

The Effect of Unemployment on 401(k) Contributions and Saving

David Love¹
Williams College
Department of Economics
Williamstown, MA 01267

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Abstract

This paper examines the effect of unemployment on saving in an economy with a 401(k) plan. The main policy experiment in the paper looks at the behavior of saving for different levels of unemployment insurance (UI), which is a perfect substitute for precautionary saving against job loss. Results from simulations of a dynamic programming life-cycle model indicate that the 401(k) may function partly as a buffer against unemployment shocks. Higher replacement rates of UI correspond with sharp reductions in 401(k) contributions for the young and comparatively small declines in other saving. Average withdrawals made from the plan during unemployment are large relative to dissaving outside the 401(k). The net impact of 401(k)s on aggregate saving in the model is positive and depends on the generosity of UI. Higher UI reduces saving in economies with and without 401(k) plans, but the reduction in saving is greatest for an economy without a 401(k).

1 Introduction

A salient feature of the U.S. economy in the nineties was the parallel rise in equity ownership on the one hand and participation in retirement accounts on the other. From 1989 to 1998, the percentage of households owning equity increased from 31.6 percent to 48.9 percent, while the percentage participating in defined contribution plans (primarily the 401(k)) went from 35.6 percent to 48 percent.¹ The measure of equity ownership includes assets held inside 401(k) plans, so these are not unrelated events. The recent rise and fall of the U.S. stock market highlighted the Janus-faced consequences of this trend, as fluctuations in net worth were experienced by a widening share of the population. In addition to giving many individuals their first taste of market volatility, a deteriorating economy after 2001 also increased their chances of becoming unemployed. The central role played by 401(k) plans in this market drama transformed the retirement saving program from a subject of debate among economists to a topic of general media interest. This paper extends a long economics literature on defined contribution plans by investigating the effect of employment risk on 401(k) contributions and total saving.

The impact of employment risk on saving and consumption should depend to a certain degree on the proportion of assets held inside a 401(k) plan. One reason for this is the fact that withdrawal restrictions are contingent upon employment status. While withdrawals from the plan are mostly prohibited until retirement, penalized withdrawals are allowed in the event of job loss. This asymmetry in liquidity means that the degree to which 401(k)s substitute for other savings should depend on the motive for saving. For retirement, it seems clear that the 401(k) is the dominant account, since the benefits of lower taxes and employer matching are not offset by penalized withdrawals. What about precautionary saving? Here, it depends on the source of the shock. While buffer-stock saving against wage fluctuations will surely be done outside the 401(k), since withdrawals during employment are heavily restricted, the location of precautionary saving against employment shocks is ambiguous. All else constant, an individual would prefer to withdraw funds from an unpenalized account in the event of job loss. Suppose, however, that doing so would deplete resources available for smoothing consumption in the face of labor income

¹Numbers taken from Bertaut and Starr-McCluer (2000).

fluctuations. In this circumstance, it might make sense for the individual to withdraw funds from the 401(k) in order to retain the ability to buffer income shocks next period. The main cost of doing so is the potential inability to make up for lost matched contributions in the future.

This paper examines the effects of return and labor income risk on the lifecycle decisions of individuals who can save in both a 401(k) plan and a conventional savings account. I characterize this risk by simulating a stochastic dynamic programming model that includes the key institutional features of the 401(k) such as withdrawal penalties, contribution limits, matching, and tax incentives. Individuals in the model maximize expected utility by choosing saving in both accounts and consumption, where expectations are formed over uncertainty in returns, wages, employment, and mortality. The cost of entering unemployment in the model is determined largely by the generosity of unemployment insurance (UI), which I model as a fraction of last period's income. The numerical solution to the model obtains decision rules for consumption and saving in each of 65 possible periods, which I then use to simulate an economy composed of 60,000 different life-cycle paths.

Simulations of the model yield insights into two central questions in the 401(k) literature. First, to what extent do 401(k) contributions substitute for other saving? The ability of 401(k) plans to increase savings depends primarily on the extent to which individuals finance increased saving in the 401(k) through a reduction in conventional saving. Any factor that influences the degree of substitution will, in turn, affect the capacity of the plan to create new savings. Results from the model indicate that the degree of substitution depends on the saving motive, with 401(k)s dominating conventional saving for both retirement saving and (more surprisingly) precautionary saving against employment fluctuations. The conventional account is used primarily for consumption smoothing over labor income shocks that occur during employment. The average withdrawal made during an unemployment spell is roughly \$8,000 in an economy with a match rate and UI replacement rate each equal to 50 percent. And second, what is the net impact on national saving, the increase of which is a primary goal of the 401(k) program? For each specification of parameters, I solve a model without 401(k)s and compare steady state saving rates. The model predicts higher national saving with the 401(k) plan, with the degree of increase

depending on the generosity of UI. Increasing the replacement rate of UI from 10 percent to 70 percent leads to a reduction in the aggregate saving rate of approximately 24 percent. For the economy without the 401(k), the reduction is even larger, around 33 percent.

I gauge the effect of unemployment on precautionary saving by changing the replacement rate of UI. This provides a straightforward test of buffer-stock saving against employment fluctuations. Unemployment insurance is itself a perfect substitute for buffer saving, so its effect on the two saving accounts reveals their respective motives. If an account is used as a buffer against employment risk, higher UI should reduce saving in that account during periods in which the precautionary motive is dominant. For a wide selection of parameters, I find that higher UI corresponds with lower contributions to the 401(k) and only slightly reduced saving in the other account. I compare ratios to income of contributions and saving and find that increasing the replacement rate of UI from 10 percent to 70 percent leads to an average reduction in the contribution ratio of 86 percent for individuals in the first 10 years of life. Saving in the outside account falls as well, but only a fourth as much.

A less central, but important, result involves the salience of the firm-imposed matching limit in determining contribution levels. There are two limits that apply to 401(k) contributions—an annual elective contribution limit set by the Employee Retirement Income Security Act (ERISA), and a matching limit set by the firm. It is the first limit that has received the most attention in the empirical literature on defined contribution plans, but the simulation results indicate that the second plays an equally essential role in predicting annual contributions. I find that the average number of years an individual contributes close to the firm matching limit is between 7 and 18 years, depending on education and UI. Any empirical exercise that fails to account for the effect of the firm limit on contributions runs the risk of underestimating the marginal impact of 401(k)s on saving.

The research most closely related to mine comprises three papers that each include a computational model of retirement plans. Eric Engen, William Gale, and John Karl Scholz (1994) solve a multiperiod model with Individual Retirement Accounts (IRAs) and find that IRAs generate little new savings. Their result follows partly from an institutional difference between IRAs and

401(k)s. The contribution limit on the IRA is approximately one-fifth the size of that on the 401(k). Desired saving in their model almost always exceed the limit, and as a consequence, the marginal incentive to save is frequently non-binding. Ayşe İmrohoroğlu, Selhattin İmrohoroğlu, and Douglas Joines (1998) model the institutional framework of IRAs in a general equilibrium life-cycle model. They find that “new” saving composes approximately 9 percent of total IRA contributions. Finally, David Laibson, Andrea Repetto, and Jeremy Tobacman (1998) return to the partial equilibrium setting of Engen, Gale, and Scholz, and model the behavior of an individual with hyperbolic preferences. Among other results, they find that hyperbolic consumers are more likely to run up against liquidity constraints. All of these papers focus on the global question of whether retirement plans increase saving. While I address this question as well, the primary contribution of my paper is its emphasis on the interaction of precautionary saving with account substitution. It is the first attempt to computationally model the impact of unemployment on saving in an economy that includes a detailed defined contribution plan.

A recent paper by Eric Engen and Jonathan Gruber (2001) examines the effect of unemployment insurance in a stochastic life-cycle model with uncertain employment and labor income. They include a pension in their model, but it accrues exogenously and resembles Social Security more than a private retirement account. Both their simulation exercise and their empirical findings support the hypothesis that unemployment insurance partially crowds out other asset holdings.

In addition to this computational literature, there is also a large body of empirical work that attempts to determine whether retirement programs have generated new national savings. Researchers are divided between those who support the conventional hypothesis that retirement saving plans “crowd out” other assets² and those who believe that these programs increase overall saving.³ The opposing vantages arise from differences in data and methodology, and it is unclear which perspective better elucidates reality.

²William Gale, Karl Scholz, and Eric Engen (q.v. Engen, Gale, and Scholz, 1994, 1996; and Gale and Scholz, 1994) are the chief proponents of this view and have found little support for the effectiveness of retirement plans in raising private saving.

³See, for example, Steven Venti, James Poterba, and David Wise (q.v. Poterba, Venti, and Wise, 1997, 1995; and Venti and Wise, 1986, 1990, 1995) who argue in a series of papers that 401(k) and IRA contributions constitute new saving.

2 401(k) Rules and Precautionary Saving

This section discusses three features of the 401(k) that limit the degree of substitution between 401(k)s and unsheltered accounts: withdrawal penalties, contribution limits and employer matching. The life-cycle model in this paper attempts to incorporate each of these plan characteristics with a satisfactory adherence to reality.

Withdrawal penalties The withdrawal rules on the 401(k) are designed to promote retirement savings. Except under special circumstances, withdrawals made before the age of $59\frac{1}{2}$ are penalized or prohibited entirely.⁴ After this age, withdrawals are unpenalized but taxed at the relevant marginal income tax rate.⁵ With the exception of plan loans, the most common means of accessing 401(k) balances before retirement is to take an early distribution in the event of a job separation. Each plan is specific to the firm, and when a separation occurs through either quitting or firing, the individual must choose one of three options. The individual can leave the 401(k) balance in the existing plan, the plan can be “rolled over” unpenalized into either a new 401(k) or an IRA, or distributions may be taken with a cost. If the individual chooses to take a distribution on some portion of the 401(k) plan, the amount is both penalized at 10 percent and taxed as ordinary income.

Contribution limits Two limits, both set by the passage of the Employee Retirement Income Security Act (ERISA), are relevant to a model of 401(k) plans. First, there is a general limit on total defined contributions of the minimum of 100 percent of earned income and \$40,000. This limit applies not only to contributions into the 401(k), but also those into other DC plans such as an IRA, Keogh, or TIAA-CREF. Second, in addition to the total DC limit, there is also an elective contribution limit of \$12,000 placed on pre-tax contributions to a 401(k). The purpose of the limit from the government’s perspective seems to be to promote savings in the middle classes,

⁴ An individual can withdraw pre-retirement if she meets one of the following conditions for hardship: (1) she is totally disabled, (2) she dies, and the money goes to a beneficiary, (3) medical expenses accumulate to more than 7.5% of gross income, (4) money is owed to a divorced spouse, or (5) the money is needed for home equity.

⁵ This consumption tax treatment in conjunction with a progressive income tax schedule may provide individuals with an incentive to smooth distributions taken in retirement. The only legal restriction imposed after retirement is that minimum distributions must be taken after age $70\frac{1}{2}$.

while restricting the tax breaks for higher income groups (Gokhale, Kotlikoff, and Warshawsky, 2001). Since asset shuffling is presumed to be most prevalent among the wealthy, who are more likely to be extra-marginal with respect to the limit, the government can reduce its revenue loss by imposing a limit on those least likely to fund saving out of depressed consumption.

Matching Employer matching, if offered, provides workers with a strong incentive to contribute to 401(k)s. Using a recent survey of participants, the Investment Company Institute (2000) reports that the employer match is the second most prevalent reason for participating in a 401(k), behind only “concern about funding retirement.” Each matched dollar placed in the account, once vested, represents a large and secure return for the employee. The particular matching formula offered by a given firm varies largely because of differences in employee demand, turnover rate, and equity of participation,⁶ Firms offering employer matching typically limit the fraction of income they are willing to match,⁷ but matched contributions within that range can be substantial.⁸

3 A Model of 401(k)s with Uncertain Income and Returns

This section describes the model of a utility maximizing individual who must choose how much to consume and how much to save in each of two possible asset locations: a 401(k) account and an unsheltered account. Assets held in either location earn the same stochastic pre-tax rate of return and both are subject to a non-negativity constraint. In each period of life, the individual forms expectations about next period’s income, returns, and probability of survival.

Preferences The framework is a standard life-cycle model with intertemporal utility maximization. The consumer maximizes the following utility function over a finite, but uncertain,

⁶Nondiscrimination tests restrict the degree to which highly compensated employee contributions can exceed those of other workers in the firm. This acts as an incentive for management to increase participation among less well remunerated employees.

⁷Olivia Mitchell (1999) reports that the modal match limit was 6% of income in 1997. Over 86% of plans had match limits below 6%.

⁸Basset, Fleming, and Rodrigues (1998) use the 1993 Current Population Survey and find a mean match rate of 62.3 percent for plans offering a positive match rate.

lifetime:

$$U_t = E_t \sum_{i=t}^T \left(\prod_{j=0}^{i-t} p_{t+j} \right) \beta^{i-t} u(C_i) \quad (1)$$

where β is the discount factor, C_t is real consumption, E_t is the expectations operator, T is the maximum life-span, and $p_t = \text{prob}(\text{alive}_t \mid \text{alive}_{t-1})$ is the conditional survival probability at period t . The period utility function is taken to be of constant relative risk aversion form:⁹

$$u(C_t) = \frac{C_t^{1-\gamma}}{1-\gamma} \quad (2)$$

where γ is the coefficient of relative risk aversion, and $\frac{1}{\gamma}$ is the intertemporal elasticity of substitution.

Income process The labor supply and retirement decisions are taken to be exogenous. The specification I choose for labor income augments the correlated process used in Hubbard, Skinner, and Zeldes (1995), Engen and Gruber (2001), and French (2001)¹⁰ with the possibility of unemployment. Let Y_t denote income that the individual receives in period t . The logarithm of income for an individual i depends on age, education, and the realization of an autoregressive shock:

$$\ln(Y_{it}) = \text{emp}_{it}(g(\mathbf{Z}_{it}) + \eta_{it}) + (1 - \text{emp}_{it}) \ln(UI_{it}), \quad (3)$$

where emp_{it} is an indicator variable that equals one if the individual is employed and zero otherwise, \mathbf{Z}_t is a vector of characteristics, $g(\cdot)$ is a trend component that depends on the characteristics, and η_{it} is an autoregressive shock with persistence ρ and a normally distributed error term ϵ_{it} :

$$\eta_{it} = \rho \eta_{it-1} + \epsilon_{it}, \quad \epsilon_{it} \sim N(0, \sigma^2).$$

⁹Despite its limitations (e.g., risk aversion and intertemporal substitution are locked down by a single parameter) the CRRA form does exhibit prudence, which is necessary to generate precautionary savings.

¹⁰The specification of log income used in these papers matches the observed hump-shaped pattern of earnings with an age polynomial (typically third-order), and characterizes persistent shocks to income with an AR(1) process.

Unemployment insurance (UI_{it}) is modeled as a fraction θ of last period's income:

$$UI_{it} = \theta \exp(g(\mathbf{Z}_{it-1}) + \eta_{it-1}).$$

In the event that an individual remains unemployed in two or more successive periods, unemployment insurance is the amount received in the first period of unemployment.¹¹ The probability of being unemployed depends on age and education and is assumed to be independent of last-period's state. In each period, the probability attached to a particular employment state, $\pi(emp)_{it} = \text{prob}(emp_{it} = emp)$, is a function of age and education (captured in the individual subscript).

This specification of income includes both persistent shocks (represented by the AR(1) process) and employment shocks. The decision not to include a completely transitory error in the log income process is motivated by a compromise between computational intensiveness (the addition of a transitory shock would require an additional integral in the expectation calculation) and a realistic depiction of income uncertainty.

Returns In each of the two locations, the assets earn a stochastic gross rate of return of R_t . The return is distributed lognormally, such that $\log(R_t) \sim N(\mu_r, \sigma_r^2)$ and $E[R_t] = \bar{R}$, where \bar{R} is the mean asset return chosen for the simulation. The assumption that both asset locations share the same rate of return is unrealistic. As discussed by Shoven (2001), the fact that returns accrue free of tax in the 401(k) plan suggests that the optimal portfolio mix inside the plan should be weighted towards more heavily taxed assets than the portfolio mix outside the plan. Modeling two separate return processes is, however, too computationally demanding to justify the added realism.

Asset constraints The individual is assumed to hold the same risky portfolio of assets in two possible locations: a 401(k) plan and an unsheltered account. Let $S_{1,t}$ denote the asset balances in the unsheltered account at the beginning of period t , and let $S_{2,t}$ denote the asset balances in

¹¹In contrast to the UI system in the U.S., this specification assumes that there are no term limits on UI. Since there is no labor supply decision in the paper, however, the issue of work incentives does not arise.

the 401(k) plan at the beginning of period t . Also, let X_t denote the contribution to (if positive), or withdrawal from (if negative), the 401(k) account in period t . Savings in the unsheltered account evolve according to the following equation.¹²

$$S_{1,t+1} = R_t S_{1,t} + Y_t - C_t - X_t - taxes_t - pen_t \quad (4)$$

where pen_t denotes any early withdrawal penalties that must be paid. Total taxes are represented by the penultimate term and include income taxes, return taxes, and the tax deduction (liability) of the 401(k) contribution (withdrawal). The structure of taxes is intended to mimic the 2000 tax code¹³ applicable for an individual. The marginal tax rate is 15 percent on income below \$26,250, 28 percent on income between \$26,251 and \$63,550, 31 percent on income between \$63,551 and \$132,600, 36 percent on income between \$132,601 and \$288,350, and 39.6 percent on income above \$288,350.¹⁴ Capital gains are taxed at 10 percent if income is under the 15-percent bracket, and 28 percent in all other brackets.¹⁵ In addition, the individuals are allowed a standard deduction of \$4,400. Taxable income is then the difference between current income and the deduction plus 401(k) contributions.

The early withdrawal penalty function is given by

$$pen_t = \begin{cases} -\kappa(emp_t) * \min(0, X_t) & \text{if } t < t^{ret} \\ 0 & \text{otherwise} \end{cases}$$

where t^{ret} is the first period in which the individual retires, and $\kappa(emp_t)$ is the penalty rate on early withdrawals, which depends on the employment state at time t . (Penalties are non-negative.) The withdrawal penalty applies to the pre-tax amount of withdrawals, so the cost

¹²The formulation of the asset accumulation constraints is similar to that used in Laibson, Repetto, and Tobacman (1998). The primary departures in my model are (1) a stochastic return, (2) an explicit treatment of unemployment, and (3) the inclusion of unemployment insurance.

¹³The Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA) significantly changed the relevant tax rates and brackets. Since the PSID data used in the paper cover periods before the EGTRRA, I do not model the new tax system.

¹⁴Amounts are indexed to year-2000 dollars.

¹⁵All returns in the model are taxed as capital gains. Thus, the tax advantage of 401(k)s in the model is essentially a lower bound.

of early withdrawals includes both the penalty and income taxes that must be paid on the full amount withdrawn. Because the 401(k) rules only permit early withdrawals in the event of a job separation or under hardship provisions (see above), the penalty function depends on the employment state. In the event of a job separation, withdrawals from the 401(k) are penalized at a rate of 10 percent. If plan loans are not permitted, the effective penalty rate on withdrawals during employment is 100 percent. It would be extreme, however, to rule out early withdrawals completely, because some plans do offer loans. I therefore solve the model for values of the employment penalty rate ranging between 20 and 100 percent.

The law of motion for asset balances in the 401(k) is given by

$$S_{2,t+1} = R_t S_{2,t} + X_t + M_t. \quad (5)$$

The employer-matched contributions are determined by a matching formula that comprises a match rate and a firm-specific match limit. Let m be the percentage of employee contributions the firm is willing to match, and ψ be the maximum fraction of income for which the firm is willing to match contributions. Matched contributions are then given by

$$M_t = \max[0, m * \min(X_t, \psi Y_t)], \quad (6)$$

where m is the rate at which contributions are matched. Equation (6) reflects the property that matches are zero if contributions are negative.

3.1 Individual's Problem

At the beginning of period t , the individual observes realizations of current income, the account returns, and the employment state. The individual then chooses consumption and saving in both accounts in order to maximize utility, given by equation (1), subject to constraints. Balances in both accounts are constrained to be non-negative, and contributions to the 401(k) are constrained to be no greater than the elective contribution limit L . Finally, contributions are not allowed

after the individual retires. These constraints are summarized by

$$S_{1,t} \geq 0 \quad (7)$$

$$S_{2,t} \geq 0 \quad (8)$$

$$X_t \leq L \quad \text{if } t < t^{ret} \quad (9)$$

$$X_t \leq 0 \quad \text{if } t \geq t^{ret}. \quad (10)$$

The set of state variables for the problem is $\{S_{1,t}, S_{2,t}, \eta_t, emp_t\}_{t=0}^T$. Note that trend income is deterministic and can therefore be absorbed into the time state. The individual forms an expectation in period t of next period's income using knowledge of both trend income $g(\mathbf{Z}_{t+1})$ and the current period's AR(1) component of income, $\eta_t = \ln(Y_t) - g(\mathbf{Z}_t)$. The set of choice variables for the problem is $\{C_t, X_t\}_{t=0}^T$. (Saving in the unsheltered plan is fully determined by the choices of consumption and savings in the 401(k) plan.) The value function for the consumer's problem is given by

$$V_t(S_{1,t}, S_{2,t}, \eta_t, emp_t) = \max_{C_t, X_t} \{u(C_t) + \beta p_t E_t [V_{t+1}(S_{1,t+1}, S_{2,t+1}, \eta_{t+1}, emp_{t+1})]\} \quad (11)$$

subject to

$$S_{1,t+1} = R_t S_{1,t} + Y_t - C_t - X_t - taxes_t - pen_t$$

$$S_{2,t+1} = R_t S_{2,t} + X_t + M_t$$

$$S_{1,t} \geq 0, S_{2,t} \geq 0$$

$$X_t \leq L \quad \text{if } t < t^{ret}$$

$$X_t \leq 0 \quad \text{if } t \geq t^{ret}.$$

The expectation in equation (11) is taken over income, return, and employment uncertainty. Specifically,

$$E_t [V_{t+1}(\cdot)] = \sum_{emp=0,1} \pi(emp)_{t+1} \int \int V_{t+1}(S_{1,t+1}, S_{2,t+1}, \eta_{t+1}, emp) dF(\eta_{t+1} | \eta_t, t) dG(R_{t+1}), \quad (12)$$

where $F(\cdot)$ and $G(\cdot)$ are the distributions of income and returns respectively. In practice, I integrate the expectation in equation (12) using two-dimensional Gauss-Hermite quadrature of order 6 on income and order 4 on the return. Beginning with the last period T , equation (11) can be solved recursively to yield consumption and saving functions, which take income and asset levels in each account as their arguments.

4 Parameter Selection and Simulation Results

4.1 Data and Calibration

Income profiles I estimate mean income profiles and error structures using data from 1988-1997 in the Michigan Panel Study of Income Dynamics (PSID).¹⁶ The estimation is intended to be consistent with two previous life-cycle models of retirement accounts, Engen, Gale, and Scholz (1994) and Laibson, Repetto, and Tobacman (1998), which estimate income by educational groups using the PSID. I define head-of-household earnings as the sum of pre-tax labor income, social security distributions, and transfer income including AFDC and SSI. This is essentially the same definition as that used in Laibson, Repetto, and Tobacman (1998), except that I do not include unemployment insurance, because I model unemployment as independent of the income trend.

The sample is divided into three educational groups according to the highest grade completed by the household head: high school dropouts (fewer than 12 years of education), high school graduates (between 12 and 15 years), and college graduates (greater than 15 years). For each group, I estimate two earnings equations: one for working years and another for retirement. I exclude observations for which the head of the household reported anything other than a working status of “employed.” This is done in order to avoid double counting unemployment spells in the model, but it results in a loss of information. A better approach would be to include a dummy in the regression for employment status. A household is considered retired if no member works more than 1,500 hours in a sample year¹⁷ and the household head is older than 55. I exclude

¹⁶I exclude the Survey of Economic Opportunities (SEO) sample to reduce selection bias.

¹⁷This definition of retirement income follows Berheim, Skinner, and Weinberg (2001) and Laibson, Repetto, and Tobacman (1998). These papers set the cut-off for retirement at 500 hours but use 1,500 hours for the definition of employment. Because this necessitates cutting out the portion of the data that meet neither requirement, I opt

from the sample any individual earning less than \$500 (all income figures are indexed to year 2000 dollars using the Consumer Price Index for urban consumers) or more than \$1,500,000 in a given year. I model log earnings as a function of the household size (FAM), an age polynomial of degree three (**AGE**) for workers and degree one for retired households, birth year dummies (**BYEAR**), and the state unemployment rate (UE) as a proxy for time-specific business cycle effects. For each education group and working status, the estimation model of earnings is

$$\ln Y_{it} = \beta_1 + \beta_2 FAM_{it} + \mathbf{AGE}_{it}\beta_3 + \beta_4 UE_{it} + \mathbf{BYEAR}\beta_5 + \eta_{it} + \nu_i \quad (13)$$

$$\eta_{it} = \rho\eta_{it-1} + \varepsilon_{it},$$

where

$$\nu_i \sim N(\mathbf{0}, \sigma_\nu^2 \mathbf{I}_T)$$

$$\varepsilon_i \sim N(\mathbf{0}, \sigma_\varepsilon^2 \mathbf{I}_T),$$

and ν and ε are orthogonal to each other and the other independent variables.

I estimate the model above using a variant of an error component model similar to that laid out in Lillard and Willis (1978). I first estimate the coefficients in equation (13) using generalized least squares on the pooled data. Next, I run a random effects regression on the residuals, allowing for the possibility of autocorrelation in the error. Let y_{it} be the log earnings residuals generated from the first regression. These residuals can be decomposed into a transitory error and a serially correlated error. Using the definitions of errors in equation (13), the residuals can be written as

$$y_{it} = \eta_{it} + \nu_i \quad (14)$$

$$\eta_{it} = \rho\eta_{it-1} + \varepsilon_{it}. \quad (15)$$

The random effects regression produces estimates of ρ , σ_ν^2 , and σ_η^2 , but the simulation model requires an estimate of σ_ε^2 . It is possible to combine (14) and (15) to find the following expression

for the more inclusive single cut-off.

Table 1: Coefficient Estimates for Income Profiles

<i>Independent Variable</i>	<i>Education <12</i>	<i>Education 12-15</i>	<i>Education >15</i>
<i>Working Households</i>			
Family Size	0.062 (0.016)	0.017 (0.008)	0.037 (0.010)
Age	0.201 (0.084)	0.099 (0.045)	0.029 (0.053)
Age ² /100	-0.358 (0.195)	-0.035 (0.106)	-0.468 (0.114)
Age ³ /10,000	0.203 (0.145)	-0.089 (0.080)	0.241 (0.079)
Constant, UE, and Cohort	6.749	7.844	6.749
<i>Retired Households</i>			
Family Size	-0.078 (0.029)	-0.073 (0.042)	0.059 (0.088)
Age	0.000 (0.000)	0.015 (0.006)	-.044 (0.008)
Constant, UE, and Cohort	8.947	9.867	13.010
<i>Error Components</i>			
AR(1) correlation (ρ)	0.698	0.665	0.698
Transitory variance (σ_ν^2)	0.132	0.109	0.129
Persistent variance (σ_ε^2)	0.044	0.028	0.026

Source: Author's estimates using the 1988-1997 Michigan Panel Study of Income Dynamics. The dependent variable is the logarithm of income in year-2000 dollars. Standard errors included below.

for the total variance:

$$\sigma_y^2 = \sigma_\nu^2 + \sum_{j=0}^{\infty} \rho^{2j} \sigma_\varepsilon^2 = \sigma_\nu^2 + \frac{\sigma_\varepsilon^2}{1 - \rho^2}.$$

Combining this result with the identity $\sigma_y^2 = \sigma_\nu^2 + \sigma_\eta^2$, the variance of the shock on the autoregressive component of wages can be written

$$\sigma_\varepsilon^2 = \sigma_\eta^2(1 - \rho^2).$$

Many authors have previously estimated similar earnings equations,¹⁸ and my results are generally consistent with these papers. Table 1 displays the coefficient estimates for the regressions

¹⁸Most of these estimations, including mine, follow the pioneering work of Lillard and Willis (1978). Previous attempts directly relevant to my paper include Abowd and Card (1989), Carroll (1992), Engen, Gale, and Scholz (1994), Hubbard, Skinner, and Zeldes (1995), and Laibson, Repetto, and Tobacman (1998).

on equation (13). Standard errors are displayed in parenthesis below the estimates. A quick look at the signs of the first three derivatives of the age polynomials verifies that the coefficient estimates reflect the well known hump-shaped pattern of earnings. The estimated correlation parameters on the AR(1) component of income are similar across educational groups and indicate a moderate degree of persistence. For each educational group, roughly 70 percent of the previous period's shock persists in the next period. These values for the correlation coefficient are lower than those in Hubbard, Skinner, and Zeldes (1995) and about the same as those in Laibson, Repetto, and Tobacman (1998). Estimates of the transitory variances are somewhat larger than previous estimates; the corresponding standard deviations range from 0.33 for high school graduates to 0.36 for college graduates. Since the transitory variance picks up measurement error in addition to contemporaneous idiosyncratic shocks, it is unlikely that these values accurately reflect transitory uncertainty. The income process I use in the paper allows for only persistent (AR1) shocks to income, so I do not actually use the transitory estimates. Estimates of the persistent variances imply standard deviations of 0.210, 0.167, and 0.161 for high school dropouts, high school graduates, and college graduates respectively. These values are slightly larger than those in Hubbard, Skinner, and Zeldes (1995) but smaller than those in Laibson, Repetto, and Tobacman (1998).

Figure 1 displays the estimated earnings profiles for each educational group. Earnings for all groups display a hump-shaped pattern and reach a peak around age 50. High school dropouts have a much flatter profile than either high school graduates or college graduates but have a higher replacement rate in retirement. Non-asset income for college graduates drops far more precipitously at retirement compared to the other two groups.

Unemployment Unemployment in the model is treated as an exogenous event subject to a probabilistic law. Since quits are predictable by the worker and likely timed to avoid severe drops in income, I exclude voluntary separations from my probability measure of job loss. The closest empirical analogue to this process is job displacement. A key source of data on job displacement is the Displaced Workers Survey (DWS) supplement to the Current Population Survey (CPS).

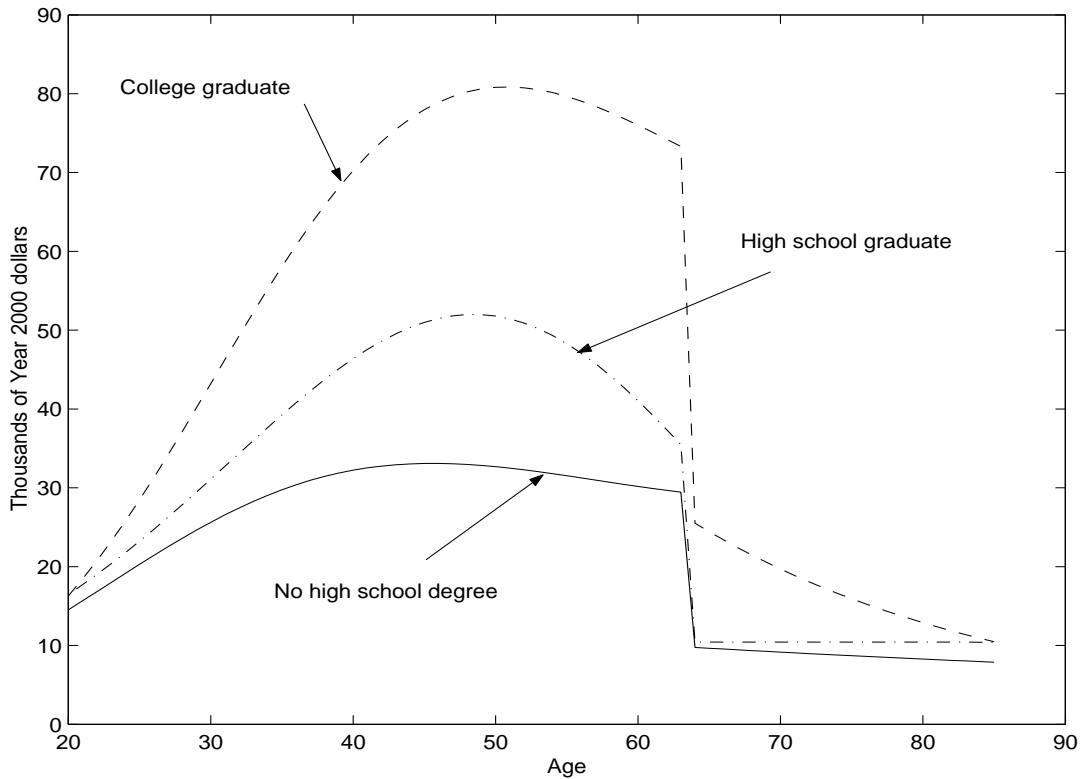


Figure 1: Estimated Age-Income Profiles

The definition of displacement in the survey requires that a person lose their job because of a plant closing, an employer going out of business, or a layoff. While these circumstances might be predictable to the extent that they move with an observed business cycle, they are exogenous with respect to the decision making process of the individual. Because my model assumes an inelastic supply of labor, this measure of unemployment reduces the potential endogeneity of job separations.

I calibrate the probability of unemployment using displacement results from a paper by Henry Farber (1997). Farber examines DWS data from 1984 to 1996 and reports displacement rates for a three year period. A person counts as displaced in the survey if in a three year span, a job separation occurs meeting any of the criteria listed above. Farber categorizes displacement rates by both education and age, which allows me to construct age- and education-dependent job loss probabilities. I compute these probabilities as follows.

Table 2: Displacement Probabilities by Age and Education

<i>Age</i>	<i>Education <12</i>	<i>Education 13-15</i>	<i>Education >15</i>
20-24	0.076	0.055	0.039
25-34	0.068	0.052	0.035
35-44	0.058	0.043	0.030
45-54	0.053	0.039	0.028
55-64	0.057	0.039	0.027

Source: Author's calculation using results from Tables A-3 and A-4 in Farber (1997).

For each age category, I calculate the average three-year rate of job loss for all occupations using Farber's Table A-3. I then perform the same exercise for each education category listed in Farber's Table A-4. I take averages over the years 1989 to 1995 in order to confine the results to the sample period I use in the PSID. Next, I combine these two measures by weighting the age rates by one plus the percentage gap between the education specific rate and the average rate for all educational groups. The weights are 1.31, 0.98, and 0.70 for dropouts, high school graduates, and college graduates respectively. The resulting probability measures apply to the event of losing a job in a three year period. Since a period in my model represents one year, I need to convert these numbers into one-year probabilities of job loss. I do this by making the simplifying assumption that the rate of displacement is constant for each period. If anything, this assumption understates the per-period rate of displacement, since the DWS does not control for multiple job losses in the three year span. For each age $i = 20, \dots, 65$, and education group $j = \text{dropout}, \text{H.S. grad}, \text{college grad}$, I define the unconditional probability of job loss as one minus the probability of never being displaced in a given year. Specifically,

$$prob_{ij}(\text{unemployed}) = 1 - (1 - r_{ij}^{disp})^{1/3},$$

where r_{ij}^{disp} is the average three-year education-weighted displacement rate between 1989 and 1995. These probabilities are reported in Table 2. Two trends are worth noting. First, the displacement rate declines with age for every education group except for dropouts. This reflects the tendency for job stability to increase with age and validates the claim made earlier in the paper that job uncertainty is greatest for the young. Second, the displacement rate declines

monotonically with education. As noted earlier, individuals with higher expected income growth, notably college graduates, are more likely to save primarily as a buffer against income shocks. The lower displacement rates faced by the better educated reduces somewhat this incentive to save.

Life-cycle parameters Individuals begin life at age 20 and live to a maximum of 85 years. For all ages under 85, I calculate the conditional survival probabilities using mortality tables from the National Center for Health Statistics US Life Tables, 1999. For the baseline set of parameter specifications, I set the discount factor β equal to 0.967, which together with the survival probabilities tends to offset the effect of the return on intertemporal consumption. Given the importance of the discount factor in determining the time path of consumption, I test the sensitivity of my results to different values of β . For the baseline specification, I set the coefficient of relative risk aversion γ to 3, which is within the range of commonly used values. Because the coefficient of relative risk aversion plays such a fundamental role in precautionary saving, I also simulate the model for γ ranging between 1 and 5.

401(k) parameters I choose parameters for the 401(k) plan that closely match those of a typical plan. The contribution limit L is set to \$10,500, which was the value of the elective contribution limit in the year 2000. The penalty rate $\kappa(emp_t)$ is taken to be 100 percent on early withdrawals before retirement if the individual is employed. This is consistent with the rules on the 401(k) which generally prohibit any early withdrawals during employment. In the presence of plan loans, this penalty is too strict. I therefore solve the model for lower values of the employment penalty to check the sensitivity of results to liquidity. If the individual is unemployed, the penalty is set to 10 percent, which is the penalty rate set by ERISA on pre-retirement withdrawals. Although I solve the model with a range of match rates from 10 to 100 percent, my baseline specification uses a rate of 50 percent and a match limit of 6 percent of earnings. This is the modal match function exhibited in the data, and 26 percent of plans with matching in 1997 offered exactly this arrangement.

Unemployment insurance The purpose of including UI in the model is to test the substitution between 401(k)s and ordinary saving; it is not intended to realistically portray unemployment insurance in the U.S. Indeed, this would be unduly burdensome, as UI varies greatly from state to state. The characterization of UI in the paper is best thought of as a national average of UI across states. Varying the generosity of UI represents the main policy experiment in the paper, and I solve all specifications of the model with replacement rates of UI ranging from 10 percent to 70 percent of the previous period's income.

Allocation and returns Individuals are assumed to hold 60 percent of their assets in stocks and 40 percent in T-Bills. This allocation is meant to replicate the average 401(k) portfolio allocation reported in a paper by Holden and VanDerhei (1999). They find that in 1999, equity funds composed 53 percent of the allocation, while company stock composed 19 percent. The remainder was split between bonds and other low risk assets. I choose an average annual return on stocks of 8 percent, which is close to the average real return of the S&P 500 over the last century, and an average real return on T-Bills of 0.6 percent. This generates an average annual return on the portfolio of about 5 percent. In addition, I assume that the standard deviations of stock and T-Bill returns are 20 percent and 4.5 percent respectively. This implies a standard deviation on the portfolio of about 15 percent.

The assumption of a fixed allocation, both inside and outside the 401(k), is clearly incorrect. The tax-favored nature of the 401(k) plan provides an incentive to place the most heavily taxed asset (here, stocks) in the plan and the remainder outside. It would not be difficult to model this type of allocation, and I plan to incorporate it in future solutions to the model.

Asset levels Empirical measures of 401(k) asset accumulation do not correspond to those generated by the life-cycle model. The model assumes that individuals have access to a 401(k) plan from the start of their working life. In reality, however, only individuals who began their working lives after 1978, when the 401(k) was introduced, have had access to the plan their entire working lives. Despite these differences, the data provide a useful check on the quantitative implications of the model, particularly those pertaining to the young, who have had access to the

plan for a longer portion of their planning horizon. Table 10 in appendix 2.73 presents mean and median asset levels of both plan and non-plan savings for the years 1995, and 1998, conditional on participating in a 401(k) plan.

While simulated asset levels should not be expected to match up with the data, contributions of younger individuals should perform better. Individuals who entered the workforce after the 401(k) was introduced in 1978 have faced a decision problem similar to the one I model. Although my goal is not to explicitly match any particular level of contributions, the empirical and simulated contributions (conditional on participating) are of the same magnitude. Annual contributions in the SCF average about 4,034,¹⁹ which is very close to the simulated contributions of the model (see table 6 below).

5 Results

This section presents results from the model simulations. I begin with an overview of the lifecycle outcomes and show a couple of representative simulations for high school graduates. While these compose only a small fraction of the total results, they provide a good look at saving behavior in the presence of unemployment shocks. I then move on to address the three central questions of the paper: (1) Do 401(k)s serve as a buffer?; (2) How does UI affect the substitution between the two accounts?; and (3) What is the net impact on national saving? Along the way, I also discuss other results, such as the role of both the contribution limit and the firm matching limit on saving and the effect of return risk on retirement distributions.

The solution method I use is outlined in my dissertation (Love, 2003). The basic idea is to work backwards from the last period, constructing interpolated value functions that are used in the pervious period's optimization problem. Once the model is solved, I then simulate 20,000 lifecycles for each parameter specification and education group.

¹⁹See table 9 in the appendix.

5.1 Representative simulations

Figure 2 depicts a single simulation of the working life of a high school graduate with a CRRA parameter equal to 3, where the UI replacement rate is 10 percent and the employer match equals 50 percent of contributions up to 6 percent of salary. Although the figure presents only one simulation out of 20,000, it offers an overview of several key features of the model. The first thing to notice about the picture is that saving in both accounts fluctuates over the working life to smooth consumption. While contributions tend to fall during periods in which income is low relative to its expected value, the majority of adjustment occurs along the margin of saving in the outside account. An exception to this is unemployment. During periods of unemployment (ages 37, 43, 49, and 62), large withdrawals are taken from the 401(k) in order to offset the reduction in consumption. This alone does not provide evidence that the 401(k) is used as a buffer stock, since bad luck might require the individual to dip into her retirement account, despite the fact that she never anticipated having to do so. In order to identify the saving motive, it is necessary to look at the change in saving in both accounts with respect to a perfect substitute for a buffer-stock—in this case, UI. This is the main experiment of the paper, and I report the results below.

Another feature that is shown in this single simulation is the importance of the contribution limit to saving in the 401(k). For about 16 years, contributions are very close to the elective contribution limit. The implications of a binding contribution limit are twofold. First, when contributions run up against the limit, desired saving in the 401(k) is likely to exceed actual saving, with the residual getting absorbed by some combination of increased saving and/or consumption. Whether the residual actually ends up in other saving depends on the wedge induced by the contribution limit on the marginal incentive to save. At the contribution limit, the expected return on saving another dollar falls due to the lost tax advantage.²⁰ The second effect of the contribution limit is more subtle. Because individuals will anticipate the likelihood of a binding constraint, they may smooth their contributions over time. This is an important point. Even if the contribution limit never binds for an individual ex post, that does not imply that the

²⁰With a matching limit of 6 percent, contributions near the limit are unlikely to be matched. Thus, the wedge is smaller than it would be if the contribution limit were lower.

contribution limit did not affect saving.²¹ As will be seen in the results below, the importance of the contribution limit depends both on the firm match rate as well as the generosity of UI.

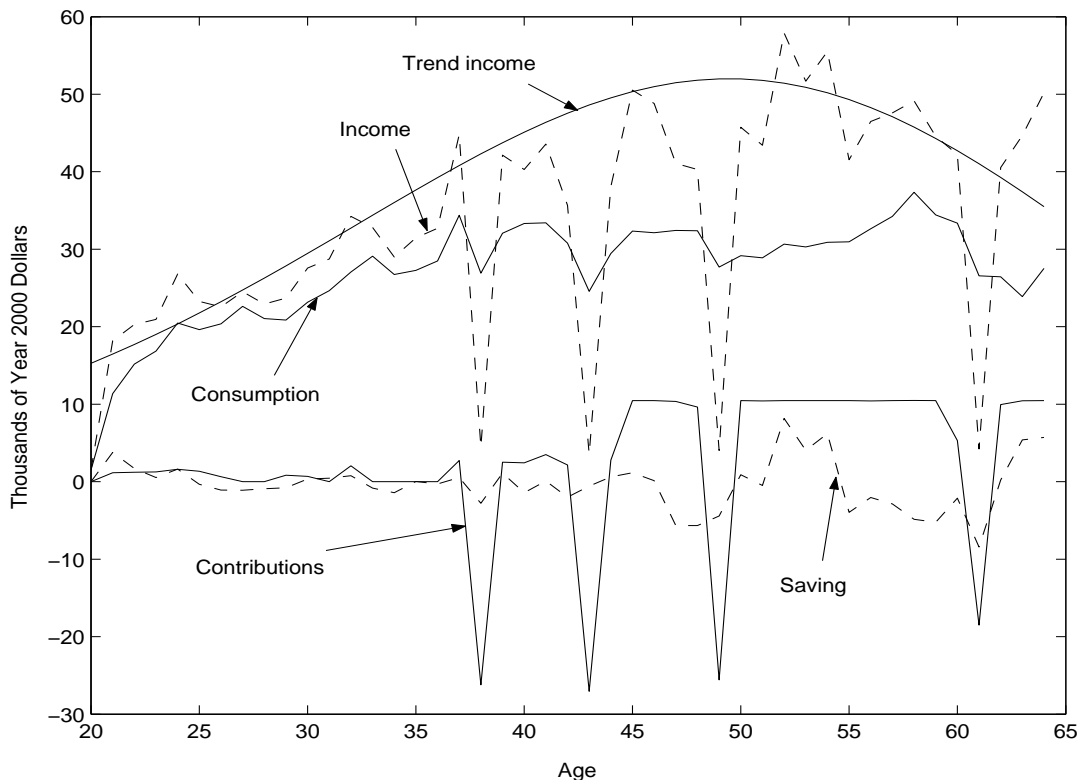


Figure 2: Working Portion of Lifecycle for High School Graduates—Single Simulation

When the model is simulated many times some of the effects that are visible after one simulation wash out in the average. So, for example, contributions can never reach the elective limit on average. This is simply due to the fact that positive shocks to income cannot push contributions above the limit, while negative shocks can push them below. This implies that the average contribution level *must* be lower than the limit, even though it is possible that the limit binds for some individuals. Nevertheless, a look at the average profiles can give one a sense of the path of variables in the aggregate. Figure 3 shows the average profiles corresponding to the single simulation presented above. In line with predictions from the buffer-stock saving literature, consumption closely tracks income for about 15 years before leveling off through retirement.

²¹Carroll and Kimball (2001) provide theoretical foundations for the interaction between liquidity constraints and precautionary savings.

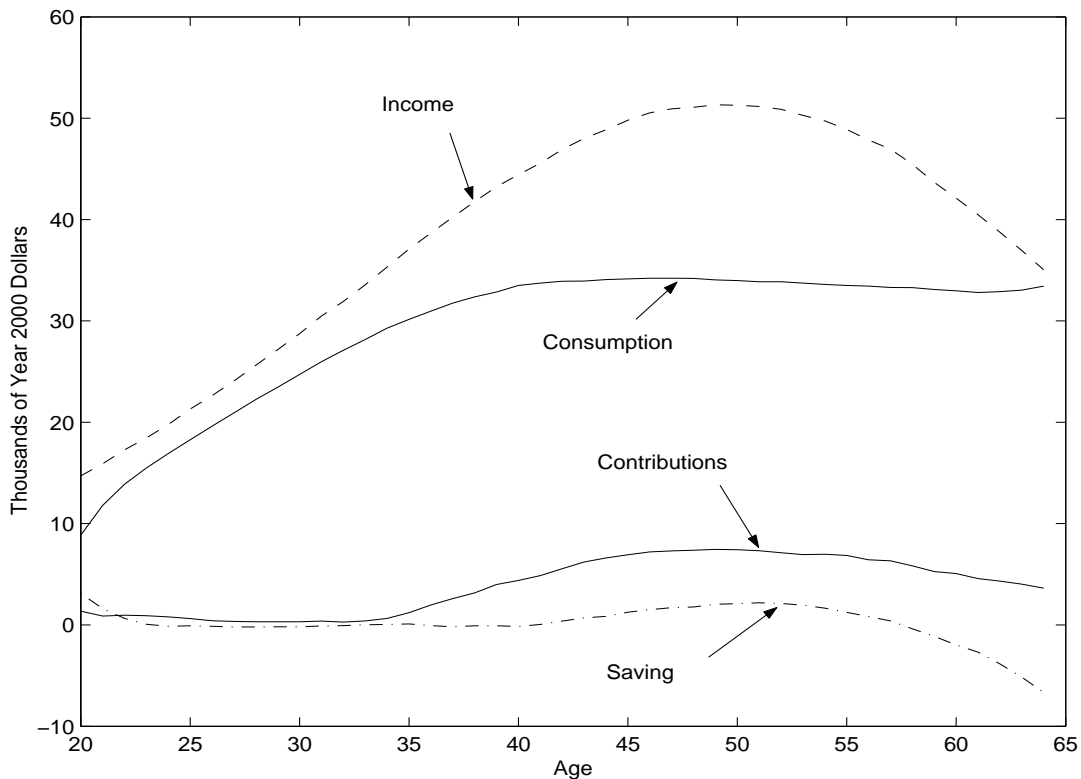


Figure 3: Working Portion of Lifecycle for High School Graduates—20,000 Simulations

(Strictly speaking, in a lifecycle model with income uncertainty and preferences that generate precautionary behavior, it is not possible to cleanly separate precautionary saving from lifecycle saving. Nevertheless, these motives will change in importance over the lifecycle, with the precautionary motive dominating in earlier years and the lifecycle motive dominating in later years.) During this same period, saving in both accounts is low but positive, suggesting the presence of precautionary saving. As the lifecycle saving motive becomes more important, contributions rise relative to other saving, while other saving actually becomes negative on the other side of the income hump. It is evident from the picture that withdrawals from conventional saving are used to prop up contributions and consumption during the predictable decline in income just before retirement.

Although this paper focuses on the working portion of the lifecycle, it is worth taking a brief look at asset accumulation over the entire life. The total lifecycle for college graduates is depicted

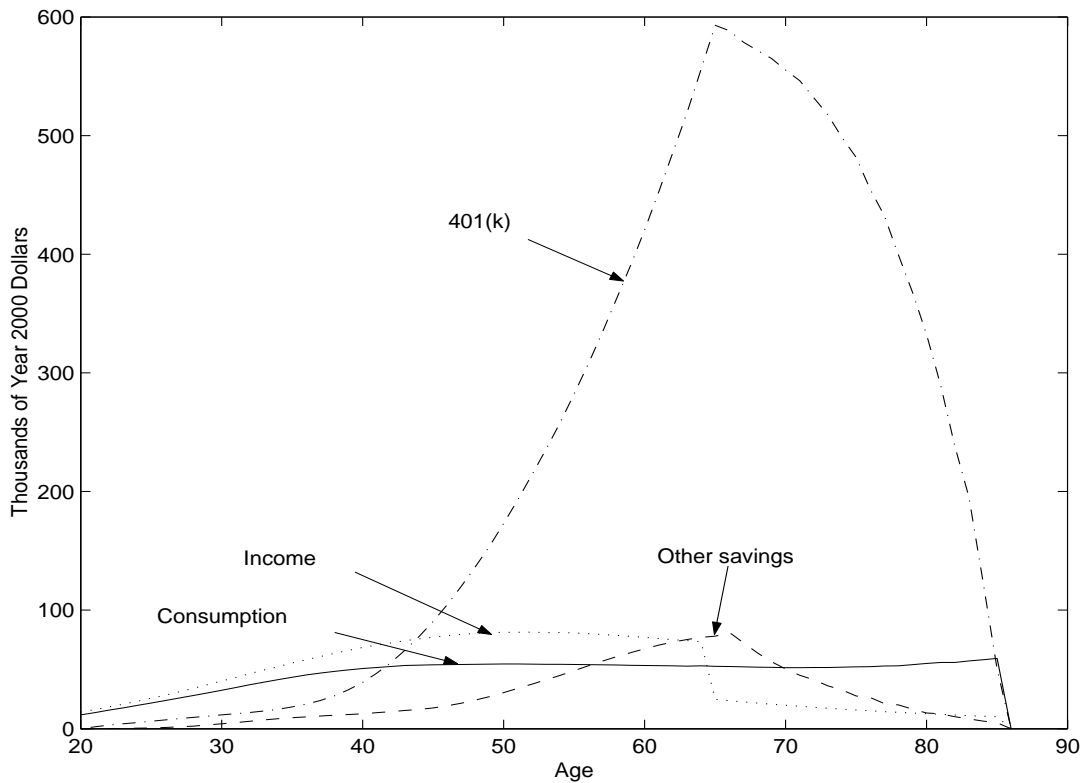


Figure 4: Lifecycle Profile for College Graduates.

in figure 3. Asset accumulation in the first 10 years is relatively small, and the majority of saving is done in the 401(k). Contributions during this period average about \$500, while average saving is around \$370. (The acceleration of the 401(k) account relative to other savings is attributable largely to fact that contributions are matched at 50 percent.) Saving in the outside asset increases slightly with income until age 45, at which point there is a noticeable rise until retirement. This occurs at exactly the point where average contributions begin to hover near the elective limit, suggesting that part of the residual desired saving in the 401(k) is located in the other account. Total accumulation in the 401(k) at retirement is about six times as large as that in the other account. The decumulation pattern in the 401(k) after retirement creates a convex savings profile in that account. The reason for this has to do with the ordinary income tax treatment of 401(k)s in conjunction with the progressive tax schedule. Since the income path declines over retirement, withdrawals must be gradually increased over time in order to maintain a constant level of taxable

Table 3: Average Dissaving in the 401(k) When Unemployed

<i>Education</i>		<i>UI=10%</i>	<i>UI=30%</i>	<i>UI=50%</i>	<i>UI=70%</i>
<12	<i>m = 50%</i>	-13,877	-11,950	-9,367	-6,336
	25%	-11,473	-9,758	-7,141	-4,757
	0%	-9,371	-7,227	-5,257	-3,948
12-15	<i>m = 50%</i>	-15,862	-11,541	-7,568	-4,472
	25%	-13,269	-9,582	-5,730	-2,882
	0%	-9,870	-6,959	-4,265	-1,138
>15	<i>m = 50%</i>	-16,941	-11,644	-7,236	-3,479
	25%	-13,616	-8,847	-4,434	-2,069
	0%	-9,876	-5,907	-2,280	-945

Source: Author's simulations. The table displays the average (dis)saving in the 401(k) (in year 2000 dollars) during periods of unemployment. CRRA = 3.

income. As in the working life figures above, consumption tracks income for the first 15 years before leveling off through retirement. The slight rise in consumption at the end of life results from precautionary behavior in the face risky asset returns.

5.2 Do 401(k)s serve as a buffer?

Table 3 displays the average (dis)saving in the 401(k) during spells of unemployment for different match rates and UI replacement rates. It is immediately apparent, from looking at the table, that the 401(k) is accessed regularly during unemployment. The average withdrawal for high school graduates, for instance, ranges between \$1,138 and \$15,862, depending on the combination of the match and UI. As would be expected, withdrawals decline with higher replacement rates of UI and lower match rates. At lower match rates, asset accumulation inside the 401(k) is smaller, and less is available in the event of job loss. A more surprising trend in the table is the relative size of withdrawals across education groups. High school dropouts, who have the lowest expected income, tend to withdraw larger amounts from their plan than high school and college graduates. This is most likely due to combination of two factors. First, the income profiles of high school and college graduates are not only higher than those of dropouts; they are also more hump-shaped. This provides a strong incentive to save in the outside account in order to smooth consumption on the other side of the hump. All else constant, this incentive tends to

push up saving in the outside account relative to the 401(k) plan, creating in the process a larger stock of outside resources that can be tapped during unemployment. The second explanation is simply that higher income individuals face a higher cost of withdrawal, since they are more likely to reach a higher marginal tax rate.

Contribution limit An important aspect of 401(k)s from a policy perspective is the effect of contribution limits on saving. The 401(k) program targets lower wealth individuals and attempts to limit the gains by individuals who would accumulate significant savings even in the absence of the plan. The simulation exercise indicates that the frequency with which the limit binds depends both on income and unemployment insurance generosity. Table 4 displays for several replacement rates the average number of years an individual contributes within 95 percent of the elective contribution limit.

The number of years an individual contributes at the limit depends negatively on the match rate, and positively on education (income) and the UI replacement rate. Dropouts are an exception and, for the most part, display the opposite pattern. For high school and college graduates, the effect of higher UI is small in comparison with the impact of a higher match rate. Increasing the match rate from zero percent to 50 percent reduces the average number of years of limit contributions by 17 percent and 21 percent for high school and college graduates respectively. There are two potential explanations for the negative relationship between the match and limit contributions. The first is that there is an income effect associated with reducing the match. With a lower match, the individual must increase contributions in order to reach the same target level of savings as before. The other explanation involves the precautionary saving motive. When the match rate drops, so too does the incentive to save in the 401(k) early in life, when the buffer-stock motive is predominant. The individual then enters the retirement accumulation stage with a lower balance in the 401(k) and must accelerate contributions to catch up.

Matching limit The effect of contribution limits on savings has received a large amount of attention in the previous literature. Less emphasis has been placed on the kink imposed by the employer matching rules. The matching formula stipulates that the firm will match contributions

Table 4: Average Number of Years Contributing at the Limit

<i>Education</i>		<i>UI=10%</i>	<i>UI=30%</i>	<i>UI=50%</i>	<i>UI=70%</i>
<12	<i>m = 50%</i>	2.81	2.69	2.71	2.86
	25%	2.30	2.10	2.13	2.10
	0%	1.95	1.74	1.65	1.59
12-15	<i>m = 50%</i>	13.53	13.81	13.95	14.05
	25%	15.01	15.15	15.21	15.32
	0%	16.28	16.56	16.59	16.63
>15	<i>m = 50%</i>	14.94	15.62	15.91	16.33
	25%	17.05	17.42	17.75	18.04
	0%	19.00	19.25	19.54	19.67

Source: Author's simulations. The table displays the average number of years an individual contributed within 95% of the elective contribution limit. CRRA = 3.

Table 5: Average Number of Years Contributing Near the Matching Limit

<i>Education</i>		<i>UI=10%</i>	<i>UI=30%</i>	<i>UI=50%</i>	<i>UI=70%</i>
<12	<i>m = 50%</i>	18.47	18.05	17.03	16.27
	25%	10.51	10.12	9.65	8.94
12-15	<i>m = 50%</i>	12.34	11.14	9.18	7.99
	25%	8.65	8.58	6.68	5.40
>15	<i>m = 50%</i>	11.66	8.62	8.03	7.45
	25%	6.91	5.65	5.13	4.09

Source: Author's simulations. The table displays the average number of years an individual contributed between 95% and 105% of the firm-imposed matching limit (ψY_t). CRRA = 3.

only up to a certain fraction of income. Results from the simulations indicate that the firm matching limit plays a large role in determining the size of contributions to the 401(k). Table 5 reports the average number of years an individual contributed between 95 and 105 percent of the firm matching limit (equal to ψY_t). Lower UI replacement rates, higher matches, and lower education are associated with more frequent contributions near the match limit. The influences of matching and UI are closely related. The primary reason individuals save in the first 10 years of life is to buffer against income fluctuations, caused, in part, by unemployment. The withdrawal penalty on the 401(k) reduces the liquidity of assets held within the plan. The generosity of the employer match can, however, offset this reduced liquidity and make the 401(k) a viable buffer account against employment risk. Lower risk of unemployment and smaller compensation in the 401(k) will then have the effect of reducing desired contributions early in life.

The influence of the employer match on contributions is apparent when one looks at the time paths of contributions as a ratio to income. Figure 5 shows the average path of contributions for a high school graduate along with the matching and contribution limits, all as ratios to income. (The U-shape of the contribution limit is just the obverse of the hump-shaped income profile.) The precautionary saving motive, in conjunction with the firm matching limit, induces an S-shaped kink in the contribution path over time. Contributions remain below the matching limit for roughly the first 10 years of life and then increase substantially as retirement accumulation begins. Higher replacement rates of UI primarily affect contributions made in the first periods of life, when the precautionary motive prevails. Contributions made after age 35 are essentially unchanged.

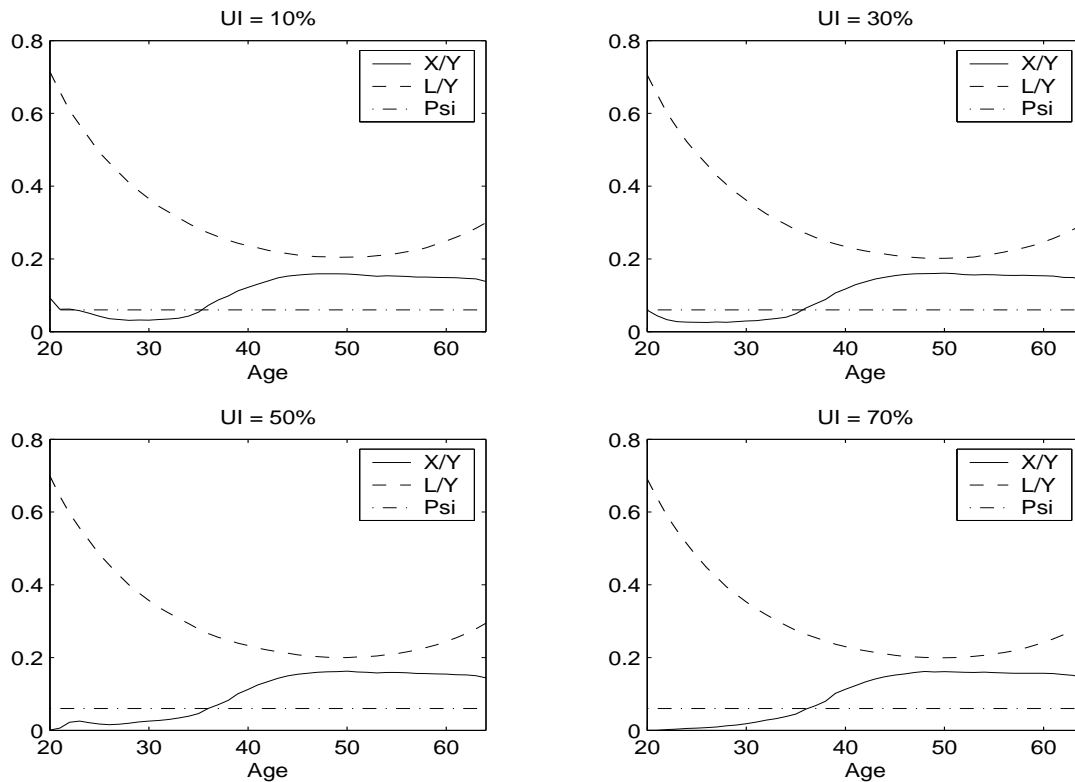


Figure 5: Simulated Ratios to Income of Contributions, the Elective Limit, and the Matching Limit.

5.3 Substitution between the 401(k) and ordinary saving

While 401(k) plans are drawn upon during unemployment, it is not clear how much saving in the 401(k) is done in anticipation of that event. The relative movements of conventional saving and 401(k) contributions with unemployment insurance can be used to assess the degree to which the 401(k) substitutes for precautionary savings against employment fluctuations. If individuals save in the 401(k) strictly for retirement, while buffering against wage and employment uncertainty in the conventional account, then an increase in unemployment insurance would likely induce individuals to save less in the conventional account. This reduction in saving would free up resources available for increased consumption and/or increased 401(k) contributions. If, on the other hand, 401(k) plans substitute for a buffer against employment risk, then the opposite should occur; higher unemployment insurance rates should correspond with lower 401(k) contributions and potentially higher conventional saving.

Table 6 reports average ratios of conventional saving and 401(k) contributions to income for different replacement rates of unemployment insurance. For several different age groups, the table displays mean saving (conditional on employment) as a fraction of income for individuals of a given education level. Looking at the movements of saving and contributions for different replacement rates, there is strong evidence in favor of the hypothesis that the 401(k) plan is the primary account for buffer savings against employment risk. The first row for each education group displays saving ratios for individuals in the first 10 years of life, during which a precautionary motive is likely to be dominant. The contribution-to-income ratios drop dramatically as the UI replacement rate increases from 10 percent to 70 percent, with declines of 67 percent, 88 percent, and 99 percent for dropouts, high school graduates, and college graduates respectively. Saving in the conventional account falls as well, but not nearly as much; the respective decreases are 14 percent, 39 percent, and 31 percent for the three education groups. This pattern largely disappears for the two age groups in the middle (ages 30 to 50) and reverses itself for the middle aged (50-64), who actually save more in both accounts with higher replacement rates of UI.

Referring back to the figure depicting a single simulation, it is clear that saving in *both* accounts falls during an unemployment spell. This phenomenon makes it difficult to identify the extent

Table 6: Contributions and Saving as Ratios to Income

Education	Age	UI Rate=10%		UI Rate=30%		UI Rate=50%		UI Rate=70%	
		X/Y	S/Y	X/Y	S/Y	X/Y	S/Y	X/Y	S/Y
<12	20-29	0.0606	0.0594	0.0431	0.0532	0.0317	0.0506	0.0210	0.0503
	30-39	0.0356	0.0344	0.0349	0.0290	0.0327	0.0291	0.0309	0.0285
	40-49	0.0722	0.0459	0.0691	0.0518	0.0674	0.0513	0.0663	0.0512
	50-64	0.1316	-0.0472	0.1276	-0.0308	0.1275	-0.0288	0.1292	-0.0313
12-15	20-29	0.0499	0.0314	0.0320	0.0232	0.0167	0.0202	0.0060	0.0186
	30-39	0.0603	-0.0017	0.0555	-0.0029	0.0515	-0.0022	0.0492	-0.0015
	40-49	0.1483	0.0201	0.1468	0.0245	0.1457	0.0250	0.1445	0.0251
	50-64	0.1505	-0.0219	0.1541	-0.0178	0.1558	-0.0131	0.1565	-0.0108
>15	20-29	0.0625	0.0180	0.0331	0.0130	0.0142	0.0114	0.0002	0.0123
	30-39	0.0287	0.0134	0.0263	0.0111	0.0246	0.0104	0.0236	0.0087
	40-49	0.0904	0.0121	0.0911	0.0147	0.0911	0.0152	0.0912	0.0163
	50-64	0.1060	0.0117	0.1088	0.0182	0.1098	0.0209	0.1110	0.0226

Source: Author's simulations. The table displays ratios of conventional savings and 401(k) contributions to non-asset income for different age/education combinations. The models were simulated with the following parameter specifications: match rate = 50%, penalty rate when employed = 100%, penalty rate when unemployed = 10%, and CRRA = 3.

a. S/Y is the average ratio of conventional saving to non-asset income for each age group, conditional on employment.

b. X/Y is the average ratio of 401(k) contributions to non-asset income for each age group, conditional on employment

to which 401(k) contributions actually substitute for precautionary saving against employment risk. The precautionary element in contributions is evidenced by the tendency for contributions to fall with higher UI replacement rates. In contrast, if other savings were the primary buffer, an increase in UI would have the effect of reducing saving outside the 401(k) while either increasing or leaving the same assets held within the 401(k).

5.4 Effects on aggregate saving

In order to get a sense of how different replacement rates affect total savings, I compare the aggregate saving rates generated by different specifications of the model. I abstract from the panel estimates of the income process and simply assume cohort specific rates of growth. Each successive cohort expects an income profile and tax schedule that is a scaled up version of those of

Table 7: Aggregate Saving (percent) by UI Replacement Rate

$n + g$	$UI = 10\%$			$UI = 30\%$			$UI = 50\%$			$UI = 70\%$		
	$m = 0\%$	25%	50%	0%	25%	50%	0%	25%	50%	0%	25%	50%
.00	8.0	7.6	7.1	7.2	6.8	6.3	6.3	6.1	5.6	6.0	5.5	5.0
.01	10.2	9.8	9.4	9.1	8.7	8.4	8.0	7.9	7.6	7.8	7.2	6.9
.02	11.6	11.3	10.9	10.4	10.0	9.7	9.7	9.2	8.9	8.9	8.3	8.1
.03	12.5	12.3	12.0	11.0	10.8	10.6	9.8	9.8	9.5	9.1	8.9	8.7
.04	13.0	12.8	12.5	11.3	11.1	10.9	9.9	9.9	9.8	9.3	8.9	8.8
.05	13.2	12.9	12.8	11.2	11.1	10.9	9.7	9.8	9.7	8.8	8.7	8.6
.06	13.1	12.9	12.7	10.9	10.9	10.7	9.3	9.4	9.4	8.1	8.2	8.2
.07	12.9	12.7	12.5	10.5	10.5	10.4	8.8	8.8	8.9	7.6	7.6	7.7
.08	12.6	12.5	12.2	10.0	9.9	9.9	8.3	8.3	8.3	7.0	7.0	7.1

Source: Author's simulations. The table displays the aggregate saving rate for combinations of UI replacement rates, match rates, and total growth rate (population + economic). $CRRA = 3$.

the cohort before. Table 7 displays national saving rates by unemployment insurance generosity for different assumed values of the birth rate (n) and the economic growth rate (g). Economic growth is assumed to be cohort-specific, so that the life-cycle variables (consumption, savings, taxes, etc.) of a cohort born at time $t + 1$ will be $(1 + g)$ times the size of those for the cohort born the period before.

Across different combinations of g and n , higher replacement rates of UI are associated with lower aggregate saving rates. In addition, as the economy grows faster and consequently places more weight on younger cohorts, the reduction in saving increases. In light of the results pertaining to the substitution of 401(k)s for precautionary saving against employment shocks, the displacement of saving due to higher UI is reflected primarily in the reduction of 401(k) contributions of the young.

As a basis of comparison, I perform the same simulation and aggregation exercises on a model without 401(k) plans. Table 8 presents aggregate saving rates for this economy. For all values of the UI replacement rate and total growth rate, this economy produces lower saving rates than the economy with 401(k)s for the entire range of match rates. In steady state, the impact of 401(k)s on saving appears to be strictly positive. What about the relative effect of changes in UI on saving in both economies? Increasing UI appears to reduce saving more in the economy without 401(k)s, though not by a large margin. The percent reduction in saving associated with

Table 8: Aggregate Saving (percent) by UI replacement Rate: No Plan

$n + g$	$UI = 10\%$	$UI = 30\%$	$UI = 50\%$	$UI = 70\%$
.00	6.0	5.2	4.5	3.8
.01	7.8	6.8	5.9	5.2
.02	9.0	7.8	6.8	6.0
.03	9.8	8.3	7.2	6.3
.04	10.2	8.5	7.3	6.3
.05	10.3	8.5	7.1	6.0
.06	10.3	8.2	6.7	5.6
.07	10.1	7.9	6.3	5.1
.08	9.9	7.4	5.7	4.5

Source: Author's simulations. The table displays the aggregate saving rate for combinations of UI replacement rates and total growth rate (population + economic) for an economy without 401(k)s. $CRRA = 3$.

changing the UI rate from 10 percent to 70 percent is around 33 for the economy without 401(k)s and around 24 for the economy with 401(k)s. One may speculate why this is the case, but it is unclear from just looking at the two tables. One candidate explanation involves the nature of precautionary saving in the two economies. In the economy without 401(k)s, saving in the first years of life is likely to be done only as a buffer against income shocks. Saving in the 401(k), on the other hand, is motivated both by the desire to build a buffer, as well as the high opportunity cost of foregoing the employer match. (Higher UI reduces desired saving in the 401(k) for the young, but not all the way to zero.) That this might be the case is suggested by the fact that in table 7, the reduction in saving associated with higher UI is greatest for lower match rates.

6 Conclusions

The simulation exercises performed in this paper suggest that saving is done in the 401(k) for two reasons: to accumulate resources for retirement and to build a buffer stock against potential income loss due to unemployment. While the first reason is obvious, the second is novel and has implications for the effect of employment risk on saving.

Two results in the paper support the idea that some precautionary saving is done inside the 401(k) plan. First, savings in the plan are regularly tapped in the event of unemployment and

the size of the withdrawals is large. In an economy with a 50 percent match and a 50 percent replacement rate of UI, the average dissaving in the 401(k) during unemployment is approximately \$8,000. Second, increasing UI, which is a perfect substitute for precautionary saving against employment risk, is associated with a large reduction in 401(k) saving for the young. Saving in the outside account falls as well, but by much less than in the 401(k). For example, contributions as a ratio to income are about 86 percent lower in an economy with a UI replacement rate of 70 percent relative to one with a replacement rate of 10 percent. The comparable reduction in saving as a fraction of income is around 23 percent.

In contrast to the popular perception that early withdrawals from the 401(k) represent poor planning on the part of the individual, the interpretation in this paper is exactly the opposite. A fully rational saver will not only withdraw from her 401(k) plan during unemployment, but more significantly, will actually plan to do so. This does not imply that for a given level of savings in both accounts the individual would prefer to withdraw from the 401(k), but rather that the opportunity cost of saving in the outside plan, in terms of forgone matching and tax benefits, is too high.

The net effect on aggregate saving of increasing UI benefits depends both on the existence of a 401(k) plan, as well as the size of the employer match. Comparing steady state partial equilibria, I find that the existence of a 401(k) plan increases aggregate saving for all values of UI and employer matching. Saving in both economies falls with higher rates of UI, but the reduction is greatest in the economy without a 401(k) plan (33% vs 24%). That saving outside the 401(k) is more reactive to changes in UI probably reflects the fact that the return to ordinary saving is too low to induce younger individuals to save except as a precaution against income risk. When the cost of being unemployed falls, the incentive to save falls accordingly. In an economy with 401(k)s, the return to saving is much higher due to the employer match. Therefore, even though higher UI reduces some of the value of contributions in their capacity as a buffer, desired saving in the plan remains positive.

At this stage, all results stem from simulations and remain to be tested empirically. While it would be ideal to look at the saving behavior of individuals using panel data, there are no

sources that contain suitable information on 401(k) plan specifics. As an alternative, it should be possible to stack up a series of cross-sections from either the Survey of Consumer Finances (SCF) or the Survey of Income Program Participation (SIPP) and use U.S. state variation in UI to measure the actual substitution between 401(k)s and conventional savings.

References

- [1] Abowd, J. M., and D. Card (1989), “On the Covariance Structure of Earnings and Hour Changes,” *Econometrica*, 57(2), 411-445.
- [2] Andrews, E. S. (1992), “The Growth and Distribution of 401(k) Plans,” in J. Turner and D. Beller, eds., *Trends in Pensions*, Washington: US. Department of Labor.
- [3] Basset, W. F., M. J. Fleming, and A. P. Rodrigues (1998), “How Workers Use 401(k) Plans: The Participation Contribution, and Withdrawal Decisions,” Staff Reports, Federal Reserve Bank of New York, No. 38.
- [4] Benítez-Silva, H. (2000), “A Dynamic Model of Labor Supply, Consumption/Saving, and Annuity Decisions Under Uncertainty,” mimeo.
- [5] Benítez-Silva, H., G. J. Hall, G. J. Hitsch, G. Pauletto, and J. Rust (2000), “A Comparison of Discrete and Parametric Approximation Methods for Continuous-State Dynamic Programming Problems,” *Preliminary Manuscript: Yale University*.
- [6] Bernheim, B. D. (1993), “Private Saving and Public Policy,” in James M. Poterba, ed., *Tax policy and the economy*, Vol. 7. Cambridge, MA: MIT Press, 73-110.
- [7] ——— (1997), “Rethinking Saving Incentives,” in A. Auerbach, ed., *Fiscal Policy: Lessons From Economic Research*, Cambridge, MA: MIT Press, 259-311.
- [8] Bernheim, B. D., J. Skinner, and S. Weinberg (2001), “What Accounts for the Variation in Retirement Wealth Among U.S. Households,” *American Economic Review*, 91, 832-857.

- [9] Bertaut, C. and M. Starr-McCluer (2000), "Household Portfolios in the United States," in Luigi Guiso, Michael Haliassos, and Tullio Japelli, eds., *Household Portfolios*, Cambridge, MA: MIT Press.
- [10] Browning, M. and A. Lusardi (1996), "Household Saving: Micro Theories and Micro Facts," *Journal of Economic Literature*, 34(1), 1797-1851.
- [11] Burman, L., J. Cordes, and L. Ozanne (1990), "IRAs and National Saving." *National Tax Journal*, 43(3), 259-83.
- [12] Carroll, C. D. (1992), "Buffer Stock Saving: Some Macroeconomic Evidence," *Brookings Papers on Economic Activity*, 1992:2, 61-156.
- [13] ——— (1994), "How does Future Income Affect Current Consumption?" *Quarterly Journal of Economics*, 109(1), 111-48.
- [14] ——— (1997), "Buffer Stock Saving and the Life Cycle/Permanent Income Hypothesis," *Quarterly Journal of Economics*, 112(1), 1-56.
- [15] ——— (2001), "A Theory of the Consumption Function, With and Without Liquidity Constraints," *Journal of Economic Perspectives*, 15(3).
- [16] Carroll, C. D., K. E. Dynan, and S. D. Krane (1999), "Unemployment Risk and Precautionary Wealth: Evidence from Households' Balance Sheets," *Finance and Economics Discussion Series Number 1999-15*, Federal Reserve Board.
- [17] Carroll, C. D., and M. S. Kimball (2001), "Liquidity Constraints and Precautionary Saving," *NBER Working Paper Number W8496*.
- [18] Carroll, C.D., and L. H. Summers (1987), "Why Have Private Savings Rates in the United States and Canada Diverged?" *Journal of Monetary Economics*, 20(2), 249-79.
- [19] Engen, E. M., W. G. Gale, and J. K. Scholz (1994), "Do Saving Incentives Work?," *Brookings Papers on Economic Activity*, 1994:1, 85-180.

- [20] ——— (1996), “The Effects of Tax-Based Saving Incentives on Saving and Wealth,” *NBER Working Paper Number W5759*.
- [21] Engen, E. M. and J. Gruber (2001), “Unemployment Insurance and Precautionary Saving,” *Journal of Monetary Economics*, 47(3), 541-579.
- [22] Farber, H. S. (1993), “The Incidence and Costs of Job Loss: 1982-91,” *Brookings Papers on Economic Activity. Microeconomics*, 1993:1, 73-119.
- [23] ——— (1997), “The Changing Face of Job Loss in the United States, 1981-1995,” *Brookings Papers on Economic Activity. Microeconomics*, 1997, 55-128.
- [24] French, E. (2001), “The Effects of Health, Wealth, and Wages on Labor Supply and Retirement Behavior,” *Manuscript: Federal Reserve Bank of Chicago*.
- [25] Gale, W. G. (1999), “The Impact of Pensions and 401(k) Plans on Saving: A Critical Assessment of the State of the Literature,” mimeo.
- [26] Gale, W. G. and J. K. Scholz (1994), “IRAs and Household Saving,” *The American Economic Review*, 84(5), 1233-1260.
- [27] Gravelle, J. G. (1991), “Do Individual Retirement Accounts Increase Savings?” *Journal of Economic Perspectives*, 5(2), 133-148.
- [28] Gokhale, J., L. J. Kotlikoff and M. J. Warshawsky (2001), “Life-Cycle Saving, Limits on Contributions to DC Pension Plans, and Lifetime Tax Benefits,” *NBER Working Paper Number W8170*.
- [29] Gourinchas, P. O. and J. A. Parker (2001), “The Empirical Importance of Precautionary Savings,” *American Economic Review*, (2001), 91 (2), 406-412.
- [30] ——— (2002), “Consumption Over the Life Cycle,” *Econometrica*, 70 (1), 47-89
- [31] Haliassos, M. and A. Michaelides (1999), “Portfolio Choice and Liquidity Constraints,” *University of Cyprus Working Papers* No. 9918.

- [32] Holden, S., and J. VanDerhei (1999), “401(k) Plan Asset Allocation, Account Balances, and Loan Activity in (1999).” *EBRI Issue Brief* no. 230.
- [33] Hubbard, G. R., J. Skinner, and S. P. Zeldes (1995), “Precautionary Saving and Social Insurance,” *The Journal of Political Economy*, 103(2), 360-399.
- [34] İmrohoroğlu, A., S. İmrohoroğlu and D. H. Joines (1998), “The Effect of Tax-Favored Retirement Accounts on Capital Accumulation,” *American Economic Review*, 88(4), 749-768.
- [35] Investment Company Institute (2000), “401(k) Plan Participants: Characteristics, Contributions, and Account Activity” *ICI Research Series*.
- [36] Joines, D. H. and J. G. Manegold (1991), “IRA and Saving: Evidence from a Panel of Taxpayers.” *Federal Reserve Bank of Kansas City Research Working Paper* No. 91-05.
- [37] Kimball, M. S. (1990), “Precautionary Saving in the Large and in the Small,” *Econometrica*, 58, 53-73.
- [38] Kusko, A. L., J. M. Poterba, and D. W. Wilcox (1994), “Employee Decisions with Respect to 401(k) Plans: Evidence from Individual-Level Data,” *NBER Working Paper No. 4635*.
- [39] Laibson, D. I., A. Repetto, and J. Tobacman (1998), “Self-Control and Saving for Retirement,” *Brookings Papers on Economic Activity*, 1, 91-172.
- [40] Lillard, L. A., and R. Willis (1978), “Dynamic Aspects of Earnings Mobility,” *Econometrica*, 46, 985-1012.
- [41] Love, D. A. (2003), “Retirement Saving Plans and Precautionary Saving,” Unpublished Doctoral Dissertation, Yale University, New Haven.
- [42] Meyer, B. D. (2002), “Unemployment and Workers’ Compensation Programmes: Rationale, Design, Labour Supply and Income Support,” *Fiscal Studies*, 23, 1-49.
- [43] Mitchell, O. (1999), “New Trends in Pension Benefit and Retirement Provisions,” *NBER Working Paper No. 7381*.

- [44] Munnell, A. H., A. Sundén, and C. Taylor (2001), “What Determines 401(k) Participation and Contributions?” *Mimeo*.
- [45] Neumark, D., D. Polsky, and D. Hansen (1999), “Has Job Stability Declined Yet? New Evidence for the 1990’s,” *Journal of Labor Economics*, 17 (4), S29-64.
- [46] Papke, L. E., and J. M. Poterba (1995), “Survey Evidence on Employer Match Rates and Employee Saving Behavior in 401(k) Plans,” *Economics Letters*, 49 , 313-17.
- [47] Poterba, J. M., S. F. Venti, and D. A. Wise (1995), “Do 401(k) Contributions Crowd Out Other Personal Saving?” *Journal of Public Economics*, 58(1), 1-32.
- [48] ——— (1996), “How Retirement Saving Programs Increase Saving,” *The Journal of Economic Perspectives*, 10(4), 91-112.
- [49] ——— (1997), “The Effects of Special Saving Programs on Saving and Wealth.” in M. Hurd and N. Yashiro (ed.), *The Economic Effects of Aging in the United States and Japan*. University of Chicago Press.
- [50] ——— (1998), “Personal Retirement Saving Programs and Asset Accumulation: Reconciling the Evidence,” in D. Wise (ed.) *Frontiers in the Economics of Aging*. University of Chicago Press.
- [51] ——— (2001), “Pre-Retirement Cashouts and Foregone Retirement Saving: Implications for 401(k) Asset Accumulation,” in D. Wise (ed.) *Themes in the Economics of Aging*. University of Chicago Press.
- [52] Samwick, A. A. (1998), “Tax Reform and Target Saving,” *National Tax Journal*, 51, 621-635.
- [53] Tauchen, G. and R. Hussey (1991), “Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models,” *Econometrica*, 59, 371-396.
- [54] Thaler, R. H. (1990), “Saving, Fungibility, and Mental Accounts.” *Journal of Economic Perspectives*, 4(1), 193-205.

- [55] Venti, S. F. and D. A. Wise (1986), "Tax-Deferred Accounts, Constrained Choice and Estimation of Individual Saving." *Review of Economic Studies*, 53(4), 579-601.
- [56] ——— (1987), "IRAs and Saving," in Martin Feldstein, ed., *The Effects of Taxation on Capital Accumulation*. A National Bureau of Economic Research Project Report, University of Chicago Press, 7-48.
- [57] ——— (1990), "Have IRAs Increased U.S. Saving? Evidence from Consumer Expenditure Surveys." *Quarterly Journal of Economics*, 105(3), 661-98.
- [58] ——— (1995), "Individual Response to a Retirement Saving Program: Results from U.S. Panel Data." *Ricerche-Economiche*, 49(3), 235-54.
- [59] Zeldes, S. P. (1989), "Optimal Consumption with Stochastic Income: Deviations from Certainty Equivalence," *Quarterly Journal of Economics*, 104(2), 275-98.

A Appendix

A.1 Additional Tables and Figures

Table 9: Contributions and Matching in the SCF

	1992	1995	1998
Percent Contributed to 401(k) ^a	14.44	19.51	22.68
Percent Salary Contributed	7.18	6.35	5.68
Average Contribution	4,400	3,639	4,034
Percent with Employer Matching	76.92	83.92	78.88
Average Match Percent	8.19	6.12	5.34
Average Match Amount	3,045	2,849	3,086

a. All other statistics in this table are conditional on participation.

Table 10: Mean and Median Asset Levels by Age and Education

	1995		1998	
	<i>Means</i>			
<i>Age</i>	Non-Plan Savings	401(k)	Non-Plan Savings	401(k)
<26	3,340	1,923	17,391	3,280
26-35	14,971	10,964	42,527	20,779
36-45	42,082	29,684	62,261	41,218
46-55	102,829	56,998	119,373	63,475
56-65	127,708	60,876	279,425	83,731
>65	250,228	34,484	239,106	43,328
<i>Education</i>				
<12	4,893	11,178	10,126	16,158
12-15	29,922	20,597	44,480	31,178
>15	96,803	53,914	182,115	68,425
	<i>Medians</i>			
<i>Age</i>	Non-Plan Savings	401(k)	Non-Plan Savings	401(k)
<26	1,387	533	2,501	1,500
26-35	3,201	4,268	5,050	8,000
36-45	8,431	11,739	11,000	18,000
46-55	16,755	17,075	20,504	25,000
56-65	16,008	16,008	18,001	25,000
>65	69,370	12,386	75,003	10,000
<i>Education</i>				
<12	1,067	3,201	2,000	10,000
12-15	4,663	8,004	5,800	12,000
>15	18,679	10,672	20,500	25,000

Source: Author's calculations from the Survey of Consumer Finances, 1992, 1995, and 1998. Non-plan savings are financial assets composed of checking, savings, mutual funds, stocks, bonds, IRAs, annuities, and trusts in 1998 dollars. The means and medians are weighted using the new SCF survey weights.

Table 11: Contributions and Saving as Ratios to Income (CRRA = 1)

Education	Age	UI Rate=10%		UI Rate=30%		UI Rate=50%		UI Rate=70%	
		X/Y	S/Y	X/Y	S/Y	X/Y	S/Y	X/Y	S/Y
<12	20-29	0.0435	0.0246	0.0346	0.0172	0.0224	0.0146	0.0107	0.0131
	30-39	0.0340	0.0024	0.0312	0.0019	0.0287	0.0018	0.0267	0.0019
	40-49	0.0615	-0.0001	0.0577	0.0037	0.0549	0.0047	0.0530	0.0051
	50-64	0.1178	-0.0151	0.1165	-0.0105	0.1154	-0.0093	0.1138	-0.0093
12-15	20-29	0.0366	0.0129	0.0256	0.0090	0.0104	0.0076	0.0049	0.0054
	30-39	0.0337	-0.0017	0.0312	-0.0024	0.0287	-0.0020	0.0257	-0.0006
	40-49	0.0805	0.0024	0.0751	0.004	0.0738	0.0041	0.0736	0.0035
	50-64	0.1296	-0.0073	0.1310	-0.004	0.1322	-0.0034	0.1301	-0.0029
>15	20-29	0.0336	0.0076	0.0230	0.0149	0.0042	0.0068	0.0001	0.0121
	30-39	0.0203	0.0054	0.0229	0.0093	0.0185	0.0004	0.0189	0.0074
	40-49	0.0565	0.0019	0.0715	0.0166	0.0548	0.0041	0.0712	0.0200
	50-64	0.0899	0.0046	0.1038	0.0216	0.0920	0.0079	0.1054	0.0257

Source: Author's simulations. The table displays ratios of conventional savings and 401(k) contributions to non-asset income for different age/education combinations. The models were simulated with the following parameter specifications: match rate = 50%, penalty rate when employed = 100%, penalty rate when unemployed = 10%, and CRRA = 1.

- a. S/Y is the average ratio of conventional saving to non-asset income for each age group, conditional on employment.
- b. X/Y is the average ratio of 401(k) contributions to non-asset income for each age group, conditional on employment