Online Appendices for the paper "Optimal Life Cycle Unemployment Insurance"

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A Data appendix

We describe the data from SIPP, CPS, PSID and Mathematica used in the paper.

A.1 The SIPP

The data from the Survey of Income and Program Participation (SIPP) is obtained from Chetty (2008) and they are constructed from the 1985, 1986, 1987, 1990, 1991, 1992, 1993, and 1996 panels of SIPP. Interviews were conducted every four months for a period of two to four years, so the data span the beginning of 1985 to the middle of 2000. The original sample is restricted to those male workers between 18 and 65 years of age with an unemployment spell, with at least three months of work history, that reported non-zero unemployment duration, that actively search for a job, that were not temporary layoffs and that received UI benefits in the first month of the unemployment spell, from all states but Maine, Vermont, Iowa, North Dakota, South Dakota, Alaska, Idaho, Montana and Wyoming since SIPP does not provide a unique identifiers for these small states. The final sample covers 4560 unemployment spells, see the Appendix in Chetty (2008) for further details. Below we describe the variables used in the paper.

Unemployment duration SIPP reports the employment status of individuals for every week that they are in the sample. Weekly employment status (ES) can take the following values: 1. With a job this week; 2. With a job, absent without pay, no time on layoff this week; 3. With a job, absent without pay, spent time on layoff this week; 4. Looking for a job this week; 5. Without a job, not looking for a job, not on layoff. A job separation is defined as a change in ES from 1 or 2 to 3, 4, or 5. As in Cullen and Gruber (2000), unemployment duration is obtained by summing the number of consecutive weeks with ES ≥ 3, starting at the date of job separation and stopping when the individual finds a job that lasts for at least one month (i.e., reports a string of four consecutive ES=1 or ES =2). Individuals are defined as being on temporary layoff if, at any point in the spell, they report ES = 3. They are defined as searching if, at any point in the spell, they report ES = 4.

Job finding probability at unemployment duration This is constructed using the weekly employment status variable ES described above and corresponds to a transition from ES=4 to a string of four consecutive ES=1 or ES=2.

Worker's age This is equal to the age of workers measured in years.

Average benefits This is the average benefits in each state and year provided by the Department of Labor.

Individual benefits Chetty (2008) estimates a first-stage equation for earnings using OLS on the full sample of individuals who report a job loss at some point during the sample period. He regresses nominal log wages in the year before job loss on years of education, age at job loss, years of tenure on the last job, a dummy for left-censoring of this job tenure variable, industry, occupation, month, and year dummies, and the unemployment rate in the relevant state/year. Using the coefficient estimates, he predicts log wages for each job loser, and recover the predicted wage in levels. He then uses the predicted wage to simulate the claimant unemployment benefit using

the UI benefit calculator by Cullen and Gruber (2000). In three states, the UI benefits calculator requires previous job tenure as an input. Tenure is imputed using a quadratic function on age which we estimate using the Mathematica data below.

Year This is a dummy that identifies the year of the survey.

Worker's wealth Asset data are generally collected only once in each panel, so pre-unemployment asset data is available for approximately half of the observations. These variables include total wealth, liquid wealth (total wealth minus home, business and vehicle equity) and net liquid wealth (liquid wealth net of unsecured debt).

Worker's net liquid wealth is measured as total wealth minus home, business and vehicle equity net of unsecured debt at the time of job loss.

Table A1 gives summary statistics for the core sample and for two different age groups: workers of age from 20 to 40 years and from 40 to 60 years. Monetary values are in 1990 dollars converted using the CPI index. The median UI benefits recipient is a high school graduate and has pre-UI gross annual earnings of 20,711. The group of workers with 20 to 40 years of age has 2873 observations, the group of workers with 41 to 60 years of age has 1522 observations. Mean unemployment duration is 20 weeks for the whole sample. Unemployment spells for workers with more than 40 years of age are 4 weeks longer than the analogous spells for workers with less than 40 years of age. The individually imputed UI benefit level (in 1990 dollars) is around 20% higher for the old than for the young. This difference is explained by the fact that mean pre-unemployment wage is 30% higher for the old. The resulting average replacement rate is therefore lower for the old workers than for the young.

Table A1: Summary Statistics, SIPP sample

Variable	*All*	*20-40 years*	*41-60 years*
Mean Annual wage	20711.27	18699.21	24665.52
Median Annual Wage	17780.48	16512.12	21745.91
Years of education	12.1	12.1	12.2
Weekly indiv UI benefits	165.72	153.30	187.87
Mean unemp. duration	20.45	18.90	22.68
Median unemp. duration	15.00	14.00	17.00
Mean liquid assets	22545.31	14897.08	34086.46
Mean net liquid assets	18583.77	11044.50	29902.03
Mean total wealth	62705.52	44955.76	90015.60
Percent with Mortgage	.45	.40	.54
Quartile of net liquid assets:			
Q_1	-2177.89	-2231.28	-2081.14
Q_2	-54.92	-63.28	-42.43
Q_3	919.15	911.81	948.12
Q_4	19897.43	12427.25	31077.48
Observations	4560	2873	1536

A.2 Aggregate US states data using CPS

Aggregate US states data are calculated using monthly data from the Current Population Survey databases freely available from Integrated Public Use Microdata Series (IPUMS), see Ruggles et al. (2010) for description of IPUMS. Information on labor force, employment, unemployment, and other demographic and labor force characteristics is available in every month, while earnings data are available in the March survey. We restrict the sample to male workers with 16 to 64 years of age. For each state, semester and age group we aggregate individual data using CPS provided weights. Below we describe more in details the variables used in the analysis.

Pre-unemployment wage: It is imputed at the individual level after running a conventional wage regression in each state and year using the March CPS survey. The dependent variable in the wage regression is weekly logged wages and the independent variables are a quadratic polynomial in age, four educational dummies (for high school dropouts, high school degree, some college and complete college), two race dummies and a marital status dummy. Using the estimated coefficients we impute wage to every unemployed worker.

Individual benefits We impute benefits at the individual level using the UI benefit calculator by Cullen and Gruber (2000). As an input we use the individual imputation for pre-unemployment wages calculated above. In three states, the UI benefits calculator requires previous job tenure as an input. As in Chetty (2008) we impute tenure using a quadratic function on age which we estimate using the Mathematica data below.

Educational composition We construct educational dummies for high school dropouts, more than fourth grade, high school degree, some college and complete college. Using these dummies we calculate the proportion of workers with the different corresponding educational levels.

Race composition We construct a dummy variable that is one if worker is white. Starting from this information we calculate the proportion of white unemployed workers in each state, period and age group.

Married dummy We construct a dummy variable that is one if worker is married. We use this information to calculate the proportion of married unemployed workers in each state, period, and age group.

Unemployment over population ratio We identify a worker as unemployed if he is non-employed and he is actively searching for a job.

Relative finding rate by age. Relative finding rates by age were used as calibration targets, see Table 4. These were computed using all unemployment spells of workers with 20 to 60 years of age in the 1998-1999 CPS panel. We focused on transitions from unemployment to employment. Transitions to out of the labor force or unemployment duration of more than 20 weeks are treated as censored observations. We estimate a Cox proportional hazard model on dummies for age, race, gender, marital status, for whether the worker has a previous job, for four educational dummies and for the relationship with the head of household and state. The estimated coefficients are used to compute quarterly hazard rate. We keep workers with 20 to 29 years of age as the base group.

Wage profile The life cycle profile of wages is used as calibration targets, see Table 4. These profiles are calculated using CPS data over the period 1990 to 2000. We use a sample of male workers with 20 to 64 years of age, who are employed and have received positive labor income in the week of the interview. We regress the log of "usual labor earnings per week at the current job, before deductions" deflated using the CPI index, on a cubic polynomial in age and on dummies for four educational groups (high school dropouts, completed high school, some college and college degree or more), marital status, race, being US native and for state and year. Observations are weighted using the personal weight provided by CPS. We use the estimated coefficients of the cubic polynomial in age to calculate relative wages by age.

Robustness exercises Table A2 reports the value of the β_n coefficients estimated from equation (8) under alternative specifications. The first column corresponds to a specification with no controls other than US states fixed effects. Column two includes all controls discussed in the main text, column three also includes the mean maximum duration of benefits as additional control, in column four benefits are lagged one year; in column five benefit levels are instrumented using its own one year lagged value. In all specifications the unemployment elasticity to benefits is increasing with age and have a similar age profile as in Figure 2.

A.3 The PSID

The Panel Study of Income Dynamics (PSID) started in 1968 collecting information on a sample of roughly 5,000 households. Of these, about 3,000 were representative of the US population as a whole (the core sample), and about 2,000 were low-income families (the Census Bureaus Survey of Economic Opportunities, or SEO sample). We use the subsample constructed by Blundell, Pistaferri, and Preston (2008), who use the core sample over the 1978 to 1992 period and focus on continuously married couples headed by a male with 21 to 65 years of age with limited changes in family composition over the sample period. In particular, only households with no change, or changes just in members other than the head or the wife are kept. These restrictions are intended to control for dramatic exogenous shocks unrelated to changes in employment status. Blundell, Pistaferri, and Preston (2008) also eliminate households with missing report on race, education, and region. We dropped observations where the head of household is inactive or only temporary laid off. The final data set is composed by 3,260 households with at most 15 observations and a mean number of observations equal to 10. The sample for consumption loss upon displacement drops observations for which we do not observe previous year employment status of the head of household. Below we describe more in details the variables used in the analysis:

Food consumption Food consumption is reported directly from PSID. Food consumption is the average weekly expenditures on food at home per capita in the household. Since interviews are usually conducted around March, it has been argued that people report their food expenditure for an average week around that period, rather than for the previous calendar year as is the case for family income. For robustness exercises we used both food consumption at home and out of home.

Table A2: Unemployment elasticity to benefits, by age group, aggregate evidence

Age group	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
16-19	-.0970	-.0389	-.0016	-.0663	.0101
	(.1295)	(.1393)	(.1893)	(.1242)	(.1176)
20-29	.2496*	.3292**	.3229	.3440**	.5596***
	(.1427)	(.1535)	(.2079)	(.1438)	(.1149)
30-39	.4224***	.4972***	.5096**	.5190***	.7123***
	(.1573)	(.1731)	(.2381)	(.1677)	(.0944)
40-49	.3498**	.4009**	.5494**	.4191***	.5866***
	(.1431)	(.1594)	(.2489)	(.1511)	(.0834)
50-59	.5372***	.5766***	.7417**	.5651***	.7376***
	(.1937)	(.1981)	(.2971)	(.1879)	(.0833)
60-64	.5800***	.6320***	.8257***	.5537***	.8726***
	(.1688)	(.1846)	(.2246)	(.1770)	(.1081)
Obs	8168	8168	5898	7801	7560

Notes: Coefficients represent the elasticity of unemployment rate with respect to UI benefits for workers of different age. Controls include the characteristics of the unemployed for each age group (the proportion of white, married, workers with working spouse, with certain level of education, and the log of the mean of the proxy of real pre-unemployment wage) and state and year fixed effects. Standard errors (in parentheses) clustered by state with the exception of the one presented in column (5). Columns present different specifications of the model: (1) only fixed effects; (2) includes additional controls; (3) includes the mean maximum duration of benefits as additional control; (4) benefits are lagged one year; (5) IV regression where benefit level is instrumented by its own value in the previous year. Source: Panels by state and age groups constructed using Current Population Survey. There are 6 age groups for 42 states in all semesters from 1984 to 1999 and first semester of 2000 (a total of 33 periods). See main text for details. Robust standard errors in parenthesis. *** indicates significance at 1%, ** at 5%, * at 10%.

Total consumption expenditures in non durables goods This is the imputation by Blundell, Pistaferri, and Preston (2008) for total consumption expenditures in non durables goods using CEX data. The definition of nondurable consumption is the same as in Attanasio and Weber (1995): it is the sum of food (defined above), alcohol, tobacco, and expenditure on other nondurable goods, such as services, heating fuel, public and private transport (including gasoline), personal care, and semidurables, defined as clothing and footwear. This definition excludes expenditure on various durables, housing (furniture, appliances, etc.), health, and education. It is the average weekly expenditures at home per capita in the household.

Employment status dummies It is equal to one if, at the interview date, the household head of age n is employed.

Unemployment status dummies It is equal to one if, at the interview date, the household head of age n is without a job and he is actively searching for one.

Time dummies This identifies the year of the survey.

A.4 The CEX

The Consumer Expenditure Survey (CEX) provides a continuous and comprehensive flow of data about American consumers. The data are collected by the Bureau of Labor Statistics and it is based on two components, the Diary survey and the Interview survey. Following most previous research, we use only the Interview sample downloaded at the NBER web page. We focus on the 1990-2003 period and we select households where the household head has between 25 and 65 years of age and with complete information about wealth. Below we describe more in details the variables used in the analysis.

Net liquid assets Net liquid assets are the sum of savings accounts, checking accounts, brokerage accounts, and market value of owned stocks and bonds minus unsecured debt, which is the amount owed by the households, with the exception of mortgages and vehicle loans (we considered these last as secured debt).

Net wealth This is the total wealth of the household (including value of housing) net of any outstanding debt.

Mean wages Mean annual wages by year are computed as the mean for each year of the annual wages and salaries of those who worked in the last year and reported positive wages.

Net liquid assets over mean wages This is the ratio of the variable net liquid assets and mean wages calculated above.

Net wealth over mean wages This is the ratio of the variable net wealth and mean wages calculated above.

A.5 Mathematica data

Mathematica conducted two surveys on behalf of the Department of Labor: (i) the Pennsylvania Reemployment Bonus Demonstration, a sample of 5,678 job losers in Pennsylvania in 1991; (ii) the Study of Unemployment Insurance Exhaustees, a sample of 3,907 workers covered by UI benefits in 1998 in 25 states of the US. The datasets are publicly available through the Upjohn Institute. The information in the two datasets is similar. They contain information on prior wages, weeks of UI paid, as well as demographic characteristics, household income, job characteristics (tenure, occupation, industry), and receipt of severance pay. Since Pennsylvania is not included in the Exhaustees study, there is only one year of data for each state in the sample. We use the sub-sample of the two data sets provided by Chetty (2008), who focuses on prime-age unemployed male workers and make exclusions analogous to those applied to SIPP. In particular all observations with missing data on severance payments, years of job tenure, reported survey durations, or variables used to predict net liquid wealth are excluded. We also exclude temporary layoffs (individuals who expected a recall). The final sample comprises 2441 spells, 18% of them for workers who have received some severance payment. Below we describe more in details the variables used in the analysis:

Unemployment duration The unemployment duration is computed as the difference in weeks between the period of displacement and the current period.

Severance pay This is a dichotomic variable that equals one if the worker has received a severance pay from the employer at the time of job displacement.

Tenure spline This is spline in the number of years spent working at the firm where the worker was laid off.

Wage spline A spline of the log of annual wages in the pre-unemployment job.

Unemployment benefits The log of the weekly UI benefit as reported in the Mathematica data.

Educational dummies A series of dichotomic variables for dropout and college graduate workers.

B Solving the optimal life cycle unemployment insurance problem

We discuss how we solve the optimal life cycle unemployment insurance problem in Section 5. We first characterize the case where search effort is observable. Then we turn to the case where search effort is unobservable and unemployment insurance induces moral hazard problems.

B.1 Numerical solution: observable search effort

In the first best problem search effort is fully observable. To solve for this problem we search for the constant value of consumption c^* that satisfies

$$\frac{1-\beta^{\bar{n}_w+\bar{n}_r+1-n}}{1-\beta}c^* - J^*\left(c^*,0,1\right)=0 \tag{22}$$

where $J^*\left(c^*,0,1\right)$ is the expected income of searching for a new job, which solves the following recursive relation:

$$J^*(c,e,n) = (1-\mu)Y^e(c,e,n) + \mu J^*(c,e,n+1) \tag{23}$$

In the expression above

$$Y^e(c,e,n) = w(e) + \beta\left[(1-\delta)Y^e(c,e+1,n+1) + \beta\delta J^*(c,e,n)\right] \tag{24}$$

is the present value of the income generated by an employed worker of age n with experience e, while, for each c, e, and n search effort is given by

$$\mu = \arg\max_s \psi(s) + u'\left(c\right)\left[(1-s)Y^e(c,e,n) + sJ^*(c,e,n+1)\right] \tag{25}$$

Given (24) and (25), and for any given value of c, we can use (23 to solve for J^*) backward starting from $n=\bar{n}_w$. After constructing the function J^*, we can solve for the value of c^* that satisfies (22).

B.2 Numerical solution: Unobservable search effort

To solve the problem in Section 5.2 where search effort is unobservable and unemployment insurance induces moral-hazard problems we redefine the promised utility

variable, v, as follows:

$$v = B(n)\chi,$$

where

$$B(n) \equiv \frac{1-\beta^{\bar{n}_w+\bar{n}_r+1-n}}{1-\beta},$$

Here χ is promised utility expressed in flow terms. We then rewrite the problem in the main text in Section 5.2 by having χ as a state variable. This will allow us to define the cost functions $C^e(n,e,\chi)$ and $C^u(n,e,\chi)$ which denote the cost to the agency of providing utility χ to a worker of age n and experience e when the worker is currently employed or unemployed, respectively. Working with χ (rather than v) is useful for several reasons. First by working with flow variables we make the support of the C^i, $i = e, u$ functions more stable when n change which improve interpolation, second the cost function is affected more directly by χ which is useful to extrapolate the C^i, $i = e, u$ functions for points out the grid. We discretize the state space of the C^i, $i = e, u$ functions. For points within the grid we interpolate using quadratic methods. The functions, C^e and C^u, are constructed by backward induction, starting from $n = \bar{n}_w$ and then back until $n = 1$.