for low wages, a no-borrowing constraint \( k_t \geq 0 \) is set. An unemployed worker is short-term unemployed if \( 0 < s \leq \bar{s} \) and long-term unemployed when \( s > \bar{s} \), where \( \bar{s} \) represents the duration of entitlement to UBs and \( s \) is the time the individual has spent in unemployment so far. Due to the tier-two UB system currently in place in Austria unemployment insurance takes the following form:

\[
B_t(s) = \begin{cases} 
B_{UB}^t = \frac{1}{2} \sum_{j=1}^{2} w_{t-j} \cdot \varepsilon_{UB} & \text{for } 0 < s \leq \bar{s} \\
B_{UA}^t = \frac{1}{2} \sum_{j=2}^{3} w_{t-j} \cdot \varepsilon_{UA} & \text{for } s > \bar{s} \\
B_{MB}^t = \text{constant} 
\end{cases}
\]  

(4)

To follow the Austrian UB system \( B_{UB}^t > B_{UA}^t \), because the replacement rates for UB and UA are \( \varepsilon_{UB} \) and \( \varepsilon_{UA} \) respectively with \( \varepsilon_{UB} > \varepsilon_{UA} \). Due to the semi-annual model periods the UB replacement rate depends on the average wage of the two model periods, \( (t - 2) \) and \( (t - 1) \), before becoming short-term unemployed. This guarantees that the model reflects the institutional setting of the current insurance system in place. Similar reasoning applies to the UA replacement rate, which also depends on labour income before entering unemployment. When an individual is long-term unemployed the UA therefore depends on the average wage of period \( (t - 3) \) and \( (t - 2) \). The third case where the individual only receives \( B_{MB}^t \) only affects individuals, which have not been in employment at all and therefore are not entitled to UB and UA, therefore \( \bar{s} = 0 \). It is important to note that the MBs are currently not part of the unemployment insurance scheme, but rather a safety net for individuals who are not eligible for unemployment insurance.

After the model is adjusted to the proposed reform of the unemployment insurance system,
life-cycle job-search model

$B_{t}^{UA}$ will not be dependent on the previous wage anymore but instead be replaced by the $B_{t}^{MB}$ which have a fixed amount equal for all recipients. The change in the unemployment system can be summarised as shown below:

$$B_{t}(s) = \begin{cases} B_{t}^{UB} = \frac{1}{2} \sum_{j=1}^{2} w_{t-j} \cdot \varepsilon_{UB} & \text{for } 0 < s \leq \bar{s} \\ B_{t}^{MB} = \text{constant} \end{cases}$$

(5)

Similar to the pre-reform system MBs will be granted to individuals who are not eligible to UBs ($\bar{s} = 0$), due to their lack of previous employment. Individuals who are long-term unemployed cannot receive UA anymore, but instead will receive the fixed MBs. Therefore once an individual’s entitlement to UBs expires ($s > \bar{s}$) and he continues to be without employment, he receives the MBs.

Within the model the individual can be in four distinct states. Individuals can be employed and therefore receiving a certain wage, but also facing exogenous lay-off with probability $\lambda$. Individuals can be short-term unemployed, with eligibility to UBs. Long-term unemployed individuals are however only entitled to UA. In case an individual has not yet contributed to the unemployment insurance system he receives MBs, which are not dependent on previous wages. In all periods the individual additionally has to decide on consumption and savings. This setup can be recursively formulated by the following value functions with capital ($k$) as the state variable.

- Individual is not entitled to UA or UB:

$$V_{t}^{MB}(k_{t}) = \max_{c_{t}, e_{t}, k_{t}, k_{t+1}} \left\{ u(c_{t}, 0, e_{t}) + \beta \left[ p(e_{t}) V_{t+1}^{emp} + (1 - p(e_{t})) V_{t+1}^{MB} \right] \right\}$$

s. t. $c_{t} + k_{t} + 1 = (1 + r) k_{t} + B_{t}^{MB}$

(6)

The individual has no previous labour income and therefore has not contributed to the unemployment insurance system, therefore he is not eligible for UB and UA. Individuals at the beginning can only choose how much to consume, save and what amount of effort they want to put into job-search.

- Individual is employed:

$$V_{t}^{emp}(k_{t}) = \max_{c_{t}, k_{t}, k_{t+1}} \left\{ u(c_{t}, 1, 0) + \beta \left[ \lambda V_{t+1}^{sump} + (1 - \lambda) V_{t+1}^{emp} \right] \right\}$$

s. t. $c_{t} + k_{t} + 1 = (1 + r) k_{t} + w_{t} h_{t}$

(7)

An employed individual maximises his utility with respect to savings and consumption. With probability $\lambda$ he will lose his job and ends up in short-term unemployment in the
next period. With probability \((1 - \lambda)\) he will keep on working in the same job in the next period.

- Individual is short-term unemployed:

\[
V_{t}^{\text{sump}}(k_t) = \max_{c_t, k_{t+1}, e_t} \left\{ u(c_t, 0, e_t) + \beta \left[ p(e_t)V_{t+1}^{\text{emp}} + (1 - p(e_t))V_{t+1}^{\text{lump}} \right] \right\} \\
\text{s. t. } c_t + k_{t+1} = (1 + r)k_t + B_{t}^{\text{UB}}
\]  

(8)

In case of short-term unemployment the individual chooses search effort, consumption and savings and receives UB for this period. With probability \(p(e_t)\) he finds employment for the next period and with \([1 - p(e_t)]\) he ends up in long-term unemployment. If the individual finds employment he has to take the job-offer. This reflects the fact that individuals in unemployment usually have to take offers, because otherwise their benefits are subject to a reduction.

- Individual is long-term unemployed:

\[
V_{t}^{\text{lump}}(k_t) = \max_{c_t, k_{t+1}, e_t} \left\{ u(c_t, 0, e_t) + \beta \left[ p(e_t)V_{t+1}^{\text{emp}} + (1 - p(e_t))V_{t+1}^{\text{lump}} \right] \right\} \\
\text{s. t. } c_t + k_{t+1} = (1 + r)k_t + B_{t}^{\text{UA}}
\]  

(9)

Long-term unemployed individuals face the same decisions as short-term unemployed individuals, however they only receive UA until they enter employment again.

In order to show potential effects of a change in unemployment insurance generosity, the model will, first, capture the current setting of the Austrian unemployment insurance system. In a second step, the calibration of the model will be altered to represent the unemployment insurance system as proposed by the conservative party. The change will only affect the UA replacement rates, which will not be dependent on previous wages after the reform, but rather have a fixed amount equivalent to the MBs.

### 6 Calibration

This section will cover the assignment of the relevant model parameters. The model will be calibrated to match the Austrian labour market with special regards to the current unemployment insurance system.

It is important to note that the model period is set to half a year, which implies that the individual faces 61 decision periods over the life-cycle. Model period zero corresponds to age 25. The individual enters the model with zero assets and without previous employment history,
implying that he commences in the MB state, where he will maximise utility with respect to consumption, effort and assets in the next period. Individuals before their 25th year of life usually find themselves in a variety of different stages, for example, education, traineeships and others. For this reason, it is assumed that the individuals start their working life unemployed, only eligible to MBs. One reason this assumption is required results from the difficulty of modelling educational decisions mostly present before age 25. These decision-making processes are interesting by themselves, however, they are not within the scope of this paper. The annual interest rate is set to 1 % reflecting the low-interest rate environment in the Eurozone. With this annual interest rate, $\beta$ will be set accordingly to 0.995. Due to the discrete choice of labour supply individuals in the model spend approximately one-third of their time at work which is in line with the common eight-hour working day of full-time workers in Austria. The mean annual disposable income in Austria in the year 2015 was 26.058 Euros (OECD, 2018c). The proportional semi-annual value is then taken as a baseline and set to unity. Individuals in the high wage group then earn 120 % of the mean disposable income and individuals in the low wage group earn 80 % of the mean disposable income in case they get into employment. MBs represent around 36 % of the mean disposable income in Austria in 2015. The two different wage groups then guarantee differences in the incentive structure when changing the UA from a wage-dependent rate to a fixed amount.

Table 1: Calibrated parameter values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate</td>
<td>$r$</td>
<td>0.00499</td>
<td>-</td>
</tr>
<tr>
<td>Discount factor</td>
<td>$\beta$</td>
<td>0.995</td>
<td>-</td>
</tr>
<tr>
<td>Disutility of labour</td>
<td>$\alpha$</td>
<td>1.35</td>
<td>Employment rate of 0.83 in data</td>
</tr>
<tr>
<td>Layoff rate</td>
<td>$\lambda$</td>
<td>0.0253</td>
<td>Job-to-jobless seperation rate estimate</td>
</tr>
<tr>
<td>Job-finding rate</td>
<td>$\theta$</td>
<td>0.6385</td>
<td>Monthly job-finding rate of 0.1561</td>
</tr>
</tbody>
</table>

The preference parameter $\alpha$ dictating the disutility of labour is set to 1.35. This value assures to match the average employment rate from 2000 to 2016 observed in the data and is therefore calibrated to an 83 % employment rate in the pre-reform setting (OECD, 2018a). The exogenous layoff probability $\lambda$ entering the employment value function was set in accordance to OECD (2010), where the annual separation rate from job-to-jobless is calculated to be 5 %. This leads in fact to a semi-annual separation rate of approximately 2.53 %. The function determining the probability of reentering employment is most importantly defined by the job-finding rate $\theta$. Hobijn and Sahin (2009) were able to estimate the monthly job-finding rate for a variety of OECD countries. For the sample period from 1994 to 2003 the respective monthly job-finding
rate for Austria is estimated to be 15.61% corresponding to a semi-annual job-finding rate of 63.85% (Hobijn and Şahin, 2009). Table 1 gives an overview about selected parameter values in the model.

7 Methodology

Once the model is calibrated to the pre-reform conditions of the Austrian labour market, it is possible to recursively find the optimal choices of consumption, search effort and assets for the next period. In order to use backwards recursion to solve the model, it is necessary to state certain final assumptions about each distinct state the individual could end the life-cycle. Given that the main focus of this paper covers the effects of changes in incentives for unemployed individuals on their job-search behaviour, the final assumptions for all states will not include any retirement or bequest decisions. The final assumptions for the four states will then look as follows:

\[
V_{MB}^{T+1} = V_{emp}^{T+1} = V_{sump}^{T+1} = V_{lump}^{T+1} = 0
\]  

Equation 10 above basically states that the individual will consume all of his assets before he leaves working-life. This assumption is crucial in order to solve the model by backwards recursion in this finite period case. After defining the final values of the Bellman equation the procedure continues by iterating backwards through each employment state in every model period. At each time period, the individual then chooses optimal consumption, assets in the next period and effort, given each possible value of assets he entered the period and given the already known values of the future value functions received by previous iteration steps. After the algorithm iterated backwards through all 61 model periods we obtain all optimal combinations of effort, consumption and assets in the next period for every possible value of assets we could enter in the respective period of interest. The final assumption, therefore, enabled us to compute all optimal solutions for each model period and every initial asset the individual enters the model.

As the backward recursion equipped us with the optimal solutions for each period, each state and each initial asset value, the next step is to simulate the model forwards. It is assumed that the individual starts working life without any assets and is only entitled to MBs. His optimisation problem is therefore given by equation 6, presented in the model section of the paper. Because the employment status in the next period is determined by probabilities, which are dependent on the job-search effort chosen in the period before, there is not a unique solution to the model, which in fact makes it a stochastic dynamic programming problem. In this paper, the probability of finding a job \( p(e_t) \) and the exogenous lay-off probability \( \lambda \) determine which
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employment status the individual will have in the next period. In order to iterate forwards, it is, therefore, necessary to compare the chosen probabilities with a random number in the interval zero to one, drawn from a uniform distribution. If the probability of finding a job is larger than the randomly drawn number the individual will be employed in the next period and vice versa. Similar reasoning applies to the situation when the individual is already in employment if the random number drawn is smaller than the exogenous lay-off rate the individual will find himself in the short-term unemployment state. With this procedure, it is possible to find the optimal values of consumption, effort, labour supply and assets over the whole life-cycle.

Due to the stochastic nature of the model, there is not a unique solution for the life-cycle employment path the individual will take. If one would simulate the model several times the choices of assets, consumption and effort would differ. In order to receive stable values for each variable in each time period, it is therefore necessary to simulate the individuals life-cycle choices a number of times. After several thousand simulations the mean of each variable for each time period is taken. The law of large numbers hereby guarantees that the mean of each time period converges towards the true value. The model is able to introduce a certain amount of wage heterogeneity by following the above procedure, first, for individuals earning 80 % of the mean disposable income and, second, for individuals earning 120 % of the mean disposable income. For each, the low and the high wage group, the model is solved recursively and then simulated forwards 50,000 times. After the procedure was applied with the current setting of the unemployment insurance system, the same model will be used to simulate the individual’s behaviour after abolishing the UA and replacing it with the MBs. The effects of this proposed reform are going to be explained in detail in the next section of the paper.

8 Results

Let us now consider the results of the simulation described in the previous section. In a first step, we will discuss the pre-reform incentives created by the current unemployment insurance system with the UA still in place. There, a special focus will be directed to the incentives the unemployment insurance system creates for individuals on the job-search. In particular, how intensively they attempt to get back into employment given the rather generous benefits from UBs and UA. In a second step, we then change the model parameters according to the proposed setting, where the UA is substituted with the MBs and therefore not dependent on previous wages anymore. The pre- and post-reform changes to the key model variables will then be compared. As the main idea behind the proposed reform of the unemployment insurance system is to incentivise individuals to reenter the labour market and tackle the unusually high unemployment rates of the past years, the model should be used to improve the discussion
about predicted implications of the reform. By comparing pre- and post-reform outcomes, with a special focus on job-search intensity, it will be possible to look at potential developments of individuals’ behavioural responses to a change in unemployment insurance generosity.

8.1 Pre-reform outcomes

The pre-reform unemployment insurance system is characterised by wage dependent replacement rates when receiving UA. UA amounts to approximately 52.25 % of previous annual net labour income. It is assumed that the individual commences working life without previous assets only eligible for MBs due to the missing previous social insurance contributions. The first periods of the life-cycle are therefore defined by choosing optimal effort and consumption in order to get into employment. Figure 1 illustrates the development of assets, income, consumption and utility over the life cycle in the pre-reform state. The values for the high (red) and low (green) wage individuals are model period averages of 50.000 simulations of the same individual in each group. The only difference between the two groups is the wage they receive when employed. The blue line depicts the respective average of high and low wage individuals. This setup is used in all future graphs unless otherwise specified by the respective legends or in the text.

Under the current setting, the individuals’ optimal employment path would lead from the MBs directly into employment in order to start accumulating assets. The lower left panel of figure 1 shows that the individuals’ optimal consumption steadily increases in the beginning and then stabilises until model period 35. The low and high wage groups behave similarly most of the time, even though high-income individuals are able to reach higher consumption and asset levels. The fact that the first few model periods illustrate a sharp increase in consumption, income and utility results from the stochastic nature of the job-finding function. It is very likely that the individual, even with considerably large effort input, does not immediately get into employment and therefore relies on MBs for the first model periods, which in fact lowers the aforementioned choice variables.

After approximately five periods, however, the individual finds employment and earns the exogenously given wages. From there onwards, individuals smooth consumption and steadily accumulate assets on average. Low wage individuals stop their saving pattern earlier compared to the high wage individuals. It is noticeable that individuals are able to slightly increase consumption even though their income is rather stable in the meantime. Small declines in consumption should be attributed to potential unemployment spells during working life. Additionally, the individuals will start decreasing the previously saved assets around period 30 in order to elevate the consumption level, which in fact increases utility until the end of the
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life-cycle. The difference between low and high wage individuals is mostly visible when looking at the development of assets and consumption, where they indeed behave slightly differently. Regarding income and utility, there is only a level effect noticeable.

Figure 1: Pre-reform outcome developments

Figure 2 graphically explains the development of the effort input variable and the corresponding life-cycle employment. As can be seen, the individuals choose relatively large effort levels only at the beginning of working life, where they are only eligible for MBs. This pattern holds for all wage groups, however, high wage individuals show a larger willingness to search for jobs, which is in line with theory, as their benefit from finding employment is relatively larger compared to low wage individuals. The effort input then sharply decreases as employment becomes more likely. From model period six onwards the average individual in more than 90% of the cases will find himself in employment, which implies that effort at the same time drops to zero.
The modest effort input during the same time has to be attributed to short unemployment spells, resulting from unexpected lay-offs. From model age 40 onwards the employment rate starts to drop consistently in all wage groups. Instead of increasing job-search effort during the same time, individuals will lower their effort input with increasing age. This is the result of the UB and UA system, where individuals after a certain age are not incentivised to actively look for jobs anymore due to small future discounted returns from working, which is in line with empirical findings from Hairault et al. (2006).

8.2 Effects on assets, income, consumption and utility

In order to look now at the effects of the proposed reform, the model is altered with respect to the UA replacement rate which is changed from 52.25 % of the previous wage income to only 36 % of the mean disposable income. Before the reform high and low wage individuals, both received 52.25 % of their previous wages as UA. In the post-reform setting, both groups are only eligible for the same replacement rate, which amounts to 36 % of the mean disposable income and is exactly the same for every individual in the model. The wage reduction for low wage individuals is, therefore, lower compared to individuals with high wages. Earlier it was explained that the MBs are characterised by the fixed amount of the replacement rate, this is guaranteed by relating the MBs to the mean disposable income in Austria in the year 2015 (OECD 2018c).

After decreasing the generosity of the unemployment benefit system especially for long-term unemployed individuals the model will then provide information about the predicted behaviour of individuals over the life-cycle. To compare the changes of the key model variables from the pre-reform unemployment system to the post-reform scenario figure 3 shows the differences
of pre-reform to post-reform outcome variables for average individuals, high and low wage individuals.

Figure 3: Differences in outcomes pre- and post-reform

In the first couple of periods of the individuals’ working life, it is clearly visible that there is almost no difference in asset accumulation, income and consumption, which results from the similar insurance structure at the beginning of the life-cycle. Individuals, pre- and post-reform, start by only being eligible for MBs and have therefore the same income and incentives to look for employment. Until model period 15, there is only a slight difference between pre- and post-reform consumption and income. With increasing age, however, this difference becomes larger. Income is over the whole life-cycle larger for individuals’ in the post-reform setting compared to the pre-reform counterpart, this pattern holds for all wage groups. It seems to be a logical response of the post-reform individuals, considering the higher risk of income loss.
in cases of long-term unemployment. The large difference in income between period 40 and
the end of the life-cycle can be attributed to a different saving behaviour of individuals under
the two unemployment insurance schemes. The higher income in the post-reform environment
translates in the beginning into higher consumption levels between period 20 and 35, which turns
afterwards, again due to larger individual savings in the pre-reform state. The development
of consumption is strongly in line with the development of utility over the life-cycle, where
bigger differences in consumption translate into larger differences in utility. The post-reform
unemployment insurance system elevates the risk of income losses during longer unemployment
spells, individuals in the post-reform state do not increase their savings, which is not in line with
predictions of the buffer stock savings literature as described for example in [Carroll (1997)]. This
can be explained on the one hand by higher consumption levels in the post-reform environment.
The risk-aversion of individuals in the economy does however not correspond with their savings
behaviour. [Rothschild and Stiglitz (1971)] argue that risk-averse individuals should have a
higher willingness to save due to increased risk of income losses. As individuals in the model
are assumed to be risk-averse the decreased saving is not in line with the model specification.

8.3 Effort input changes and employment effects

The result of the decreased generosity of unemployment insurance is now illustrated with the
change in employment rates. Figure 4 graphically presents the different developments of em-
ployment under the pre-reform environment and the post-reform environment. The left panel
of the graph depicts the development of average employment over the life-cycle and the right
panel adds the corresponding differences in employment for low, high and average individuals
from the pre- to the post-reform state. The model clearly predicts an increase in employment
between model period 5 and the end of the life-cycle. At the beginning of working life, dif-
ferences in employment are only marginal, as individuals in both states have only access to
MBs. With increasing time employment in the post-reform environment increases, as unem-
ployment is less attractive due to lower replacement rates. On average this difference amounts
to approximately 7.5 percentage points, indicating a 90 % employment rate in the post-reform
state compared to the 83 % target in the pre-reform state. Especially at the end of working
life, the less generous unemployment insurance system incentivises higher employment rates.
This is in line with the findings of [Hairault et al. (2006)] who show that early retirement and
retirement options, as well as generous replacement rates for unemployed individuals strongly
disincentivise reentering the labour market at later ages. The right panel of figure 4 offers the
possibility to look at the differences in employment in the different wage groups. One strik-
ing finding is the large difference at the beginning of the life-cycle for low wage individuals.
In the post-reform state, those individuals show a significant difference in employment compared to their pre-reform counterparts, which is mainly driven by their larger incentive to start accumulating assets early in their working life.

**Figure 4: Employment pre- and post-reform**

![Employment pre- and post-reform](image)

Additional to employment the main objective of this paper is to investigate the effort individuals’ put into job-search. The changes in the employment rate over the life-cycle already indicate that individuals have an increased interest in staying in employment, as well as leaving unemployment faster in the post-reform environment. This incentive structure is further confirmed when looking at the different effort inputs in the two unemployment insurance schemes depicted in figure 5. Similar to before the beginning of the life-cycle does not show significantly large differences in effort input. However, beginning with model period 37 individuals in the post-reform state elevate their effort input in order to reenter the labour market in case of unemployment. In line with the smaller asset profile discussed earlier, the post-reform environment forces individuals to stay in employment and out of unemployment in order to smooth their consumption, which makes it necessary for them to look for jobs more intensively. The right panel of figure 5 offers even more detailed insights regarding the differences in effort between pre- and post-reform individuals. Over the whole life-cycle individuals in the high wage group show larger differences in effort inputs. Due to the fixed amount of the UA in the post-reform case, high wage individuals lose a larger fraction of their income in case of long-term unemployment compared to their low wage counterparts. Consequently, their incentive to stay out of long-term unemployment elevates and directly translates into the larger effort inputs in the post-reform era.

The opposite reasoning applies to low wage individuals who are relatively better off with the non-wage dependent UA in the post-reform scenario. Relative to high wage individuals long-
term unemployment is more attractive to them, which indicates smaller differences in effort input between the pre- and post-reform state. This prediction would, therefore, favour a change of the current UA system for a less generous unemployment insurance system when aiming for higher employment rates and larger job-search intensities. The consistently larger effort input in the post-reform state proves individuals’ stronger incentives for leaving unemployment, even though the average difference between the pre- and post-reform effort inputs appear to be small at first. However, with closer examination, this proves wrong because especially for low levels of effort input the increase in the job-finding probability is rather substantial.

Figure 5: Effort input pre- and post-reform

In a next step, we are going to look at the changes in the length of unemployment spells. Due to the abolishment of the UA and replacement with MBs, changes in the duration of unemployment are expected. It has already been argued, that effort in the post-reform environment increased especially at the end of the life-cycle and in particular for high wage individuals. Figure 6 confirms the effectiveness of the reform on tackling long-term unemployment and incentivising job-search. In line with predictions, the big upper panel of figure 6 indicates a slight increase in short-term unemployment especially in the end of the life-cycle. This is in fact not surprising, because, first, the generosity of UBs has not changed compared to the pre-reform state, but is now relatively more attractive for the low wage group. Second, as employment increased in the post-reform economy a larger fraction of individuals will get laid off each period and will then try to find employment again, to avoid long-term unemployment. If one compares figure 4 and the upper panel 6 it is easily visible that the largest differences in employment coincide with the periods, where employment pre- and post-reform starts to drift apart. The previously mentioned hypothesis is further confirmed when looking at the development of short-term unemployment for high wage individuals (lower left panel) in comparison
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to the low wage group (lower right panel). It appears to be true that individuals with high wages are more affected by short-term unemployment, due to larger employment rates and the lower disincentive of short-term unemployment relative to long-term unemployment. Low wage individuals on the opposite avoid short-term unemployment to a larger extent in comparison to their high wage counterparts. Nevertheless, the combination of larger employment and the increased attractiveness of short-term compared to long-term unemployment in the post-reform state explain the, on average, larger fraction of short-term unemployed individuals in the post-reform environment.

Figure 6: Short-term unemployment pre- and post-reform

Turning to figure 7 where the fraction of long-term unemployed individuals over the life-cycle is illustrated, one recognises a contrary development compared to the development of short-term unemployment. The reduction in benefits consistently decreases the fraction of individuals in long-term unemployment over the whole life-cycle. On average long-term unemployment dropped by around 7.5 percentage points from around 12% in the pre-reform
state to approximately 4 % in the post-reform state. Again, the largest differences in all wage groups are recognised at the end of the life-cycle, where individuals through early retirement and other retirement decisions have stronger incentives to stay out of the labour market. The lower long-term unemployment share is further driven by the strong avoidance behaviour of high wage individuals, who are most negatively affected by the change in the unemployment insurance scheme. Low wage individuals show avoidance behaviour as well, however not to the same extent as the difference in wage dependent UA and the fixed post-reform UA is relatively smaller compared to high wage individuals. This model outcome is in line with observations from the German HARTZ reforms, where especially medium- and high-income individuals were affected by the benefit reduction (Launov and Wälde, 2013).

Figure 7: Long-term unemployment pre- and post-reform

8.4 Welfare effects

The previously presented results indicate substantial effects on long-term unemployment and employment, as well as small effects on short-term unemployment and effort. In order to relate
these results to changes in overall welfare from the pre-reform to the post-reform state, this subsection will make use of a concept named sum of discounted lifetime utilities. This approach allows comparing the different discounted lifetime utilities of the pre-reform to the ones in the post-reform case. By comparing the changes in discounted lifetime utilities it is possible to gain insights into the changes in welfare for all individuals and different subpopulations, like the different wage groups.

<table>
<thead>
<tr>
<th></th>
<th>Δ utility units</th>
<th>Δ percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low wage</td>
<td>-0.4084</td>
<td>-1.01 %</td>
</tr>
<tr>
<td>High wage</td>
<td>-0.8945</td>
<td>-4.48 %</td>
</tr>
<tr>
<td>Average</td>
<td>-0.6515</td>
<td>-2.15 %</td>
</tr>
</tbody>
</table>

In table 2 the changes in the sums of discounted lifetime utilities are presented. The differences are calculated by subtracting the pre-reform values from their respective post-reform values. The first column shows the difference in welfare between the post- and pre-reform state measured in discounted lifetime utility units. The second column depicts the corresponding percentage changes resulting from the reform. In line with economic theory and previous literature on the welfare effects of the HARTZ reform, analysed in [Launov and Wälde (2013)], the largest change in welfare has to be attributed to the high wage group. The high wage group overall loses approximately 4.5 % in discounted lifetime utility. High wage individuals recognize the largest increase in effort input and employment, which both are utility decreasing. Even though their consumption increases substantially in the post-reform case it cannot fully compensate for the utility losses resulting from the larger effort input and the increased labour supply. For low wage individuals, this effect appears to be rather marginal. Discounted lifetime utility only falls by 1 % for this subgroup. The drop in welfare for the low wage group has similar reasons compared to the high wage group, however, due to smaller changes in effort from the pre- to the post-reform environment and an overall lower employment rate, the magnitude of the welfare decrease is smaller. For average individuals, the reduction in discounted lifetime utility amounts to around 2 %.

In total, the changes in welfare appear to be small compared to the substantial effects on employment, even though they should be considered carefully when thinking about a cut in unemployment insurance generosity. Nevertheless, it is positive to observe that especially individuals in the low wage group are less affected by the reform. This could be an important step in order to curb income inequality. One aspect which has not yet been considered is the changed governmental expenditure. If the reform proves to decrease governmental expenditure
these welfare losses could be neutralised by reallocating available public funds or decreasing the tax burden in the economy.

8.5 Governmental expenditure

Due to the change from a wage-dependent second leg of the unemployment insurance to a flat replacement rate, it is expected that governmental expenditure will change as well. Therefore table 3 offers insight into the effects of the reform on the replacement rate payments the unemployment insurance system guarantees. The values in table 3 are calculated by taking the difference between the pre- and the post-reform discounted replacement rate payments, where negative values indicate larger expenses in the post-reform state. It is important to note that the long-term unemployment row in table 3 refers to the difference in payments for long-term unemployed individuals between the pre- and post-reform case. This includes the pre-reform UA payments and the post-reform MB payments for long-term unemployed individuals only. The row depicting the MB expenditures for the different wage groups only refers to individuals who have not been employed before and are therefore not entitled to UB or UA.

<table>
<thead>
<tr>
<th></th>
<th>Δ Low wage</th>
<th>Δ High wage</th>
<th>Δ Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum benefits</td>
<td>-165.02</td>
<td>-54.01</td>
<td>-109.52</td>
</tr>
<tr>
<td>Short-term</td>
<td>-1,475.57</td>
<td>-3,096.86</td>
<td>-2,286.22</td>
</tr>
<tr>
<td>Long-term</td>
<td>72,827.67</td>
<td>155,145.09</td>
<td>113,986.38</td>
</tr>
<tr>
<td>Overall</td>
<td>71,187.08</td>
<td>151,994.22</td>
<td>111,590.65</td>
</tr>
</tbody>
</table>

Note: Column sums do not fully add up, due to rounding issues.

The expenditure for MBs increases slightly for all wage groups. Even though employment and effort are larger in the post-reform case and should, therefore, imply decreased MB payments the expenditure comparison suggests differently. One explanation for this phenomenon could be that certain individuals stay in the MB scheme longer compared to the pre-reform case and therefore contribute to the slightly higher MB payments in the post-reform case. The increased UB payments in the post-reform environment are in line with the development of short-term unemployment, which increases for all wage groups after the reform. On average expenditure for UBs increases by approximately 8%. Especially the high wage group increases the expenditure for UBs, as their incentive to stay in short-term unemployment is relatively larger compared to the low wage group. The contrary pattern is observed for individuals in long-term unemployment, where the reduction in payments is strongest for high wage individ-
uals due to their strong disincentive for long-term unemployment. The expenditure changes for long-term unemployed individuals are substantial, with an average decrease in payments of approximately 76%. Overall the reform would reduce public expenditure for the whole unemployment insurance system by approximately 51% according to the model. The strongest changes are again found among the high wage group, enabling to argue for an income equalising effect of the reform. Even though the reduction in expenditure is in line with theory and previous literature, the magnitude of the expenditure drop should be seen with healthy scepticism.

To summarise, the reform of the unemployment insurance system could have strong incentivising effects for individuals in unemployment and could potentially increase the employment rate. On the one hand, long-term unemployment and public expenditure might be reduced by introducing a system similar to the German HARTZ IV scheme. On the other hand, increases in the fraction of short-term unemployed individuals and a slight decrease in welfare are observed. Nevertheless, it is important to note that the predictions presented here, represent a simplified model version of the Austrian economy, which does not account for general equilibrium effects. The general tendencies, however, might be helpful for policy-makers in order to design efficient and target-oriented insurance schemes, to foster higher employment rates.

9 Discussion

This section will discuss shortcomings of the models resulting from the partial equilibrium approach taken. In order to analyse these potential deficits, the model economy will be put into a general equilibrium perspective, which should further help to understand various aspects of unemployment insurance not previously presented in the results section.

There are several channels and parts of the economy which are affected by a change in the unemployment insurance system, which have not been discussed in the partial equilibrium analysis provided in previous sections. So far, this article only focused on the decision making process and incentive structure of individuals in unemployment or employment. However, there are several aspects such as taxation, firm behaviour and job market competition which have not yet been taken into consideration when talking about a labour market with governmentally provided unemployment insurance. It is easily visible for the reader, that all matters of funding the public expenditure on unemployment insurance have been neglected in this paper, due to the focus on individuals' incentives. Nevertheless, the funding of publicly provided unemployment insurance will have effects not only on individuals’ behaviour but on other economic actors as well. Assuming that the reform will decrease public expenditure on the unemployment insurance system as predicted by the model, the question arises how to proceed with those newly
available funds. One way to deal with the additional funds would be to lower taxes on labour income, which in fact could lead to even higher employment rates and increased production in the economy. Distortionary effects resulting from labour taxation might encourage individuals who previously stayed out of the labour market completely, to join the workforce again. This would in total increase the labour supply in the economy providing firms with a larger share of potential workers, which could decrease equilibrium wages through a larger competition for jobs and increased wage bargaining power for firms. Diamond (1982) argues that decreasing unemployment insurance generosity could affect the Nash-bargaining solutions in the wage-setting process in favour of firms, which in fact would then lower the wage-share in the economy.

Additional to the effects on individuals’ job-search behaviour, firms will alter their activity in the labour market. Mitman and Rabinovich (2015) argue that lower benefits encourage firms to create more job vacancies. They argue that general equilibrium effects increase the responsiveness of unemployment to unemployment insurance. Lower benefits in their model decrease the outside options of workers and encourage firms to post a larger amount of vacancies (Mitman and Rabinovich, 2015).

Other aspects the partial equilibrium model neglects are fiscal externalities resulting from behavioural responses affecting the take up of social insurance programmes as discussed in Chetty and Finkelstein (2013). Interactions between different governmental insurance programmes such as disability insurance and unemployment insurance have crucial implications for the effectiveness of reforms such as the one currently discussed in Austria. Individuals who get laid-off for example might decide to drop out of the labour market completely by applying for disability insurance. Chetty and Finkelstein (2013), therefore, argue that an ideal analysis should incorporate social insurance and tax policies altogether in order to account for interactions between those programmes.

The general equilibrium effects discussed in this chapter might affect various aspects of the economy and therefore could jeopardise the external validity of the results presented in this article. I tried to address some of the aspects which might interfere with the unemployment insurance reform, however, there are certainly other channels through which a change in unemployment insurance generosity affects an economy.

10 Conclusion

The effect of unemployment insurance on individuals behaviour, especially on the length of unemployment spells is a well-researched area within several branches of economics. This project commenced by investigating potential effects of a currently discussed reform plan of the Austrian government. The aim of the reform is to tackle recently high levels of unemployment in
Austria and incentivising individuals to actively search for employment on the one hand and trying to keep them in employment on the other hand. The paper uses a macroeconomic framework to inquire the mechanisms and effects of a change in the unemployment insurance system on the behaviour of Austrian labour market participants. In order to understand the changes in job-search intensity, a macroeconomic model of the Austrian labour market with endogenous search effort was developed. By modelling the current labour market situation in Austria it was possible to investigate how a decrease in the generosity of the tier-two unemployment insurance system affects the behaviour of individuals in different employment states. Through backwards recursion of four distinct Bellman equations, it was possible to find optimal solutions for individuals’ labour market decisions. Even though this model does not fully account for general equilibrium effects and interactions with different parts of the labour market, the heterogeneity in wages and the endogeneity of job-search effort offered insight in the dynamics of labour market choices of individuals.

The main findings of the paper suggest that the decrease in generosity together with the change from a wage-dependent replacement rate to a fixed rate increases employment substantially. The various channels through which the unemployment insurance influences the employment rate is best understood by looking at the effects on individuals’ consumption, savings and job-search decisions after the reform was introduced in the model. Individuals at the beginning of the working life do not change their job-search effort, however especially at the end of the life-cycle effort input seems to increase due to the lower attractiveness of the UA. Heterogenous effects for low and high wage workers indicate stronger disincentives for the latter. In a next step, the differences in long- and short-term unemployment were analysed. The disincentivising effect of the reduction in the UA leg of the unemployment insurance system appeared to increase short-term unemployment for both low and high wage workers. However, this downside came hand in hand with a higher employment rate, which might increase the number of job-losses per period. Long-term unemployment, on the other hand, shows an opposing development in the post-reform state. On average individuals avoid long unemployment spells due to the now declined generosity of the UA. Similar to the development of the short-term unemployment fraction, long-term unemployment shows heterogeneous developments for the high and low wage groups as well. Due to the relatively larger loss in generosity for the high wage group, resulting from the abolishment of the wage dependency, this groups’ fraction of long-term unemployed individuals drops substantially over the whole life-cycle, with the largest differences at the end of working life. Consistently the reaction of low wage individuals to the reform is noticeably smaller when looking at the fraction of long-term unemployed individuals. The reform appears to have small welfare-reducing effects when looking at the sum of discounted lifetime utilities for the different wage groups, where high wage earners are affected.
Life-cycle job-search model

strongest. Public expenditure on unemployment insurance could be reduced substantially by
decreasing benefit generosity. Especially the disincentive to fall into long-term unemployment
drives the lower public expenditure in the post-reform case.

It appears important to point out, that there are several ways to extend the presented work
in the future. In order to increase the level of heterogeneity, the analysis would benefit from
different skill groups, which would enable investigating the effects on human capital as has been
done by Ljungqvist and Sargent (1998). Although a broad literature on unemployment and
labour market matching has been presented, such a mechanism could clarify and show that
a certain level of unemployment, combined with an unemployment insurance system might
be beneficial for better employer-employee matches, especially regarding workers productivity
(Acemoglu and Shimer 2000). Additionally, a more realistic incorporation of the supply and
demand dynamics of imperfect labour markets could shed light on the interaction of unemploy-
ment insurance and the wage setting process.

Finally, it can be concluded that the reform would have a substantial effect on long-term
unemployment, short-term unemployment and the overall employment rate in the economy.
Increases in short unemployment spells are expected on the one hand, as well as a decrease
in long-term unemployment on the other hand. Elevated levels of job-search effort especially
for older workers appear to be very likely and have already been confirmed in studies of other
geographical labour markets such as Hairault et al. (2006). The magnitude of the overall
effects is ambiguous when considering only parts of a dynamic economy. However, the insights
gained from this paper might help to understand possible implications of a reduction in benefit
generosity, which previously appeared unclear.
Appendix

In order to guarantee replicability of the above-presented results, the appendix contains the Matlab code used in order to simulate the life-cycle job-search model. The first part of the code only contains the backward recursion and forward simulation part of the main results. The job-finding function is defined in the second part of the Matlab code. The code used to produce the graphs presented earlier will not be provided here. However, after obtaining the main result variables from the first part it is straightforward producing these graphs, by using the simulated results in combination with the explanations in the previous sections. Please note, that the backwards recursion and simulation part has to be run four times in total. Once for each wage group in the pre-reform unemployment insurance setting and once for each wage group in the post-reform setting.

```matlab
% Begin backwarc recursion and simulation file
clear
clc

% Parameters
effbar = 10; % maximum effort equal to maximum working time
effbar = 10; % maximum effort equal to maximum working time
effbar = 10; % maximum effort equal to maximum working time
effbar = 10; % maximum effort equal to maximum working time
effbar = 10; % maximum effort equal to maximum working time
zeta = 0.2; % percentage above or below mean disposable income
alphaw = 1.35; % disutility from work matching employment rate
r = 0.00499; % interest rate semiannual
beta = (1/(1+r)); % discount factor semiannual
eps_ub = 0.55; % replacement rate UB
eps_usa = 0.95*eps_ub; % replacement rate UA pre-reform (change to MB)
lambda = 0.0253; % exogenous layoff probability semiannual
wage = (1+zeta)*1; % high wage (change for low wage)
Bmb = 0.36*1; % Minimum benefits
effgridint = 0.1; % effort grid fineness
agridint = 0.1; % asset grid fineness
T = 110; % age last period
t0 = 50; % age first period
ps = T - t0 + 1; % number of overall periods

% Asset grid
abar = 30; % upper bound for assets
agrid = (0:agridint:abar)'; % asset grid in agridint steps
na = length(agrid); % longest dimension of agrid
```
\textbf{Life-cycle job-search model}

\%Labour supply grid
lgrid = [0; 1/3]; \%labour supply either 0 or 1/3

\%Unemployment benefits
Bu= (0.5*2*wage)*eps_ub; \%Unemployment benefits
Bu= (0.5*2*wage)*eps_un; \%Unemployment assistance (change post-reform)

\%Effort grid
effgrid=(0:effgridint:effbar)'; \%effort grid in effgridint steps
ne=length(effgrid);

\%Defining end states
VpMB=zeros(na,1);
VpMBnew=zeros(na,1);
IndexMB=zeros(na,1);
VpEmp=zeros(na,1);
VpEmpnew=zeros(na,1);
IndexEmp=zeros(na,1);
VpSump=zeros(na,1);
VpSumpnew=zeros(na,1);
IndexSump=zeros(na,1);
VpLump=zeros(na,1);
VpLumpnew=zeros(na,1);

tic

\%Backwards induction
for t=T:-1:t0
  for i1=1:na \% given assets
    incmb= Bmb + (1+r)*agrid(i1,1); \% should depend on assets (index i1)
    for j1=1:na \%loop for consumption
      conmb=max(incmb - agrid(j1,1),0);
      for j2=1:ne \%loop for effort
        v(j1,j2)=log(conmb)-effgrid(j2,1)\ldots
        + beta*(1-jobfinding(effgrid(j2,1)))*VpMB(j1,1)\ldots
        + beta*jobfinding(effgrid(j2,1))*VpEmp(j1,1);
      end
    end
  end
end
Life-cycle job-search model

\[ v = v(\cdot); \]
\[ [VpMB_{\text{new}}(i1, 1), \text{IndexMB}(i1, 1)] = \max(v, [], 1); \]
\%Employment
\[ x = \text{ones}(na, 1); \]
\[ \text{incemp} = \text{wage} + (1+r) * \text{agrid}(i1, 1); \]
\textbf{for} j1 = 1:na \%loop for consumption
\[ \text{conemp} = \max(\text{incemp} - \text{agrid}(j1, 1), 0); \]
\[ x(j1) = \log(\text{conemp}) - \text{alphaw} \times \text{grid}(2, 1) \ldots \]
\[ + \beta_a \times (1 - \lambda) \times \text{VpEmp}(j1, 1) \ldots \]
\[ + \beta_a \times (\lambda) \times \text{VpSump}(j1, 1); \]
\textbf{end}
\[ x = x(:); \]
\[ [VpEmp_{\text{new}}(i1, 1), \text{IndexEmp}(i1, 1)] = \max(x, [], 1); \]
\%Short-term unemployment
\[ y = \text{ones}(na, 1); \]
\[ \text{incsump} = \text{Bub} + (1+r) * \text{agrid}(i1, 1); \]
\textbf{for} j1 = 1:na \%loop for consumption
\[ \text{consump} = \max(\text{incsump} - \text{agrid}(j1, 1), 0); \]
\textbf{for} j2 = 1:ne \%loop for effort
\[ y(j1, j2) = \log(\text{consump}) - \text{effgrid}(j2, 1) \ldots \]
\[ + \beta_a \times \text{jobfinding( effgrid(j2, 1))} \times \text{VpEmp}(j1, 1) \ldots \]
\[ + \beta_a \times (1 - \text{jobfinding( effgrid(j2, 1))}) \times \text{VpLump}(j1, 1); \]
\textbf{end}
\textbf{end}
\[ y = y(:); \]
\[ [VpSump_{\text{new}}(i1, 1), \text{IndexSump}(i1, 1)] = \max(y, [], 1); \]
\%Long-term unemployment
\[ z = \text{ones}(na, 1); \]
\[ \text{inclump} = \text{Bua} + (1+r) * \text{agrid}(i1, 1); \]
\textbf{for} j1 = 1:na \%loop for consumption
\[ \text{conlump} = \max(\text{inclump} - \text{agrid}(j1, 1), 0); \]
\textbf{for} j2 = 1:ne \%loop for effort
\[ z(j1, j2) = \log(\text{conlump}) - \text{effgrid}(j2, 1) \ldots \]
\[ + \beta_a \times \text{jobfinding( effgrid(j2, 1))} \times \text{VpEmp}(j1, 1) \ldots \]
\[ + \beta_a \times (1 - \text{jobfinding( effgrid(j2, 1))}) \times \text{VpLump}(j1, 1); \]
\textbf{end}
\textbf{end}
\[ z = z(:); \]
\[ [VpLump_{\text{new}}(i1, 1), \text{IndexLump}(i1, 1)] = \max(z, [], 1); \]
\textbf{end}
\%Minimum benefits
\[ \text{VpMB} = \text{VpMB_{\text{new}}}; \]
\[ \text{inMB} = \text{genvarname('IxMB', who)}; \]
eval( [inMB ' =IndexMB; ' ] );
%Employment
VpEmp = VpEmpnew;
inEmp = genvarname( 'IxEmp', who );
eval( [inEmp ' =IndexEmp; ' ] );
%Short−term unemployment
VpSump = VpSumpnew;
inSump = genvarname( 'IxSump', who );
eval( [inSump ' =IndexSump; ' ] );
%Long−term unemployment
VpLump = VpLumpnew;
inLump = genvarname( 'IxLump', who );
eval( [inLump ' =IndexLump; ' ] );
end

IxMB0 = IxMB;
IxEmp0 = IxEmp;
IxSump0 = IxSump;
IxLump0 = IxLump;

clear IxMB IxEmp IxSump IxLump maxInd maxInde maxIndex . . .
effIxLump effIxSump effIxMB

%Simulation forwards
rng( 'default' )
SM = 50000;
inas = 1;
ass = zeros( T− t0 + 2, 1 );
con = zeros( T− t0 + 1, 1 );
hrs = zeros( T− t0 + 1, 1 );
inc = zeros( T− t0 + 1, 1 );
util = zeros( T− t0 + 1, 1 );
eff = zeros( T− t0 + 1, 1 );

Simulation loop
Over all SM individuals
for indsim = 1:SM
inas = 1;
jobprobmb = zeros( T− t0 + 2, indsim );
jobprobemp = ones(T-t0+2, indsim);
jobprobsump = ones(T-t0+2, indsim);
indmb = zeros(1, 1);

% For all time periods
for t = 1:T-t0+1
    transpmb = rand;

    % MB state
    if indmb(1) == 0 && jobprobmb(t, indsim) <= transpmb:
        is = ['IxMB' int2str(T-t0+1-t)];
        index = eval(is);
        index = index(inas, 1);
        eindex = ceil(index/na);
        inas = index - (eindex - 1)*na;
        eff(t, indsim) = effgrid(eindex, 1);
        jobprobmb(t+1, indsim) = jobfinding(eff(t, indsim));
        ass(t+1, indsim) = agrid(inas, 1);
        inc(t, indsim) = Bmb;
        con(t, indsim) = max(inc(t, indsim) + (1+r)*ass(t, indsim)...
                             - ass(t+1, indsim), 0);
        utl(t, indsim) = log(con(t, indsim) - eff(t, indsim));
        status(t, indsim) = 0;
        emp(t, indsim) = 1;
    else
        indmb(1) = 1;
        transpemp = rand;

        % Employment state
        if jobprobemp(t, indsim) >= transpemp:
            is = ['IxEmp' int2str(T-t0+1-t)];
            index = eval(is);
            index = index(inas, 1);
            eindex = ceil(index/na);
            inas = index - (eindex - 1)*na;
            jobprobemp(t+1, indsim) = (1-lambda);
            hrs(t, indsim) = lgrid(2, 1);
            ass(t+1, indsim) = agrid(inas, 1);
            inc(t, indsim) = wage*lgrid(2, 1)/lgrid(2, 1);
            con(t, indsim) = max(inc(t, indsim) + (1+r)*ass(t, indsim)...
                                  - ass(t+1, indsim), 0);
            utl(t, indsim) = log(con(t, indsim) - alphaw*hrs(t, indsim));
            status(t, indsim) = 1;
            emp(t, indsim) = 1;
        else
            transpsump = rand;
%Sump state

if jobprobsump(t, indsim) >= transpsump;
    is = ['IxSump' int2str(T-t0+1-t)];
    index = eval(is);
    index = index(inas, 1);
    eindex = ceil(index/na);
    inas = index - (eindex - 1)*na;
    eff(t, indsim) = effgrid(eindex, 1);
    jobprobemp(t+1, indsim) = jobfinding(eff(t, indsim));
    jobprobsump(t+1, indsim) = 0;
    ass(t+1, indsim) = agrid(inas, 1);
    inc(t, indsim) = Bub;
    con(t, indsim) = max(inc(t, indsim) + (1+r)*ass(t, indsim)...
                          - ass(t+1, indsim), 0);
    utl(t, indsim) = log(con(t, indsim)) - eff(t, indsim);
    status(t, indsim) = 2;
    emp(t, indsim) = 0;
else

%Lump state

is = ['IxLump' int2str(T-t0+1-t)];
index = eval(is);
index = index(inas, 1);
 eindex = ceil(index/na);
in as = index - (eindex - 1)*na;
 eff(t, indsim) = effgrid(eindex, 1);
 jobprobemp(t+1, indsim) = jobfinding(eff(t, indsim));
 jobprobsump(t+1, indsim) = 0;
 ass(t+1, indsim) = agrid(inas, 1);
 inc(t, indsim) = Bua;
 con(t, indsim) = max(inc(t, indsim) + (1+r)*ass(t, indsim)...
                       - ass(t+1, indsim), 0);
 utl(t, indsim) = log(con(t, indsim)) - eff(t, indsim);
 status(t, indsim) = 3;
 emp(t, indsim) = 0;
end
end
end
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%End of backward recursion and simulation file%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
function \( p = \text{jobfinding}(\text{effgrid}) \)
theta = 0.6385;
\( p = 1 - \exp(-\theta \cdot \text{effgrid}) \);
end

function [p]= jobfinding ( effgrid )
theta = 0.6385;
p=1-exp(-theta*effgrid);
end
Life-cycle job-search model

References


