Unemployment Accounts

Ofer Setty*
Tel Aviv University

February 9, 2011

Abstract

Unemployment Accounts (UA) are mandatory individual saving accounts that can be used by governments as an alternative to the Unemployment Insurance (UI) system. The goal of this paper is to study the welfare implications of a shift from the current UI system to a new UA system in the United States. The UA system works as follows. During employment, the worker is mandated to make deposits into the individual saving account. The worker is entitled to withdraw payments from this account only during unemployment. In contrast, UI is funded by a payroll tax and provides benefits for a limited duration. I build an heterogeneous agents, incomplete-markets life-cycle model, in which workers face income fluctuations and unemployment shocks. UI is modeled as a choice of a replacement rate, and a time limit of unemployment benefits. UA is modeled as a choice of a deposit rate into the account during employment and a withdrawal rate during unemployment. Qualitatively, a shift from UI to UA can lead to either a welfare gain or a welfare loss depending on the role of frictions and incentives in the model. This observation puts the paper at the nexus of the macroeconomic debate on the level of disutility from work. Quantitatively, for a plausible parameterization the shift from UI to UA leads to an average welfare gain of 0.9% of lifetime consumption.

JEL Classification: E24; E61; J64; J65

Keywords: Disutility from work; Job-search; Mechanism Design; Moral hazard; Optimal Policy; Unemployment Accounts; Unemployment Insurance

*This paper served as my job market paper. I am grateful to my advisor and mentor Gianluca Violante. The two other members of the dissertation committee, Gian Luca Clementi and Lars Ljungqvist have given me excellent advise and support. The paper benefits from suggestions given by Marina Agranov, Chris Flinn, Greg Kaplan, Iris Kashman, Virgiliu Midrigan, Ariell Reshef, Thomas Sargent, Chloe Tergiman, Chris Tonetti, Roine Vestman, Michael Waugh, and participants at the NYU Stern Macro lunch seminar. All remaining errors are mine.

1 Introduction

Unemployment Accounts (UA) are mandatory individual saving accounts that can be used by governments as an alternative to the Unemployment Insurance (UI) system.

The goal of this paper is to study the welfare implications of a shift from the current UI system to a new UA system in the United States. The importance of such a study is reflected even in the pre-crisis 2007 statistics: state UI programs paid $32 billion in unemployment benefits to 7.6 million unemployed workers[1]. As noted by Feldstein (2005), these policies are particularly important because of their impact on macroeconomic performance. Using a calibrated structural model, I provide a quantitative analysis of both the average and the distributional welfare effects of a shift from UI to UA.

UA work as follows. During employment, the worker is mandated to save a fraction of her labor income in an individual saving account. The worker is entitled to withdraw payments as a fraction of her last earnings (a "replacement rate") from this account only during unemployment. At retirement the residual balance is transferred to the worker. A system of UA was implemented in Chile in 2002 and it is debated whether such a system should be implemented in the United States and in other countries, e.g., Feldstein (2005), Orszag and Snower (2002), and Sehnbruch (2004)[2].

Figure 1 shows a graphic representation of the UA system for a worker who starts off employed, becomes unemployed and remains unemployed indefinitely. The bottom panel of the figure shows the balance of the unemployment account. The balance is zero at the starting point, increases gradually during employment and then declines gradually during unemployment. Once the balance is exhausted the account remains at its lower bound of 0. The top panel of Figure 1 shows the withdrawals and transfers associated with the unemployment system for that worker. During employment the worker pays her mandated

[1] U.S. Department of Labor (2008). "Unemployment Insurance Data Summary," available at: http://www.ows.doleta.gov/unemploy/content/data.asp. Accessed on October 27, 2009.

[2] Sehnbruch (2004) reports that advisors from the Chilean Ministry of Labor have travelled to several other countries in Latin America to present the UA as a "success story".

contribution to the unemployment account. Upon unemployment, the worker withdraws payments from the account at a pre-specified rate until the account is exhausted. From that point onwards the worker receives Social Assistance benefits.

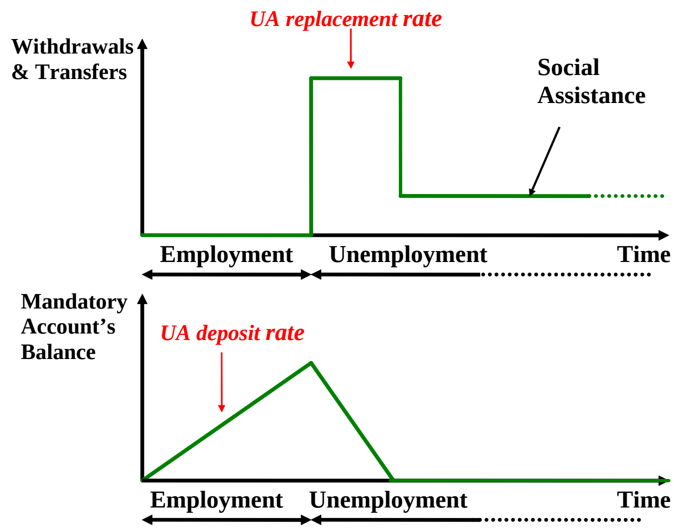


Fig. 1. The UA system. In this example the worker starts off employed. During employment, the worker is mandated to save in the mandatory account (bottom panel). Upon unemployment, the worker withdraws payments from the account at a pre-specified rate (top panel). When the account is exhausted the worker receives only Social Assistance benefits.

In contrast to the UA system, UI is funded by a payroll tax and benefits are a replacement rate for a limited duration. Figure 2 shows a graphic representation of the UI system for the same worker examined above. During employment, the worker pays an unemployment tax. Upon unemployment, the worker receives benefits proportional to her last earnings, for the duration of UI benefits. Once the time limit of benefits is reached, the worker receives Social Assistance benefits. Note that while the maximum duration of benefits in UI is fixed, the duration of withdrawals in UA depends on the balance of the unemployment account at the beginning of the unemployment spell. This duration can be longer or shorter than the time limit of UI benefits. In other words, in UA it is the fixed replacement rate and the initial balance, rather than a fixed time limit, that determines the duration of payments.

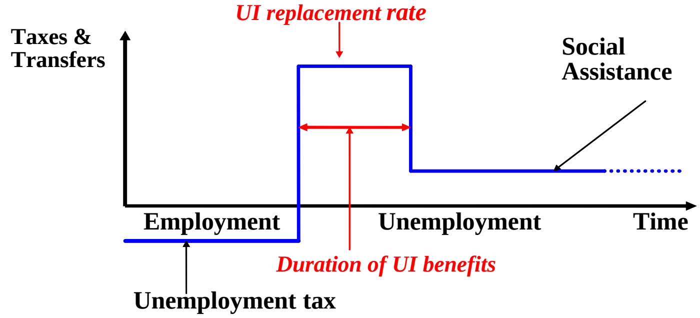


Fig. 2. The UI system. In this example the worker faces the same employment and unemployment spells as in the UA system (Fig. 1). During employment the worker pays an unemployment tax. Upon unemployment, the worker receives a replacement rate for the duration of UI benefits. When the worker reaches the time limit of UI benefits, she receives Social Assistance benefits indefinitely.

Thus, the main difference between the two systems is the source of funding payments during unemployment: in UI payments are funded by a common fund, whereas in UA payments are funded by the worker's own resources. At the same time, the two systems share two common principles: unemployment payments are provided for a limited duration and payments are indexed to past earnings.

In order to study the welfare effects of a shift from UI to UA, I build an heterogeneous agents, incomplete-markets life-cycle model, in which workers face income fluctuations and unemployment shocks. Workers in the model differ along several key dimensions including age, unemployment risk, income and wealth. Unemployment in the model is driven both by exogenous factors (layoffs for employed workers and search frictions for unemployed workers) and endogenous decisions (job quits for employed workers and job-offer rejections for unemployed workers).

The government can implement either a UI or a UA system. The UI policy is modeled as a choice of a replacement rate, and a time limit of unemployment benefits. The UA policy is modeled as a choice of a deposit rate into the account during employment and a withdrawal rate during unemployment. Workers who exhaust their unemployment payments in either policy regime (they reached the time limit in UI and they have a zero balance in UA) receive Social Assistance indefinitely.

Given the unemployment policy, workers allocate their resources optimally between consumption and savings. In addition, workers with employment opportunities choose between employment and unemployment. The government takes into account these endogenous decisions when designing the parameters of the unemployment system in order to maximize the welfare of the workers.

Under the UI system, labor supply decisions are distorted by the presence of unemployment benefits, which increases the value of being unemployed, and by the payroll tax required to finance unemployment benefits, which decreases the value of being employed. The main advantage of UA is that it alleviates this incentive problem.

On the other hand, the insurance provided by the UA policy may not be enough for two types of workers. The first is young workers who start off with no mandatory savings. Upon unemployment, these workers would exhaust their mandatory account quickly and will only receive Social Assistance benefits. The second type of workers who are under insured in the UA regime is workers with consecutive unemployment spells. Such workers might not be able to replenish the mandatory account during the employment interval between the unemployment spell. Thus, they will find themselves with no unemployment payments in the upcoming unemployment spells. In contrast, such workers in UI would be equally insured for each unemployment spell. The under insurance of these two groups of workers is especially important for poor workers who have limited ability to smooth their consumption during unemployment.

These two opposite effects of UA, the improved incentives and the reduced insurance, imply that the question of whether unemployment is "voluntary" is closely linked to the welfare implications of a shift from UI to UA. If workers choose to be unemployed, then UA can improve average ex-ante welfare by increasing the employment level and decreasing the labor tax. If, however, workers are involuntarily unemployed due to exogenous frictions, such as the absence of job-offers, then the UI system is preferred and the shift to the UA leads to a welfare loss, which is especially high for workers who enter the labor force with little wealth.

This observation puts the paper at the nexus of two important debates. The first debate refers to the level of disutility from work. This value is central in the determination of whether unemployment is mostly involuntary as assumed, for example, by Kitao, Ljungqvist, and Sargent (2008) and Ljungqvist and Sargent (2008), or mostly voluntary as assumed, for example, by Rogerson and Wallenius (2007) and Prescott, Rogerson, and Wallenius (2009)[3]. The second debate refers to the value of leisure or non-market activity. This debate, which is found in the search-matching literature, is complementary to the one on disutility from work as it examines the benefit of being unemployed instead of the disutility from being employed. Various values are used for this parameter in the literature: Shimer (2005a) uses a low level for this parameter, Hall (2009) uses an intermediate value, and Hagedorn and Manovskii (2008) use a value that is almost as high as the productivity of employment. In this literature a high value is needed to generate large business cycle fluctuations of unemployment and vacancies. This parameter is also key for the "frictional wage dispersion" in Hornstein, Krusell, and Violante (2009), where a low value of leisure is needed to match the data on the frictional difference between the average and the minimum wage.

I contribute to these debates by connecting my model with the extensive literature that studies the effect of variations in the UI policy on some observable moments. By matching the elasticity of average unemployment duration with respect to changes in UI benefits, I provide a convincing point estimate for disutility from work.

Using this estimate I show that the shift from UI to UA leads to an average ex-ante welfare gain of 0.9% of lifetime consumption. This shift makes workers in all quintiles of initial assets better off. Young workers, however, are worse off because they have low balances of mandatory accounts.

[3]See Ljungqvist and Sargent (2007) for important implications of the level of disutility from work for the sensitivity of employment decisions to changes in the unemployment policy.

To put this welfare change in context, it is useful to use the model of UI as a laboratory for two additional questions. First, what is the average ex-ante welfare gain from fine tuning the instruments of the current UI system? This question can be assessed well within my model because the model has very close ties with the actual UI policy in the sense that the key instruments in the two policies (the actual UI policy and the UI in the model) are the same. I show that setting the UI instruments in the model at their optimal level, leads to only a modest welfare increase of 0.3% of lifetime consumption.

Second, what is the value of insuring workers against unemployment? To answer this question I compare the welfare of workers in the UI system with the optimal choice of instruments to the welfare of workers in a system without an unemployment policy. In this exercise, the government still operates other activities such as Social Security and Social Assistance. I show that the welfare gain from insuring workers against unemployment shocks, compared with no unemployment system, is about 0.5%. Hansen and Imrohoroglu (1992) show that the absence of an unemployment insurance system reduces welfare by 1%. My finding is somewhat consistent with this result because Hansen and Imrohoroglu (1992) do not include Social Assistance in their model.

These two last findings on the value of fine-tuning the UI policy (0.3% of lifetime consumption) and on the value of the optimal UI policy (0.5%) suggest that the importance of the welfare gain associated with a shift from UI to UA (0.9%) is sizeable in the context of labor market policy reform.

Related literature

This paper relates to several branches of literature. An extensive body of literature studies the design of optimal unemployment insurance policies. These papers use recursive contracts to formulate a parsimonious relationship between the principal (the government) and the agent (the worker) that is based on the whole labor history of the worker. The seminal paper by Hopenhayn and Nicolini (1997) shows that in the optimal contract, benefits should decline during unemployment, and the labor tax upon re-employment should increase. These two mechanisms guarantee that it is worthwhile for the worker to exert a high job-search effort level during unemployment, because the outcome of employment is at least as good for her as the outcome of unemployment[4].

The recursive contracts setting is the appropriate framework for characterizing optimal contracts. One technical limitation of this framework, however, is that in this model workers are not allowed to save. For the analysis of UA, allowing workers to save is very important because savings determine the self-insurance level of workers in the economy. The literature has established that the addition of savings has important implications for the UI policy (e.g., Shimer and Werning (2008), Kocherlakota (2004)). In addition, the importance of long term contracts reduces significantly when savings are allowed (e.g., Hansen and Imrohoroglu (1992) and Abdulkadiroglu, Kuruscu, and Sahin (2002)). Another important advantage of short-term contracts is that they are relatively easy to implement. Indeed, the design of policies in my paper is closely linked to the actual unemployment systems in the real world. Nevertheless, I am still able to adopt the main insights of the optimal unemployment insurance literature.

The literature on UA systems is relatively new and consists mainly of models with 2-3 periods that compare the two systems and capture qualitatively the difference in employment incentives between the two. Orszag and Snower (2002) use a two period model that compares a UI system with no savings to a UA system. The authors show that UA decreases unemployment because the tax level is lower and because workers use their own resources to finance payments during unemployment.

Feldstein and Altman (1998) perform an interesting accounting exercise based on the PSID data. They show that a reasonable saving rate of 4% of labor income is sufficient for financing the unemployment benefits of the vast majority of workers, leading to negative

[4] Other selected contributors to this literature are Wang and Williamson (2002) and Pavoni (2007) who shows that if the government is committed to a minimum welfare level for the workers, then the optimal contract is quite close to the actual one. A sub-branch of optimal contracts literature consists of papers that examine simultaneously more than one policy towards unemployment. Pavoni and Violante (2007), Setty (2009) and Pavoni, Setty, and Violante (2009) study a variety of Welfare-to-Work programs. These are a mix of government expenditures on various labor market policies targeted to the unemployed.

balances of only 5% of workers at retirement, death or upon exiting the panel. In addition, they show that the cost of forgiving the negative balances (which is the only usage of the unemployment tax) is roughly half of the cost of the unemployment insurance system.

2 The model

This section has six parts. First, I describe the economic environment of the model. This environment is invariant to the government's activities including the unemployment system. Second, I introduce the government and explain in detail the unemployment policies (UI and UA), the Social Assistance policy and the Social Security policy. Third, I present the worker's optimization problems under each unemployment policy. In these problems, workers take the unemployment system and its parameters as given and maximize their utility. Fourth, I define the stationary recursive competitive equilibrium for the economy. Fifth, I describe the optimal unemployment policy for each system as the choice of the system's instruments over the relevant policy space that maximizes workers' welfare. The sixth and last subsection describes the economic forces at work in the model.

The model is rich in especially two aspects. First, workers are heterogeneous in several dimensions including age, unemployment risk, wealth and income. This richness is important for analyzing the welfare gain or loss of various demographic groups. Second, the model includes a detailed productivity process and realistic government transfers including Social Security and Social Assistance. These details are important for matching the net resources that workers have over the life-cycle and across various states.

2.1 The economy

2.1.1 Demographics

The model is in discrete time. The economy is stationary, i.e., there are no aggregate shocks. Workers are born at date 1, and live up to T periods. Throughout the life-cycle workers face an age-dependent unconditional survival rate Φ_t.

The life-cycle $[1, T]$ is split into two periods. During age $[1, T_R - 1]$ workers are in the labor force and can be either employed or unemployed. I abstract from labor-force entry and exit considerations since unemployment payments are conditional on being attached to the labor force. During age $[T_R, T]$ workers are retired. I refer to the time span $[1, T_R - 1]$ as the *working age,* and to the time span of $[T_R, T]$ as the *retirement age.*

2.1.2 Preferences

Workers' period utility is $u(c) - Bq$ where c is consumption, B is disutility from work and q is an employment indicator that equals 1 if the worker is employed and 0 if the worker is unemployed or retired. Workers discount the future at rate β. Therefore, workers maximize:

$$U = E_0 \left\{ \sum_{t=1}^{T} \Phi_t \beta^{t-1} \left[u(c_t) - Bq_t \right] \right\}$$

where:

$$q_t = \begin{cases} 1 & if\ employed\ at\ time\ t \\ 0 & otherwise \end{cases}$$

2.1.3 Labor market and timing

Figure 3 shows the labor market structure and the timing of the model for employed and unemployed workers[5]. An employed worker is laid off with probability ψ_t that depends on her age t. If the worker is laid off, then she becomes unemployed with an unemployment duration of 1 period. A worker that is not laid off does not necessarily continue to be employed. Instead, such a worker decides whether to retain or to quit the job. If the

[5]The model does not include a choice of intensive margin mainly for simplicity. Note that UI in most states in the US does not cover part-time workers. See National Employment Law Project (2009): The Unemployment Insurance Modernization Act: Filling the Gaps in the Unemployment Safety Net While Stimulating the Economy. Available at http://www.nelp.org/page/-/UI /uima.fact.sheet.jan.09.pdf?nocdn=1. Accessed September 1, 2009.

worker retains her job, then she remains employed. If the worker quits her job, then she becomes unemployed with an unemployment duration of 1 period.

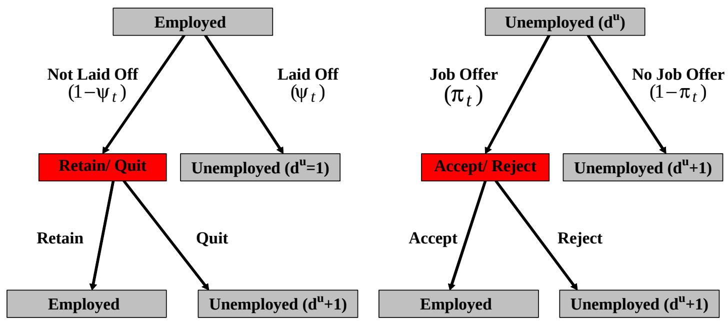


Fig. 3. The labor market and the timig of the model. An employed worker is laid off with an age-dependent probability. A lay off leads to unemployment. An employed worker who is not laid off decides whether to retain the job and remain employed or to quit her job and become unemployed. An unemployed worker receives a job offer with an age-dependent probability. An unemployed worker who does not receive a job offer remains unemployed. An unemployed worker who does receive a job offer chooses whether to accept the job-offer and become employed or to reject the job-offer and stay unemployed.

The process for an unemployed worker is similar. An unemployed worker with an unemployment duration of d receives at the beginning of the period a job offer with probability π_t that depends on her age t. If the worker does not receive a job offer, then she remains unemployed and her unemployment duration increases by 1 to $d+1$ periods. Here, too, a worker that receives a job offer does not necessarily become employed. Instead, such a worker decides whether to accept or to reject the job offer. If the worker accepts the job offer, then she becomes employed. If the worker rejects the job offer, then she stays unemployed. I discuss the probabilities of observing quits and job-offer rejections later on, when I introduce the government.

The labor market transitions described here include two driving forces for unemployment. The first driving force of unemployment is exogenous frictions. Employed workers who are laid off and unemployed workers who do not receive a job-offer do not have a work opportunity in that period and do not choose to be unemployed (even though some workers are better off unemployed, there are also workers who would like to be employed). The second driving force of unemployment is incentives. Employed workers who quit their job and unemployed workers who reject available job-offers are unemployed by choice.

2.1.4 Labor productivity process

The individual labor productivity process that I use is standard in macroeconomics. It accounts for a life-cycle trend and persistent income shocks. The log labor income of an employed individual i at age t is:

$$\begin{aligned} y_{i,t} &= k_t + z_{i,t} \\ z_{i,t} &= \rho z_{i,t-1} + \eta_{i,t} \end{aligned}$$

The first component, k_t, is a common life-cycle trend that accounts for the return to experience over the life-cycle and supports the hump shape of labor income towards unemployment[6]. The second component, $z_{i,t}$, is an idiosyncratic AR(1) process with persistence ρ, and innovations $\eta_{i,t} \sim N\left(\frac{-\sigma_\eta^2}{2}, \sigma_\eta^2\right)$. Note that by drawing $z_{i,1}$ from a non-degenerate distribution, this process allows for initial heterogeneity in earnings even at date 1.

During unemployment, the persistent component of labor income is constant. This formulation is useful for recovering the last labor income, which is the basis for unemployment payments in both systems.

2.1.5 Initial wealth and savings

Workers are born at date 1 with an initial wealth of $a_{i,1}$. The log of initial wealth is distributed $N\left(\frac{-\sigma_a^2}{2}, \sigma_a^2\right)$. Workers can save and borrow up to $\underline{a}$, and the periodic interest rate on assets is r.

[6] Capturing the hump shape of the income profile by the trend mimics the decline in human capital accumulation towards retirement.

2.2 The government

The government implements an unemployment policy (either UI or UA) for insuring workers against unemployment. Following the details of the two unemployment systems, I describe three additional government activities: Social Assistance, Social Security for retired workers, and government consumption.

2.2.1 The UI system

The UI policy includes the two key instruments of the US policy (see Figure 2). The first instrument is the replacement rate, denoted by Q_{UI}. This instrument determines for each worker the **level** of benefits during unemployment. The second instrument is the duration of the benefits, denoted by D_{UI}. This instrument determines the **time limit** of benefits.

Following the UI policy in the US, UI benefits are only provided to workers who were laid off. Workers who quit are ineligible to benefits. The implied assumption of this restriction is that quits are observed by the government. This assumption is supported by a component of the UI system called "experience ratings", that indexes the unemployment tax rate to the layoffs experience of the firm. Thus, a firm that reports a quit as a layoff would, in general, face a higher unemployment tax rate. This guarantees that the firm has the incentive to report the truth[7].

Rejections of job offers, on the other hand, are assumed to be unobservable by the government. Compared with quits, rejections of job-offers are hard to detect as they involve a third party that has no interest in reporting the job-offer rejection. Although some monitoring of job-offers takes place in the US, Setty (2009) documents that the average monthly monitoring probability of job-search effort in the US is 0.22. This is an upper bound for the probability of observing a job-offer rejection because monitoring the job-search effort does not always lead to a detection of a job-offer rejection. Therefore, in the benchmark calibration I assume that job-offer rejections are perfectly unobservable.

[7] For more on experience ratings see Wang and Williamson (2002).

2.2.2 The UA system

The UA policy includes two instruments. The first instrument is the mandatory saving rate during employment, denoted by M_{UA}. This instrument, which is a fraction of labor earnings, determines the **inflow** into the account. The second instrument is the withdrawals during unemployment as a replacement rate, denoted by Q_{UA}. This instrument determines the **outflow** from the account. Upon retirement, the balance of the mandatory account becomes available for the worker.

The private saving and borrowing described earlier are fundamentally different from the mandatory account: while the worker can withdraw from her private savings up to the borrowing limit and save freely, she has no control over either the inflow or the outflow from the mandatory account.

I assume that the mandatory account bears the same periodic interest, r, as private saving[8]. Note that given that the return on the two assets is the same and that the liquidity of the mandatory account is lower, the worker would always prefer to deposit the minimum amount in the account, and withdraw the maximum amount from the account.

The mandatory account has an upper bound $\overline{a_m}$ and a lower bound of 0. The upper bound is used for technical convenience only and will be calibrated to a level that has no effect on welfare compared with a choice of no bound[9]. In Section 5, I relax the assumption that the lower bound of the mandatory account is 0 and allow workers to have temporary negative balances.

For consistency with the UI system, I assume that only laid off workers are eligible to

[8]The return on the mandatory savings could be different than that of the regular savings for at least three reasons: higher regulation on the investment (among other reasons to avoid moral hazard); a higher interest rate given the central management of the funds; and an overhead. I abstract from these considerations and leave them to further research.

[9]As will be shown later, an important reason for saving in the model is for retirement. Workers save to smooth consumption because they realize that their income in retirement decreases significantly. Therefore, workers who have a high level of the mandatory account substitute regular savings with the mandatory savings, without a significant effect on the total saving level.

withdraw payments from the unemployment account[10].

The UA system described here is similar to the UA system implemented in Chile with a few differences. Appendix 1 presents the Chilean system in detail and describes these differences.

2.2.3 Other government activities

In addition to the unemployment policy, the government administers three other activities. The inclusion of these activities is important for setting the conditions that workers face during employment and during retirement.

The first activity is Social Assistance for workers with no unemployment payments. In UI, these are workers who continue to be unemployed past the time limit of UI benefits. In UA, these are workers who continue to be unemployed past the exhaustion of their mandatory account. Inspired by US policies such as Temporary Aid for Needy Families (TANF) and Food Stamps, workers with no unemployment payments receive a low monthly payment, denoted by b, indefinitely[11]. Including this policy in the model is important as it provides additional insurance for unemployment workers.

The second activity is retirement payments to retired workers. This activity follows the two main principles of the Social Security retirement plan in the US: payments are based on lifetime earnings and payments are progressive. The retirement policy in the model differs from the actual retirement policy in the US in the way lifetime savings are calculated. Since lifetime earnings in the model are not part of the worker's state, they are approximated by the worker's last observed labor income. This approximation is explained in the calibration section.

The third activity is Government Consumption. The government spends a fixed

[10]Since the worker is using her own resources to finance the unemployment benefits, it is interesting to examine the welfare effect of relaxing the eligibility criterion of UI in UA. In fact, under the Chilean UA policy workers who quit their job are still eligible to withdrawals under some conditions (see Conerly (2002)). This extension is in progress.

[11]TANF has a lifetime max of 60 months that is not included in the model. The measure of workers who past the limit is, however, negligible.

amount on exogenous expenditures that do not benefit workers. These expenditures are important for setting the correct average labor tax distortion that workers face.

The government finances its four activities (the unemployment system, Social Assistance, Social Security, and Government Consumption) by collecting a labor income tax for either UI or UA, denoted by τ^{UI} and τ^{UA}, respectively. Note that these two alternative taxes are not decision variables, but rather used to balance the government budget.

2.2.4 Information structure

Mandatory savings in the UA regime are regulated by the government and hence are observable by both the government and the workers. Private individual savings are unobservable to the government.

2.3 The worker's problems

2.3.1 UI

The worker's state under the UI system is composed of five components: age (t), private savings (a), persistent component of labor income (z), unemployment duration (d), and eligibility for unemployment benefits (e).

Workers in the model have two types of decisions. The first type of decision is an *intertemporal* decision of consumption and savings. This decision is based on a specific employment state (employed or unemployed). The second type of decision is the *intratemporal* decision of employment. This decision is relevant only for workers with an employment opportunity (employed workers who are not laid off and unemployed workers with a job offer). Such workers decide whether to be employed or unemployed.

For clarity of the value functions' presentation, I use two types of value functions, one for each type of decision. The values for the employed and unemployed workers are $W^{UI}(t, a, z)$ and $V^{UI}(t, a, z, d, e)$ respectively. These values are the outcome of an *intertemporal* maximization over consumption and savings. Note that the value for the employed worker does not include the eligibility state since eligibility is only relevant for the unemployed. In addition, unemployment duration is not part of the employment state.

The values for workers with job opportunities are given as follows. The value of a worker who was **employed** in the previous period and **was not laid off is** $J_w^{UI}(t,a,z)$. The value of a worker who was **unemployed** in the previous period and **has a job offer** is $J_u^{UI}(t,a,z,d,e)$. These values are the outcome of an *intratemporal* maximization over a choice between employment and unemployment:

$$J_u^{UI}(t,a,z,d,e) = \max_{\{accept,reject\}} \left\{ W^{UI}(t,a,z), V^{UI}(t,a,z,d,e) \right\} \tag{1}$$

$$J_w^{UI}(t,a,z) = \max_{\{retain,quit\}} \left\{ W^{UI}(t,a,z), V^{UI}(t,a,z,1,0) \right\} \tag{2}$$

The value for an unemployed worker who holds a job offer, $J_u^{UI}(\cdot)$, is determined as a choice between becoming employed (accept) and remaining unemployed (reject). Note that since rejections are unobservable by the government the eligibility of remaining unemployed (e) is carried unchanged to unemployment.

Similarly, the value for an employed worker who does not face a layoff shock, $J_w^{UI}(\cdot)$, is determined as a choice between remaining employed (retain) and becoming unemployed (reject). Note that since quits are observable by the government the eligibility upon becoming unemployed (e) is 0.

Using these values, we can now define the value for the employed and the unemployed workers based on the intertemporal decisions. The value of an unemployed worker under

UI is:

$$
\begin{aligned}
& V^{UI}(t,a,z,d,e) = \qquad (3)\\
& \max_{c,a'} \left\{ u(c) + \beta\phi_t \mathbf{E}_t \left\{ \pi_t J_u^{UI}(t+1,a',z,d+1,e) + (1-\pi_t) V^{UI}(t+1,a',z,d+1,e) \right\} \right\} \\
& s.t.
\end{aligned}
$$

$$
\begin{aligned}
a' &= a(1+r) - c + s \\
a' &\geqslant \underline{a} \\
s &= \left\{ \begin{array}{ll} Q_{UI} \exp(k_t + z)\left(1-\tau^{UI}\right) & if\ e=1\ and\ d \leq D_{UI} \\ b & otherwise \end{array} \right\}
\end{aligned}
$$

The worker in this problem decides on current consumption (c) and future assets (a') in order to maximize current utility from consumption and the future value. The discounted future value is multiplied by the age-dependent conditional survival rate ϕ_t. The future value itself is a composition of the values of receiving and not receiving a job offer with the respective probabilities of π_t and $(1-\pi_t)$.

The first constraint is a standard budget constraint where s is the government transfer. A worker who is eligible for unemployment benefits and whose unemployment duration is within the time limit of UI benefits, receives a replacement rate of the previous labor earnings. All other workers receive Social Assistance benefits b.

The value of an employed worker under UI is:

$$
\begin{aligned}
& W^{UI}(t,a,z) = \qquad (4)\\
& \max_{c,a'} \left\{ u(c) - B + \beta\phi_t \mathbf{E}_t \left\{ (1-\psi_t) J_w^{UI}(t+1,a',z') + \psi_t V^{UI}(t+1,a',z',1,1) \right\} \right\} \\
& s.t.
\end{aligned}
$$

$$
\begin{aligned}
a' &= a(1+r) - c + \exp(k_t + z)\left(1-\tau^{UI}\right) \\
a' &\geqslant \underline{a}
\end{aligned}
$$

Note that the eligibility state upon being laid off is equal to 1. Also note that the value of the worker includes the disutility from work $(-B)$.

2.3.2 UA

The value functions for the worker under the UA policy are similar to the ones in UI. The worker's state under the UA system is composed of five components as well: age (t), private savings (a), mandatory savings (a_m), persistent component of labor income (z), and eligibility for withdrawals (e). It differs from the worker's state under UI, because of the additional mandatory savings (a_m), and the absence of the unemployment duration (d). These two changes in the state space of the worker reflect the criterion for unemployment payments: in UI it is the unemployment duration and in UA it is the endogenous balance of the mandatory account. The intratemporal value functions under UA are:

$$\begin{aligned} J_u^{UA}(t,a,a_m,z,e) &= \max_{\{accept,reject\}} \left\{W^{UA}(t,a,a_m,z), V^{UA}(t,a,a_m,z,e)\right\} \\ J_w^{UA}(t,a,a_m,z) &= \max_{\{retain,quit\}} \left\{W^{UA}(t,a,a_m,z), V^{UA}(t,a,a_m,z,0)\right\} \end{aligned}$$

The value of an unemployed worker under UA is:

$$V^{UA}(t,a,a_m,z,e) = \tag{5}$$

$$\max_{c,a} \left\{u(c) + \beta\phi_t \mathbf{E}_t \left\{\pi_t J_u^{UA}(t+1,a',a_m',z,e) + (1-\pi_t) V^{UA}(t+1,a',a_m',z,e)\right\}\right\}$$

$s.t.$

$$\begin{aligned} a' &= a(1+r) + m + \min\{\max\{0, b-m\}, b\} - c \\ a_m' &= a_m(1+r) - m \\ m &= \left\{\begin{array}{ll} \min\left\{Q_{UA}\exp(k_t+z)\left(1-\tau^{UA}\right), a_m(1+r)\right\} & if\ e=1 \\ 0 & otherwise \end{array}\right\} \\ a' &\geqslant \underline{a} \end{aligned}$$

The objective function that determines $V^{UA}(\cdot)$ is similar to the one in the value of an unemployed worker under UI with the necessary adjustments. Future private savings in the first constraint are determined by the sum of current private savings including the interest rate, the withdrawal from the account, and the Social Assistance payment minus consumption.

The withdrawal for an eligible worker (m) is equal to the replacement rate of previous earnings if the account has a sufficient balance. Otherwise, it is the balance of the account. The Social Assistance transfer is equal to b if the withdrawal is lower than b, equal to the difference between b and the withdrawal if the withdrawal is lower than b, and equal to 0 otherwise.

The mandatory account's balance in the second constraint is updated according to the withdrawal. Note that the worker does not decide on inflows or outflows of the mandatory account, which are dictated by the government policy.

The value of an employed worker under UA is:

$$
\begin{aligned}
& W^{UA}(t,a,a_m,z) = \\
& \max_{c,a'} \left\{ u(c) - B + \beta\phi_t \mathbf{E}_t \left\{ (1-\psi_t) J_w^{UA}(t+1,a',a'_m,z') + \psi_t V^{UA}(t+1,a',a'_m,z',1) \right\} \right\} \\
s.t. \quad & : \\
a' \quad & = \quad a(1+r) + \exp(k_t+z)\left(1-\tau^{UA}\right) - c - (a'_m - a_m(1+r)) \\
a'_m \quad & = \quad \min\left\{\overline{a_m}, a_m(1+r) + \exp(k_t+z) M_{UA} \right\} \\
a' \quad & \geqslant \quad \underline{a}
\end{aligned}
$$

The budget constraint of the worker in the first constraint of $W^{UA}(\cdot)$ includes the deposit to the mandatory account $(a'_m - a_m(1+r))$. This deposit is equal to the deposit rate, times the labor earnings as long as the account's balance is lower than $\overline{a_m}$. Otherwise, it is the deposit that sets the mandatory account's balance at its upper bound.

2.4 Technology

Firms have access to a production technology that uses two inputs: $F = AK^{\alpha}N^{1-\alpha}$ where F is production, A is total factor productivity, K is aggregate capital, N is aggregate labor, and α is the elasticity of output to capital.

2.5 A Stationary Recursive Competitive Equilibrium (UI)

As noted above the state of an employed worker is a subset of the state of the unemployed worker. For the presentation of the equilibrium in this subsection I define $d = 0$ as the employment state[12].

A stationary recursive competitive equilibrium is value functions $J_u^{UI}, J_w^{UI}, V^{UI}, W^{UI} : S \rightarrow \Re$; policy functions $a' : S \rightarrow \Re$, and $c : S \rightarrow \Re_+$ for all workers, an acceptance decision $x_1 : S \rightarrow \{accept, reject\}$ for unemployed workers with a job offer, a job retaining decision $x_2 : S \rightarrow \{retain, quit\}$ for employed workers who are not laid off; policies for the firm N and K; prices r and w; a government UI policy $\{Q_{UI}, D_{UI}\}$ and a stationary measure λ^* such that:

- given prices $\{r, w\}$, the government policy $\{Q_{UI}, D_{UI}\}$, and τ^{UI}, the policy functions $\{a', c, x_1, x_2\}$ solve the workers' problems (1,2,3,4) with $J_u^{UI}, J_w^{UI}, V^{UI}, W^{UI}$ as the associated value function respectively,

- given prices $\{r, w\}$, the firm optimally chooses N and K, i.e. $r + \delta = F_K(K, N)$ and $w = F_N(K, N)$,

- the labor market clears: $N = \int_{t<T_R \times A \times Z \times d=0 \times E} \exp(k_t + z)\, d\lambda^*$,

- the asset market clears: $K = \int_{T \times A \times Z \times D \times E} a'(t, a, z, d, e)\, d\lambda^*$,

- the goods market clears: $\int_{T \times A \times Z \times D \times E} c(t, a, z, d, e)\, d\lambda^* + \delta K = F(K, N)$,

[12] Given this definition, the eligibility (e) can be chosen arbitarily to be 1.

- the government budget is balanced[13]: $\int_{t<T_R\times A\times Z\times d=0\times E} w\exp\left(k_t+z\right)\tau^{UI}=$
$\int_{t<T_R\times A\times Z\times 1\leq d\leq D_{UI}\times e=1} Q_{UI}w\exp\left(k_t+z\right)\left(1-\tau^{UI}\right)+\int_{(t<T_R\times A\times Z\times d>D_{UI}\times E)U(T\times A\times Z\times D\times e=0)} b+$
$\int_{t\geq T_R\times A\times Z\times D\times E}\exp\left(k_t+z\right)g\left(z\right)+G,$

- for all $(\mathcal{T}\times\mathcal{A}\times\mathcal{Z}\times\mathcal{D}\times\mathcal{E})\in\mathcal{B}$, the invariant probability measure λ^* satisfies

$$\lambda^*\left(\mathcal{T}\times\mathcal{A}\times\mathcal{Z}\times\mathcal{D}\times\mathcal{E}\right)=\int_{T\times A\times Z\times D\times E} Q\left(\left(t,a,z,d,e\right),\mathcal{T}\times\mathcal{A}\times\mathcal{Z}\times\mathcal{D}\times\mathcal{E}\right)d\lambda^*,$$

where Q is the transition function defined as:

$$\begin{aligned}&Q\left(\left(t,a,z,d,e\right),\mathcal{T}\times\mathcal{A}\times\mathcal{Z}\times\mathcal{D}\times\mathcal{E}\right)\\=\;&I_{\{t+1\in\mathcal{T}\}}I_{\{a'(t,a,z,d,e)\in\mathcal{A}\}}I_{\{z'(z)\in\mathcal{Z}\}}I_{\{d'(t,a,z,d,e)\in\mathcal{D}\}}I_{\{e'(t,a,z,d,e)\in\mathcal{E}\}}\end{aligned}$$

The Stationary Recursive Competitive Equilibrium for UA is a straightforward extension of the one above. The government balanced budget for this equilibrium is: $\int_{t<T_R\times A\times A_M\times Z\times E} w\exp\left(k_t+z\right)\tau^{UA}=$
$\int_{(t<T_R\times A\times A_M\times Z\times E)}\min\left\{\max\left\{0,b-m\right\},b\right\}+\int_{t\geq T_R\times A\times A_M\times Z\times E}\exp\left(k_t+z\right)g\left(z\right)+G,$
where m is defined in (5). The main difference in the government balanced budget in UA is of course the absence of the unemployment expenditure.

Solving the model for the general equilibrium as defined in this section is computationally demanding because the prices are endogenous. It is however feasible and will be included in a later version of the paper. For now I am calibrating the prices outside of the model. The general equilibrium analysis will allow for analyzing the effect of the changes in savings and employment on the interest rate and wages.

[13] $g\left(z\right)$ is the determination of Social Security benefits based on the persistent component of labor income.

2.6 Optimal unemployment policies

The objective of each of the optimal unemployment policies is to maximize the average ex-ante welfare of the workers in the economy. The welfare metric that I use is consumption equivalent variation. When comparing two policies, this is the percentage increase in consumption that needs to be given to the average worker at each date in her lifetime in the baseline policy (e.g. current UI) to make her exactly as well off as under the suggested policy (e.g. optimal UI).

We are now ready to define the optimal unemployment policies. Let ξ_0 denote the measure of employed workers at date 0.

An optimal *Unemployment Insurance* policy is a pair $\{D^*_{UI}, Q^*_{UI}\}$ such that:

- $\mathbf{E}_0 \left\{\xi_0 W^{UI}(t=0,a,z) + (1-\xi_0) V^{UI}(t=0,a,z,d=1,e=1)\right\}$ is maximized,
- the government budget is balanced (as defined above for UI),

where the expectation operator is taken with respect to initial wealth and the initial persistent component of income.

An optimal *Unemployment Accounts* policy is a pair $\{M^*_{UA}, Q^*_{UA}\}$ such that:

- $\mathbf{E}_0 \left\{\xi_0 W^{UA}(t=0,a,a_m=0,z) + (1-\xi_0) V^{UA}(t=0,a,a_m=0,z,e=1)\right\}$ is maximized,
- the government budget is balanced (as defined above for UA),

where the expectation operator is taken with respect to the same variables as in the definition above.

2.7 Economic forces

This section discusses the trade-offs between the two unemployment policies for several economic factors[14].

[14] The instruments of either system can be chosen in order to create a wide range of policies. In this section I assume instruments' levels that are consistent with employment incentives and welfare

2.7.1 Employment incentives

Compared with UA, labor supply disincentives are stronger in UI for two reasons. First, the presence of unemployment benefits in UI that are financed from a common fund increases the value of unemployment. In contrast, in UA the worker receives payments from her own resources and hence she realizes that withdrawing from her mandatory account leads to less individual savings in the future. Second, the unemployment tax in UI that is required for financing unemployment benefits decreases the value of employment in UI. In contrast, workers in UA pay a lower labor tax. These two effects distort the employment decisions of workers in UI.

2.7.2 Insurance

The improved incentives that come with UA are accompanied by an important welfare cost. Under the UA system, the benefits of the unemployed workers in UA are tightly linked to the employment history of each worker. This link implies lower transfers between workers who are ex-ante the same but differ by the level of employment opportunities.

As explained in the introduction, the limited insurance matters especially to young workers, who start off with no mandatory savings, and workers who face consecutive unemployment spells. Figure 4 shows the average number of months that a worker is covered for in the two systems, over a working age of $[25, 65]$. In this example, I use the actual UI policy in the US and a UA policy with a deposit rate of 3% (similar to the deposit rate in Chile) and a replacement rate of 50% (as in the actual UI system). The number of coverage months in UI is simply the time limit of 6 months and it is constant over the life-cycle. For UA, the number of coverage months depends on the average mandatory savings. It starts at 0 at age 25, and increases considerably over the life-cycle.

---

maximization.

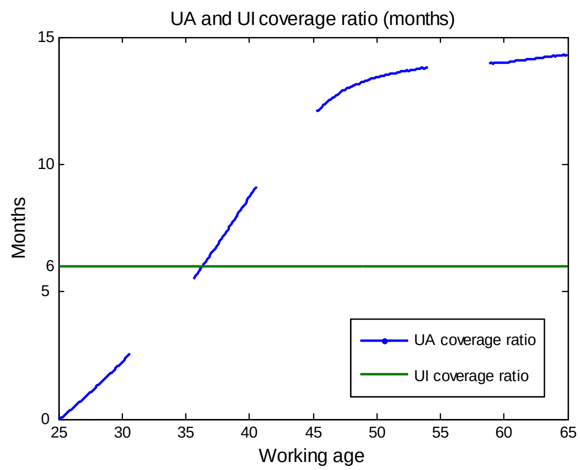


Fig. 4. UA and UI coverage. The figure shows the average number of months that workers receive unemployment payments in both unemployment systems over the working age. In UI the coverage is 6 months. In UA the coverage increases gradually as workers accumulate savings in the mandatory account.

In this example, workers at the age of 35 in UA have, on average, the same number of coverage months as in UI. Notice that the strong curvature of the UA coverage, at around 13 months of coverage, is a result of the upper bound on the mandatory savings[15].

2.7.3 Savings

Workers save voluntarily in the model for several reasons: to smooth consumption over the working age, for retirement, and to insure themselves against unemployment or income shocks. In UA, workers are also mandated to save in an account that can only be used during unemployment (and to a lesser degree during retirement)[16]. Although the mandatory savings may decrease the private savings, the elasticity of private savings with respect to the mandatory savings depends on the various incentives for each worker to save. Furthermore, since UA under-insures some workers, it is also possible that the private savings in UA will be higher than the private savings in UI.

[15] Note that the actual bound implies a higher coverage than 13 months because the mandatory account of some workers (e.g. unemployed workers) is unbounded.

[16] In this sense there is some inefficiency in the mandatory account that insures workers against one specific shock, as opposed to the regular savings where $1 of savings can be used in a range of situations.

2.7.4 Comparison of UA to self insurance

The gain from UA compared with self insurance comes from the ability of the government to provide Social Assistance to workers selectively. This gain is expected to increase with the importance of incentives as the driving force of unemployment.

It is interesting to note that UA typically leads to a welfare gain: compared with self insurance, in UA workers pay less taxes because the expenditure on Social Assistance is smaller. On the other hand, they receive less Social Assistance because it is delayed until the account is exhausted. For the young workers who are an important demographic group that needs insurance, the tax effect is the same as on everyone else. However, the delayed Social Assistance effect is very small for them because they have low mandatory savings. Therefore, UA dominates self insurance because the accounts act as a screening mechanism that allows the government to target Social Assistance selectively for the young.

Also note that while means test benefits can be used as an alternative to the mandatory account, this mechanism may distort workers' savings decisions. In contrast, the mandatory account inflows and outflows are dictated by the government and hence immune to saving distortions. On the other hand the mandatory savings distort savings decisions, especially for the young.

3 Calibration

The model is calibrated to match key moments in the economy. The unemployment system used to calibrate the model is the current UI policy in the US.

This section has two parts. The first part covers parameters that are calibrated externally to the model. The second part covers several parameters in order to match some moments.

3.1 Externally calibrated parameters

Table 1 summarizes the values for the externally calibrated parameters in the model.

TABLE 1

Externally calibrated parameters

Parameter	**Value**	**Source/Moment to match**
$u(c)$	logarithmic	
Interest rate	4% (annual)	Cooley (1995)
Labor income process		
Persistence (ρ)	0.946 (annual)	Kaplan (2007) PSID (1968-1997)
Initial wage variance	0.056 (annual)	Kaplan (2007) PSID (1968-1997)
Innovation variance	0.019 (annual)	Kaplan (2007) PSID (1968-1997)
Median earnings	$3,340 (monthly)	CPS (2001-2005)
Other		
Social Assistance	$350	TANF (Department of HHS 2002)
Median initial wealth	$5,600	SIPP (1995)
Mean/median initial wealth	4.2	SIPP (1995)
UE and EU transitions	age dependent	Shimer (2005b) CPS (1990-2005)

3.1.1 Life-cycle

The unit of time is one month. This frequency, which is relatively high for a life-cycle model, supports a careful distribution of unemployment shocks. The survival rates are taken from the US Census (2005).

Workers join the labor force at age 25 and are part of the labor force until they are 65. The retirement age of 65 is set to an age that is between the full retirement age range in the US of 65 to 67 (depending on the year of birth) and the early retirement option at age 62[17]. The maximum age, T, is calibrated to 100 years of age.

The life-cycle therefore consists of a working age span of 40 years (or 480 months) and a retirement age span of 35 years (or 420 months).

[17] For more on the Social Security timing see http://www.socialsecurity.gov/retire2/agereduction.htm

3.1.2 Labor productivity

The age profile (k_t) is estimated using mean earnings with cohort effects from the PSID. See Huggett, Ventura, and Yaron (2006) for more details.

The income process is based on Kaplan (2007), where $\rho = 0.946$, $\sigma_\eta^2 = 0.019$ (both annual), and the initial variance of the persistent shock is $\sigma_{z_1}^2 = 0.056$.

Median monthly earnings are equal to \$3,340, based on the 2009 CPS data.

3.1.3 Unemployment inflows and outflows

The age-dependent transitions between employment and unemployment (ψ_t and π_t) are taken from Shimer (2005b). These values are based on the period of 1990-2005 from the CPS data.

3.1.4 Initial employment and eligibility

The initial employment level is set according to the unemployment rate at age 25. At age 25 workers are assumed to be eligible because at young age most separations are exogenous. This assumption is reasonable given that the majority of workers (91.3%) start off the life-cycle employed.

3.1.5 Initial wealth and borrowing limit

The initial wealth of workers is set in order to match the median wealth of \$5,600 and the Gini coefficient of assets of 0.78 at age 25 in the 1995 SIPP data (Anderson (1999)).

In the current calibration, borrowing is not permitted. Relaxation of the borrowing constraint is in progress[18].

[18] Since young workers are under-insured in UA relative to UI (see Fig. 4), relaxing the borrowing constraint is expected to increase the welfare gain from a shift from UI to UA. Thus, the welfare implications of the shift from UI to UA in this paper are most likely lower bounds.

3.1.6 Current UI and Social Assistance policies in the US

The current UI policy in the US varies across states but the principles and the levels of instruments are fairly consistent. On average, UI benefits in the US are based on a replacement rate of 50% for a duration of 6 months.

The Social Assistance benefits are set to $350 per month, which is the average TANF benefit for an unemployed worker with one dependent.

3.2 Parameters that are matched to specific moments

Table 2 summarizes the values for the Parameters that are matched to specific moments in the model.

TABLE 2
Parameters that are matched to specific moments

Parameter	**Value**	**Moment to match**	**Source**
Discount rate	0.9973	Wealth income ratio (2.36)	SCF (1989-1992)
Gov. expenditure/Income	12%	Effective labor tax (0.29)	Mendoza, Razin, and Tesar (1994)
Average retirement income	$1350	SS formula (monthly)	US policy (2002)

3.2.1 Employment incentives and frictions

In order to investigate the effect of the two driving forces of unemployment, frictions and incentives, I create three separate calibrations of the economy. All three calibrations match the unemployment rate of 5.4%, as well as the inflows and outflows of unemployment as calibrated above.

The three calibrations differ, however, in the composition of the driving forces of unemployment, as shown in Figure 3. In the first calibration, I assume that there is no disutility from work ($B = B_L = 0$). In this extreme scenario workers neither reject a job-offer, nor quit any job. Thus, the transitions between employment to unemployment are equal exactly to the layoff probabilities ψ_t, and the transitions between unemployment to employment equal exactly the job-finding probabilities π_t.

In the second calibration, I increase the disutility from work to $B = B_M = 0.2$. In this calibration workers are unemployed not only because of frictions but also because they choose to. This requires decreasing the employment frictions in order to maintain the same transitions within the labor force (and the same average unemployment rate). The changes are small though, as workers reject on average less than 1% of job-offers and there are no quits.

In the third calibration, I further increase the disutility from work to $B = B_H = 0.4$ and I further increase the job-offer probability so that the transitions within the labor force will remain the same. In this calibration workers reject about 15% of job-offers.

A point estimate for disutility from work

The three calibrations described above are useful for studying the welfare gain of the shift from UI to UA with respect to the role of incentives in the model. In order to get a quantitative estimate, however, it is required to give a point estimate for disutility from work. To do so, I use the extensive literature that studies the elasticity of the average unemployment duration with respect to changes in the level of benefits. Krueger and Meyer (2002) survey numerous empirical studies that estimate this elasticity using the variations in the UI instruments. They conclude that: "An elasticity of unemployment duration with respect to [unemployment] benefits of 0.5 is not an unreasonable rough summary, though there is a wide range of estimates in the literature."

I can match this elasticity in my model since I run experiments for various levels of each instrument. More specifically, I check how an increase of the replacement rate from 50% in the current UI policy in the US to 60% affects the average unemployment duration. I find that at $B = B_M = 0.4$, the average duration of unemployment increases by about 10% (from 2.94 months to 3.23 months). Since this is a response to an increase of 20% in the benefits (from 50% to 60%) the 0.5 elasticity of the average unemployment duration with respect to benefits is matched precisely for this level of disutility.

The value of $B = 0.4$ is between the $B = 0.3$ used by Kitao, Ljungqvist, and Sargent

(2008) (where "a typical individual worker is at a work-full-time corner unless something extraordinary happens") and the significantly higher values used by Rogerson and Wallenius (2007) and Prescott, Rogerson, and Wallenius (2009). This is also considered an intermediate value in the search-matching literature by Shimer (2005a), Hall (2009) and Hagedorn and Manovskii (2008), who use values of leisure of 0.4, 0.55, and the somewhat controversial 0.955 respectively. The value of leisure and the level of disutility from work cannot be compared directly, because the two parameters are based on two different specifications of preferences in two different models. It is, however, possible to convert the level of disutility from work to the value of leisure. For the optimal UI policy, the equivalent of $B = 0.4$ in my model is a value of leisure of 0.53, very close to the one in Hall (2009)[19].

3.2.2 Interest rate and discount rate

The interest rate r, and the discount rate β, are the key parameters that determine the wealth-income ratio through the determination of the average savings in the economy. The wealth-income ratio target of 2.5 is, approximately, the average wealth to average income ratio computed from the 1989 and 1992 Survey of Consumers Finances (SCF), when wealth is defined as total net worth, income is pre-tax labor earnings plus capital income, and when the top 5% of households in the wealth distribution are excluded[20]. See Kaplan and Violante (2009) for more details. To match this target I set the annual interest rate to 4% (Cooley (1995)) and adjust the discount rate accordingly. The resulting value for the monthly discount rate is 0.9973.

[19] In the simulations of the optimal UI policy given $B = B_H = 0.4$, 56% of workers receive unemployment benefits with a reploacement rate of 0.6, and 44% receive Social Assistance benefits that represent an average replacement rate of 0.14. The value of leisure is composed of the absence of disutility and the replacement rate: $0.56 * exp(0.4) * 0.6 + 0.44 * exp(0.4) * 0.14 = 0.53$

[20] Note that given that the top 5% hold 54% of the net worth of wealth (Cagetti and Nardi (2006)), the wealth-income for the whole economy is considerably higher. In general, these 5% are of little interest for the unemployment policy. Nevertheless, for the analysis of general equilibrium (in a future version of the paper) I will take the wealth of those 5% into account.

3.2.3 Social Security payments method

As in the US, Social Security payments for retired workers are based on the worker's lifetime labor earnings. As described above, the lifetime earnings of workers is not a part of the worker's state. To approximate the retirement payment for each worker, I simulate earnings paths based on the productivity process described earlier and aggregate lifetime earnings for each worker. Then, I regress the lifetime earnings on the last observed level of earnings. The resulting formula is used to approximate lifetime earnings on the last observed earnings in the model. The approximation is fairly good. The variation of the last earnings level explains 85% of the variation in lifetime earnings. This is due to the high persistence in the productivity process.

3.2.4 Government Consumption

The Government Consumption is set to match the effective tax rate of 0.29 of Mendoza, Razin, and Tesar (1994). This tax is split between the transfers of UI, Social Security and Social Assistance that account for a labor tax of about 17%, and Government Consumption that accounts for a labor tax of about 12%. The equivalent **amount** of government expenditures remains fixed throughout the experiments of both UI and UA[21].

3.3 Model fit

Figure 5 shows the first two moments of key variables over the working age $[25, 65]$, in the simulation for the current UI with the intermediate level of disutility from work. The figure shows that the model has very reasonable implications for these variables over the working age. The left panel shows the average annual consumption, annual earnings and assets over the working age. Assets increase over the lifecycle, flattens at age 55 and then decreases slightly. The high level of savings at age 65 is used by workers as a buffer for retirement, given the low replacement rate of Social Security. Consumption in the

[21] Therefore the government expenditure is the same in all experiments.

first part of life, until around age 40, is lower than earnings. This is because workers save for precautionary reasons to insure themselves against unemployment shocks and negative income shocks. In the second part of life, consumption is higher than earnings as precautionary savings are less needed.

The right panel shows the Gini coefficients of consumption, earnings and assets. The Gini coefficient of assets starts at a high level that is matched to the data and decreases dramatically as workers with low assets save for precautionary reasons. The Gini coefficient of consumption is relatively high at the beginning of life because poor workers who face either unemployment shocks or negative income shocks have too little assets for smoothing their consumption. The Gini coefficient of earnings increases slightly over the working age.

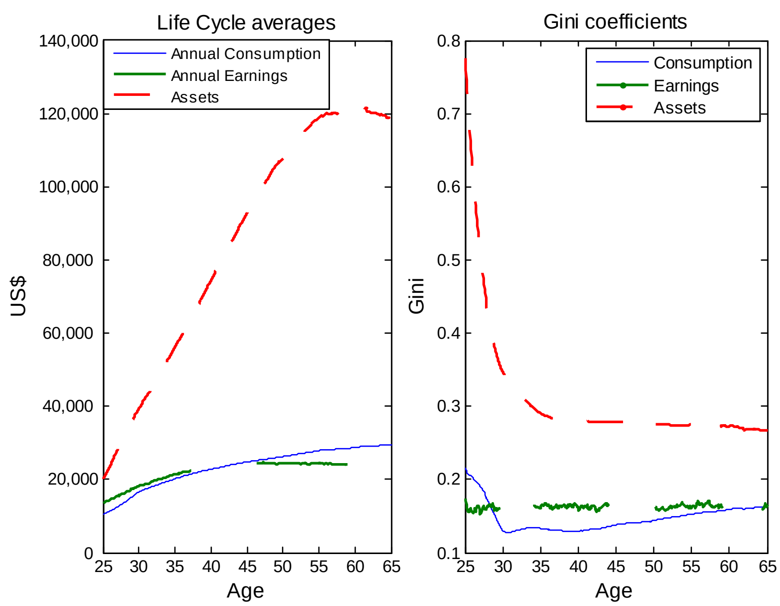


Fig. 5. Model fit. The left panel shows the model's prediction for lifecycle consumption, earnings and assets. Assets increase gradually over the lifecycle as workers save for precautionary reasons and for retirement. In the first part of life, workers' average consumption is lower than their average earnings because they save for precautionary reasons. In the second part of life this trend is reversed. The right panel shows the Gini coefficient for consumption, earnings and assets over the lifecycle. The assets Gini declines gradually as workers with low levels of wealth increase their savings. The consumption Gini is high for young workers because of poor workers who face unemployment.

Figure 6 shows the comparison between the employment rate in the model and in the data over the working age. The good fit is a result of allowing both inflows and outflows of unemployment to be age-dependent.

Fig. 6. The employment level in the data and in the model. The figure shows the employment level over the lifecycle. The match is good due to the age-dependent unemployment inflows and outflows in the model.

4 Results

The computational method is described in details in Appendix 2. I start this section by describing the optimal UI and the optimal UA policies separately and discuss their properties. I then move to the research question of the paper and compare the average and distributional welfare of the two systems. I conclude this section with a discussion on the value of insurance.

4.1 Optimal UI

The optimal UI policy in the model is the optimal choice of the two instruments: the replacement rate and the duration of benefits. Table 3 shows the instruments' values and the cross-sectional statistics for the actual policy in the US, and for the optimal policy for the three calibrations.

TABLE 3

Actual UI versus Optimal UI for the three calibrations of disutility from work

Instruments and statistics	**Actual policy**	**Opt** (B_L)	**Opt** (B_M)	**Opt** (B_H)
Time limit of benefits	6 months	8 months	3 months	2 months
Replacement rate	50%	80%	60%	60%
Tax level	30.8%	31.7%	30.9%	30.0%
Unemployment level	5.40%	5.40%	5.40%	5.50%
Welfare improvement		**0.25%**	**0.27%**	**0.33%**

The actual UI policy provides eligible workers with a replacement rate of 50% for a maximum duration of 6 months. The tax level in this economy of 30.8% finances the government activities. Out of this tax, 2.3 percentage points are used to finance the UI system. This level is consistent with the average unemployment tax level in the US[22]. The cross-section unemployment rate of 5.4% is achieved by matching the transitions between employment and unemployment in the actual policy.

The economy in the first calibration, denoted by B_L, is one in which workers are unemployed only due to frictions. In this economy, insuring workers against unemployment shocks does not lead to incentive problems. Therefore, the optimal UI policy is a generous one with a replacement rate of 80% for 8 months. Increasing the duration of unemployment benefits beyond 8 months is insignificant from a welfare perspective as the measure of unemployment months that are above 8 months of unemployment duration is negligible.

The economy in the second calibration, denoted by B_M, is one in which incentives play only a minor role and the vast majority of workers are still unemployed due to frictions. Compared with the actual policy in the US, the optimal UI policy for this economy consists of a higher replacement rate (60% instead of 50%) and a lower time limit (3 months instead of 6 months). The fact that the tax rate increases from 30.8% in the actual policy to 30.9% in the optimal policy is an indication that the optimal policy is still more generous than the actual policy for this economy.

[22] U.S. Department of Labor. 2008. Comparison of State Unemployment Laws, Chapter 2, Table 2012, 2008. Available at http://www.ows.doleta.gov/unemploy/uilawcompar/2008/comparison2008.asp.

The economy in the third calibration, denoted by B_H, is one in which incentives play a stronger role. Although the vast majority of workers are still unemployed due to frictions, workers are more sensitive to the UI policy. For this economy the optimal replacement rate is still higher than the one in the actual policy, but it is provided only for two months. Note that some workers, e.g., the poor, might save part of these payments in order to insure themselves against a longer unemployment spell. In this economy, compared with the actual policy, both the unemployment rate and the tax rate are lower.

The optimal replacement rates are consistent with the one that Chetty (2008) reports. These replacement rates demonstrate the importance of consumption smoothing as discussed by Gruber (1997). Specifically, the observation of Browning and Crossley (2001) that the consumption smoothing benefit of UI is concentrated among a measure of one third of workers in the data (Canadian administrative UI data), highlights the importance of heterogeneity in wealth in my model.

The three calibrations lead to two main conclusions. First, the average ex-ante welfare improvement of fine tuning the instruments of the UI policy is quite small, at 0.3% of average consumption. As will be shown later, these changes are small compared with the welfare change of the shift from UI to UA. This is an important finding because it shows that the welfare change following a shift from UI to UA does not come from sensitivity to the policy. For more on this see Ljungqvist and Sargent (2008).

The second conclusion is that by looking at the three calibrations, we can see how the optimal UI policy reacts to the employment incentives problem in the economy: as incentives play a bigger role in determining unemployment, the optimal policy is less generous. This drives both the unemployment rate and the tax rate down.

4.2 Optimal UA

Table 4 shows the instruments and the cross-section statistics for the optimal UA policy for the three calibrations side by side. In general, the generosity of the UA policy decreases with the deposit rate and increases with the replacement rate. This is because both high balances and small payments delay the Social Assistance for unemployed workers. As the role of incentives in the economy increases, the UA policy is less generous. This trend is similar to the one in the optimal UI above. Note the effectiveness of UA in reducing the voluntary unemployment in the two right columns.

TABLE 4

Optimal UA for the three calibrations of disutility from work

Policy & Statistics	B_L	B_M	B_H
Deposit rate	2.5%	3%	4%
Replacement rate	60%	60%	50%
Tax level	29.2%	28.9%	28.5%
Unemployment level	5.40%	5.36%	5.20%

4.3 Optimal UI versus optimal UA

We are now ready to compare the two systems, UI and UA. Table 5 presents the information given in the previous two tables and provides a welfare analysis of the shift from UI to UA. It is interesting to note that as the disutility from work increases, the number of months of benefits decreases in UI, while the number of months of payments paid from the unemployment account increases. This is because the UA coverage increases as the generosity decreases.

TABLE 5

optimal UI versus Optimal UA for the three calibrations of disutility from work

Policy & Statistics	**Opt** (B_L)		**Opt** (B_M)		**Opt** (B_H)	
Policy	UI	UA	UI	UA	UI	UA
Duration/deposit rate	8 *mo*	2.5%	3 *mo*	3%	3 *mo*	4%
Replacement rate	80%	60%	60%	60%	60%	50%
Tax level	31.7%	29.2%	30.9%	28.9%	31.0%	28.5%
Unemployment level	5.40%	5.40%	5.40%	5.36%	5.50%	5.20%
Welfare improvement of a shift from Opt UI to Opt UA	**-0.2%**		**0.3%**		**0.9%**	

Note that no unemployment tax is collected to finance the UA system. The tax decrease in the UA system compared with UI system is, however, lower than the full unemployment tax. This is because the cost of Social Assistance in UA is higher (especially for young workers who have low mandatory accounts' balances).

Finally, relative to the UI policy, as incentives increase, the optimal UA policy leads to lower unemployment levels.

The bottom line of Table 5 shows for each calibration the welfare gain or loss that is associated with a shift from the steady state economy with the optimal UI, to the steady state economy with the optimal UA. From this table it is clear that qualitatively, whether a shift from UI to UA leads to a welfare gain or a welfare loss depends on the role of frictions and incentives in the model: when employment incentives play only a minor role as the driving force of unemployment, a shift from UI to UA leads to a welfare loss. As the role of incentives as the driving force of unemployment increases, UA leads to a welfare gain.

Quantitatively, given the point estimate of disutility from work, the relevant welfare gain of the shift from UI to UA is 0.9%. In terms of robustness, the fact that UA dominates UI already at B_M together with the observation that the disutility of B_M is associated with less than 1.0% rejections of job-offers (and no quits) is a strong evidence that for the US economy, UA indeed dominates UI.

4.3.1 Distributional welfare change

The existence of heterogeneity in the model across age, employment risk, wealth and income, implies that the average ex-ante welfare change already accounts for different types of workers in the economy. Nevertheless, it is of interest to look at the welfare change of the shift from UI to UA across initial wealth, which is a key source of heterogeneity in the model.

Figure 7 shows the welfare gain and loss for the three calibrations over the five quintiles of initial assets. The doted line shows the welfare change for the B_L calibration, for which the average ex-ante welfare loss is 0.2%. It is evident from the figure that for workers in the lowest quintile of initial assets, the welfare loss is three times higher than the average, at 0.6% . This is the case because workers with low levels of initial wealth are under-insured in the UA system, relative to the UI system.

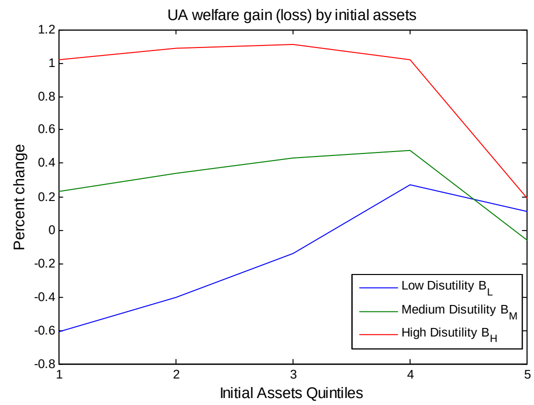


Fig. 7. UA welfare gain (loss) by initial assets. The average welfare gain increases with the level of disutility from work which represents the role of incentives in the model. The welfare gain increases with initial wealth because workers with higher levels of assets can insure themselves.

As the role of incentives increases in the other two calibrations, the welfare change becomes flatter across quintiles of wealth because the welfare gain from alleviating the distortions of employment decisions dominates the welfare loss from under insurance. Note that the change in welfare for the highest quintile is always around zero as these workers finance a big fraction of their consumption from their personal wealth.

4.4 The value of insurance

To put the welfare change of the shift from UI to UA in context, I use the model of UI as a laboratory for studying the value of insurance. In this exercise I eliminate the unemployment system. This can be done either by setting the time limit of UI to 0 or setting the deposit rate in UA to 0 because with these parameters the two systems become identical. Note that Social Assistance is still active in this exercise. I compute the welfare of workers in this economy for each of the three calibrations and compare it to the welfare of the optimal UI policy. The value of insurance provided by UI that is computed in this way is equal to 0.6%, 0.5%, and 0.4% for the three calibrations, respectively.

As expected, the value of insurance is declining with the role of incentives in the model. The welfare gain for the third calibration (the point estimation of disutility from work) is smaller than the welfare gain of the shift from UI to UA. This is a further indication that the welfare gain of this shift is significant.

Hansen and Imrohoroglu (1992) show that the absence of UI reduces welfare by 1%. My finding is somewhat consistent with this result because Hansen and Imrohoroglu (1992) do not include Social Assistance in their model.

5 Extension: Borrowing against future labor income

This section is inspired by Stiglitz and Yun (2005) who allow unemployed workers to borrow against future labor income. This policy alleviates the capital market imperfections by using the retirement savings as a collateral. In their life-cycle model employment is deterministic in all periods but the second. They find that integration of an unemployment policy with the option to borrow is more desirable when risk aversion is low, when unemployment shocks are relatively short, and when the elasticity of search with respect to the policy is high[23].

Following this rational, I relax in this section the assumption that the lower bound of the mandatory account is 0. Now, an unemployed worker can withdraw payments from her mandatory account up to a limit of $\underline{a_m}$ (see Figure 8 compared to Figure 1). It should be noted that the level of the lower bound of the mandatory account (in absolute value) is smaller than the size of Social Security payments by an order of magnitude (on average). Therefore, I abstract from situations where retired workers arrive to retirement with much lower levels of Social Security payments compared with the case of a zero lower bound.

[23] Note that although this mechanism has more complementarities with the UA system, it is also possible to implement it in the UI system, as Stiglitz and Yun (2005) study.

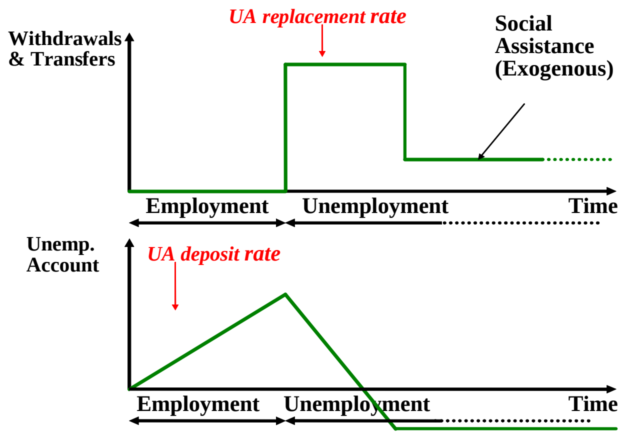


Fig. 8. The UA system when negative balances are allowed. Compared with figure 1, when negative balances of the mandatory accounts are allowed workers receive unemployment payments for a longer duration.

The introduction of this additional instrument increases the average maximum number of withdrawals for unemployed workers, especially for the young. Initial experiments indicate that this effect further increases the welfare of workers beyond the gain from the shift from UI to UA. For example, allowing workers to reach a negative balance up to \$10,000 in the calibration with $B = B_H$ leads to an additional welfare gain (beyond the shift from UI to UA) of about 0.8%. This welfare gain is an upper bound because in the current calibration the borrowing limit $\underline{a}$ is zero. More work on this is in progress.

6 Conclusions and further research

The UA system is a relevant alternative to the existing UI system in the United States. Qualitatively, a shift from UI to UA can lead to either a welfare gain or a welfare loss depending on the role of frictions and incentives in the model. This observation puts the paper at the nexus of the macroeconomic debate on the level of disutility from work. Quantitatively, for a plausible parameterization of the level of disutility from work the shift from UI to UA leads to an average ex-ante welfare gain of 0.9% of lifetime consumption.

This shift makes workers in all quintiles of initial wealth better off. Young workers, however, are worse off because they have low balances of mandatory accounts.

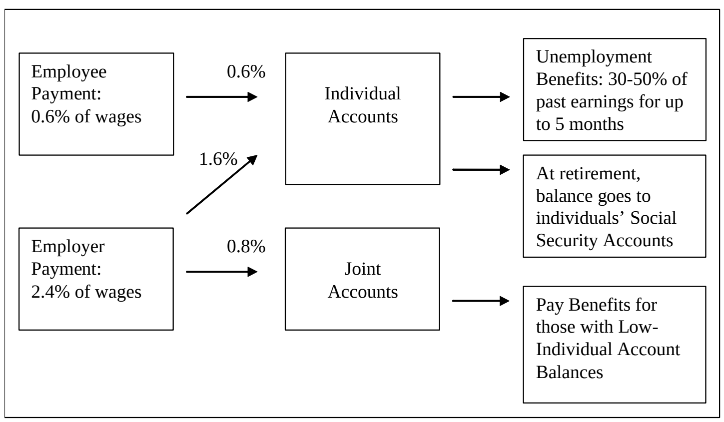
Allowing workers to borrow against future labor income using their Social Security payments as a collateral can further increase the welfare gains os the shift from UI to UA.

This paper compares two unemployment policies in a steady state framework. Given the movements of employment during a business cycle, it would be of interest to examine the performance of the policies during recessions. This would require some assumptions on the way that both systems are adjusted during recessions.

Another direction for further research is designing policies that incorporate the two unemployment systems discussed in this paper. As I have shown in this paper, UA leads to significant welfare gains, but it under-insures the young. Given these insights, a hybrid policy that uses the advantages of both policies should be examined: an implementation of UI in the first part of the worker's life and of UA in the second part of her life. Such a system is expected to lead to further welfare gains.

APPENDIX A: COMPARISON OF UA IN THE MODEL WITH THE CHILEAN SYSTEM

Figure 9 describes the Chilean UA system for workers with open-ended contracts[24]. Both the employee and the employer provide monthly contributions to the UA system. The employer pays the majority of the contribution (2.4% of earnings) and the worker pays an additional 0.6% of her earnings. About 75% of the contribution (2.2% out of the 3%) is deposited in the worker's mandatory account. The remaining of the contribution (0.8% out of 3%) is deposited in the common fund. Upon unemployment, workers are entitled to a schedule of payments that starts at a replacement rate of 50% and decreases linearly to 30% over 5 months. These payments are first financed from the mandatory account. If the account of an unemployed worker is exhausted before the schedule is over, then payments are provided from the common fund.



Source: NCPA. Brief Analysis. No. 424. 2002

Fig. 9. The Chilean UA system.

There are two key differences between the instruments of the UA policy in the model and those in the Chilean policy. First, upon exhaustion of the account's balance, instead of receiving the same level of benefits from the common fund as in the Chilean system, the worker in the model stops receiving unemployment payments. This change creates a

[24] The rules of savings and withdrawals for fixed-term contracts are slightly different. For an overview of the Chilean UA system see Sehnbruch (2004) and "Unemployment insurance in Chile: Reform and innovation", 2009, International Social Security Association.

stronger link between the worker's account and the worker's unemployment benefits compared with the Chilean policy and allows a sharp comparison between the two insurance concepts. In this sense, the Chilean implementation is a mix of the two systems presented in this paper. Second, the UA policy in the model is supplemented by a Social Assistance policy, which provides further insurance for unemployed workers.

In addition to these key differences, the withdrawals from the account during unemployment are constant in the model (they decline in the Chilean policy). This assumption, which simplifies the policy space, is motivated by several recent papers that find that when savings are allowed the importance of declining benefits decreases significantly, e.g. Shimer and Werning (2008), Kocherlakota (2004), and Abdulkadiroglu, Kuruscu, and Sahin (2002).

APPENDIX B: COMPUTATIONAL METHOD

This appendix describes the computational method of the model. It includes three parts. First, I describe the solution method for the workers' problems for a given UI. Second, I explain how I measure the cross-sectional moments that result from the workers' decisions. Third, I describe the solution method for the optimal UI policy given the cross-sectional moments calculated in the second part.

The computational method for the UA problems and the optimal UA policy follow the same principles with the necessary adjustments

1. **Solving the workers' problems**

   I describe here the solution of the worker's problems under UI for the *working age*. The solution for the retirement age is a simple special case of the one for *retirement age* with a smaller state space.

   (a) **The state space**

   The worker's state under UI is: age (t), private savings (a), persistent component of labor income (z), unemployment duration (d), and eligibility for unemployment benefits (e).

   The state space of age is $\{1, 2, ..., 480\}$ because the unit of time in the model is one month. The state space of unemployment duration is $\{1, 2..., D_{UI} + 1\}$, because unemployment duration becomes irrelevant past the time limit of UI benefits. The state space of eligibility for unemployment benefits is $\{0, 1\}$.

   The other two variables, private savings (a), and persistent component of labor income (z) are continuous. These two variables are discretized linearly over the intervals $[\underline{a}, \overline{a}]$ and $[\underline{z}, \overline{z}]$, respectively.

   $\underline{a}$ is the borrowing limit (currently zero), $\overline{a}$ is equal to \$900,000 so that workers never exceed that level of assets (to avoid unnecessary extrapolations).

   The highest and lowest grid points of z are: $\pm 3 * \sigma_{z_{i,1}} + \sqrt{t-1} * \sigma_{\eta}$, where $\sigma^2_{z_{i,1}}$

is the variance of the initial wage and σ_η^2 is the variance of labor productivity innovations (see the calibration part for the values). The rest of the grid values are spread linearly across $[\underline{z}, \overline{z}]$.

Using 65 values for the grid of assets and 5 values for the grid of the persistent component of labor income, the size of the state space for the worker's problem under the actual UI policy is 2,184,000. This is only the ball park of the number of problems that needs to be solved for two reasons. First, the state space increases with the time limit of the UI policy. Second, the unique number of problems is smaller than the size of the state space since some of the worker's problems over the state space are identical (e.g., the unemployment duration is meaningless for an ineligible worker).

(b) **Solving the worker's problems**

For each possible state over the state space described above, I first solve the intertemporal decisions of consumtpion-savings for (1) the employed and (2) the unemployed workers with a job opportunity and for (3) the worker with no job opportunity. These are three standard problems in which the labor income or benefits are well defined[25]. Note that since I am using dynamic programming, the future value is already known for each point on the state space.

(c) **Solution method**

For the solution of the three standard problems I use the Endogenous Grid Method (EGM), developed by Carroll (2005). According to the EGM the grid of assets is taken over future assets rather than current assets. This reformulation of the problem reduces the computational burden significantly. For a more detailed description of this method as well as a comparison of computa-

[25] Note that the state of the persistent component of labor income is the net one. This means that the tax level in the economy is not required for solving the worker's problems.

tion time between EGM and Value Function Iteration (VFI) see Barillas and Fernandez-Villaverde (2007). My own experience with using the VFI method for previous versions of the model supports these findings, and I believe that the EGM played a key role in solving the big state-space model in a reasonable time.

The computation of the employment decision for employed and unemployed workers with job opportunities are trivial and are described in the model part of the paper.

2. **Cross section moments**

   (a) **Initial state**

   In order to calculate the relevant cross section moments of the economy (for a given UI policy) I start with an initial guess for the tax τ_1^{UI} and simulate one cohort of $N = 8000$ workers over dates $\{1, 2, ..., T\}$. Note that these workers face survival shocks so the size of the population decreases with age.

   The initial state of workers (employment status, income, and assets) and the income and unemployment shocks, are drawn from the relevant distributions, as explained in the calibration section above.

   For each worker and for each date (as long as the worker is alive), I collect data on taxes and transfers (including UI benefits, Social Assistance, and Social Security).

   (b) **Updating the tax rate**

   The statistics on transfers together with the per capita Government Consumption determine the government's expenditure, denoted by E_G. The government's income I_G is simply the sum of tax income over all workers at all ages. As long as $|E_G - I_G| > \varepsilon$, I adjust the tax rate as follows. Given a tax guess τ_m^{UI}, if $E_G - I_G > \varepsilon$, then $\tau_{m+1}^{UI} = \tau_m^{UI} * \sqrt{\frac{E_G}{I_G}}$. Otherwise, if $E_G - I_G < \varepsilon$, then $\tau^{UI}_{m+1} = \tau^{UI}_{m} * \sqrt{\frac{I_G}{E_G}}$. I use a square root of the expenditure-income ratio to avoid big jumps in the tax level. I also use bounds on the ratio at $\{0.5, 2.0\}$ to avoid overshoots.

(c) **Calculating moments**

When the government budget is balanced according to the conversion criterion above, I calculate the rest of the moments of the model, including average monthly consumption, earnings, assets, and employment, and the Gini coefficient for consumption, earnings, and assets. In addition, I calculate the average utility per worker in the economy (over the working age and the retirement age).

3. **The optimal policy**

The process described so far gives the moments of a stationary economy given a UI policy. In order to choose the optimal UI policy I follow these steps:

(a) **The UI policy grid**

Define the UI policy grid as $D_{UI} \in \mathcal{D}_{UI} \equiv \{0, 1, ..., 10\}, Q_{UI} \in \mathcal{Q}_{UI} \equiv \{0.0, 0.1, ..., 1.0\}$.

(b) **Solve for all policy grid points**

$\forall D_{UI} \in \mathcal{D}_{UI}, Q_{UI} \in \mathcal{Q}_{UI}$ repeat steps (1) and (2) above.

(c) **The optimal policy**

The optimal policy is the policy that maximizes the average ex-ante utility of workers.

A note on computational time

The number of unique policy grid points is 101 (the replacement rate is meaningless for $D_{UI} = 0$). Running one UI policy node on a two Intel Xeon Quad-Core 64-bit processor, running at 2.33GHz takes about 30 minutes. The solution of one UA policy node takes about 60 minutes (the size of the state space is bigger because of the continuous a_m component).

In order to solve each calibration in a reasonable time I have used "Union Square" (formerly known as the General Cluster), which is a multi-purpose high performance computing resource for the NYU research community. This allows me to solve for several policy nodes simultaneously.

See http://hpc.es.its.nyu.edu/wiki/index.php/DellCluster.

References

Abdulkadiroglu, A., B. Kuruscu, and A. Sahin (2002): "Unemployment Insurance and the Role of Self-Insurance," *Review of Economic Dynamics*, 5(3), 681–703.

Anderson, J. M. (1999): "The Wealth of U.S. Families: Analysis of Recent Census Data," *U.S. Department of Commerce, Bureau of the Census*.

Barillas, F., and J. Fernandez-Villaverde (2007): "A Generalization of the Endogenous Grid Method," *Journal of Economic Dynamics and Control*, 31(8), 2698–2712.

Browning, M., and T. F. Crossley (2001): "Unemployment Insurance Benefit Levels and Consumption Changes," *Journal of Public Economics*, 1, 1–23.

Cagetti, M., and M. D. Nardi (2006): "Entrepreneurship, Frictions, and Wealth," *Journal of Political Economy*, 114(5), 835–870.

Carroll, C. (2005): "The Method of Endogenous Gridpoints for Solving Dynamic Stochastic Optimization Problems," *National Bureau of Economic Research*, Technical Working Paper 309.

Chetty, R. (2008): "Moral Hazard vs. Liquidity and Optimal Unemployment Insurance," *Journal of Political Economy*, 116, 173–234.

Conerly, W. B. (2002): "Chile Leads the Way with Individual Unemployment Accounts," *National Center for Policy Analysis*, Brief Analysis No. 424.

Cooley, T. (1995): *Frontiers of Business Cycle Research*. Princeton University Press.

Davila, J., J. H. Hong, P. Krusell, and J.-V. Rios-Rull (2005): "Constrained Efficiency in the Neoclassical Growth Model with Uninsurable Idiosyncratic Shocks," *Penn Institute for Economic Research, PIER Working Paper*, 05-023.

Feldstein, M. (2005): "Rethinking Social Insurance," *American Economic Review*, 95(1), 1–24.

Feldstein, M. S., and D. Altman (1998): "Unemployment Insurance Savings Accounts," *NBER Working Paper No. W6860*.

Gruber, J. (1997): "The Consumption Smoothing Benefits of Unemployment Insurance," *American Economic Review*, 87, 192–205.

Hagedorn, M., and I. Manovskii (2008): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies Revisited," *American Economic Review*, 98(4), 1692–1706.

Hall, R. (2009): "Reconciling Cyclical Movements in the Marginal Value of Time and the Marginal Product of Labor," *Journal of Political Economy*, 117(2), 281–323.

Hansen, G. D., and A. Imrohoroglu (1992): "The Role of Unemployment Insurance in an Economy with Liquidity Constraints and Moral Hazard," *Journal of Political Economy*, 100, 118–42.

Hopenhayn, H. A., and J. P. Nicolini (1997): "Optimal Unemployment Insurance," *Journal of Political Economy*, 105(2), 412–438.

Hornstein, A., P. Krusell, and G. L. Violante (2009): "Frictional Wage Dispersion in Search Models: A Quantitative Assessment," *Working Paper*.

Huggett, M., G. Ventura, and A. Yaron (2006): "Human capital and earnings distribution dynamics," *Journal of Monetary Economics*, 53(2), 265–290.

Kaplan, G. (2007): "Inequality and the Lifecycle," *Working paper*.

Kaplan, G., and G. L. Violante (2009): "How Much Insurance in Bewley Models?," *Working paper*.

Kitao, S., L. Ljungqvist, and T. Sargent (2008): "A Life Cycle Model of Trans-Atlantic Employment Experiences," *Working Paper.*

Kocherlakota, N. (2004): "Figuring out the Impact of Hidden Savings on Optimal Unemployment Insurance," *Review of Economic Dynamics*, 7(3), 541–554.

Krueger, A. B., and B. D. Meyer (2002): "Labor Supply Effects of Social Insurance," *NBER*, Working Paper No. 9014.

Ljungqvist, L., and T. J. Sargent (2007): "Do Taxes Explain European Employment? Indivisible Labour, Human Capital, Lotteries and Savings," *CEPR Discussion Papers*, 6196.

Ljungqvist, L., and T. J. Sargent (2008): "Two Questions about European Unemployment," *Econometrica*, 76(1), 1–29.

Mendoza, E. G., A. Razin, and L. L. Tesar (1994): "Effective Tax Rates in Macroeconomics: Cross-country Estimates of Tax Rates on Factor Income and Consumption," *Journal of Monetary Economics*, 34, 297–323.

Orszag, J. M., and D. J. Snower (2002): "From Unemployment Benefits to Unemployment Accounts," *IZA Discussion Paper*, 532.

Pavoni, N. (2007): "On Optimal Unemployment Compensation," *Journal of Monetary Economics*, 54(6), 1612–1630.

Pavoni, N., O. Setty, and G. L. Violante (2009): "Optimal Welfare Programs with Search, Work and Training," *Working Paper.*

Pavoni, N., and G. Violante (2007): "Optimal Welfare-to-Work Programs," *Review of Economic Studies*, 74 (1), 283–318.

Prescott, E. C., R. Rogerson, and J. Wallenius (2009): "Lifetime Aggregate Labor Supply with Endogenous Workweek Length," *Review of Economic Dynamics*, 12(1), 23–36.

Rogerson, R., and J. Wallenius (2007): "Micro and Macro Elasticities in a Life Cycle Model with Taxes," *NBER*, Working Paper 13017.

Sehnbruch, K. (2004): "Privatized Unemployment Insurance: Can Chile's New Unemployment Insurance Scheme Serve as a Model for Other Developing Countries?," *Center for Latin American Studies, UC Berkeley*, p. 12.

Setty, O. (2009): "Optimal Unemployment Insurance with Monitoring," *Working Paper.*

Shimer, R. (2005a): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies," *American Economic Review*, 95, 25–49.

——— (2005b): "Reassessing the Ins and Outs of Unemployment," *Working Paper.*

Shimer, R., and I. Werning (2008): "Liquidity and Insurance for the Unemployed," *American Economic Review*, 98(5), 1922–1942.

Stiglitz, J. E., and J. Yun (2005): "Integration of Unemployment Insurance with Retirement Insurance," *Journal of Public Economics*, 89, 2037–2067.

Wang, C., and S. D. Williamson (2002): "Moral hazard, Optimal Unemployment Insurance, and Experience Rating," *Journal of Monetary Economics*, 49(7), 1337–1371.