How Do Politicians Save? Buffer Stock Management of Unemployment Insurance Finance

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Abstract

This paper uses Carroll's (1992) buffer stock model to study government savings behavior exemplified by the Unemployment Insurance (UI) programs of U.S. states from 1976 to 2008. We find strong empirical support for the model from regressions and simulations. Empirically, we find that political consumption, defined in the context of the model from discretionary components of UI benefits and taxes, rises when savings and other spendable resources rises. We calibrate and simulate the model using the methodology pioneered by Jappelli, Padula, and Pistaferri (2008) and we find the model fits well. A key implication is that intertemporal planning by governments is expressed by a trade-off between impatience—politicians' desire to immediately expend all savings—and risk aversion—politicians' fear of running out of resources to support UI. We quantify the amount of fiscal stimulus from the UI program under buffer stock saving.

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1 Introduction

The recent sovereign debt crisis underscores the need for understanding how politicians manage governments' intertemporal budgets. Specifically, questions have been raised about whether governments need new savings vehicles to smooth tax revenue and spending over time.[1] In a similar vein, questions have been raised about whether to impose limits on the deficits of national governments. For example, the Euro area entered into a Fiscal Compact in March 2012 in the hope of avoiding further sovereign debt crises within the Euro area. Our objective in this paper is to examine intertemporal government savings behavior in the context of governments with clear budget constraints. Specifically, we present and estimate a model showing how U.S. state governments manage their Unemployment Insurance (UI) systems. This is important and relevant because there is not currently an extant empirical model which successfully explains how governments manage budgets over time. The UI context is particularly interesting because the system is designed with economic fluctuations as the underlying context. Further, UI is an excellent empirical example because it has existed for a long period of time, and because UI savings occur in a trust fund segregated from the state general fund so the UI program is not subject to the contemporaneous balanced budget requirements of state governments' general funds (see Poterba, 1994).

UI provides an ideal institutional environment in which to examine how government behavior reflects the competing preferences of impatience and avoidance of budget crisis.[2] On the one hand, state government politicians may use UI revenues as quickly as possible to reap the public expenditure benefit of current taxation.[3] On the other hand, politicians may be subject to voter disapproval if they end up with insufficient savings to fund UI benefit increases in periods of high unemployment.

The buffer stock model of Carroll (1992) applied to government behavior has the

[1]For example, for U.S. states, "rainy day funds," which allow state governments to run deficits, in spite of balanced-budget rules, by drawing on them, have been adopted by a number of states in recent years.

[2]Policy makers' choices may be a reflection of the voters they represent, or they may reflect politicians' preference for being reelected, or they may reflect political ideology. We do not model the source of politicians "as if" preferences.

[3]This statement presumes politicians benefit from increasing government expenditures.

potential to capture the preferences which motivate politicians. Specifically, the model incorporates consumers who are inherently impatient, risk averse, and face borrowing limits.[4] Further, the application to UI captures essential elements for modeling the preferences and constraints facing governments. As we explore more fully below, UI is financed by an earmarked tax on firms, so if savings are insufficient to fund increased UI benefits during a recession, the required tax increases will place an obvious burden on the public.[5] At the same time, using tax money raised from firms today without providing an immediate public expenditure benefit would be expected to be perceived by politicians as "expensive" in terms of foregone political benefits. A final institutional element that completes the budget constraint is that the federal government essentially caps borrowing for UI, forcing states to balance their UI budget over time.

Past empirical work has attempted to fit government behavior to Hall's (1978) Permanent Income Hypothesis (PIH) with little success (Borge and Tovmo, 2009). That is, whether because of institutional constraints or governmental preferences, government expenditure is not found to be a random walk (martingale). Alternatively, a better approximation might be to consider expenditure as exogenous. Barro (1979) shows that, if government expenditures are exogenous and tax collection costs are increasing in tax rates governments should (if they are efficient) smooth taxes over time and—for typical modeling choices—tax rates should behave like random walks. The Barro tax smoothing model successfully explains why national governments run deficits in the face of large shocks, such as wars and devastating earthquakes, but it has met with little success in explaining day-to-day fluctuations in government deficits and saving. We briefly show that neither the PIH nor the tax smoothing model explain the fluctuations of state level UI taxes and benefits over the business cycle, nor do they explain the management of the UI trust fund savings account.

[4] Carroll (1997) extends the model to allow for life cycle savings on individuals with finite lives; however, the UI systems are not expected to shut down in finite time.

[5] The rules, see U.S. Department of Labor (2012), are: "In order to assure that a state will repay any loans it secures from the [federal UI] fund, the law provides that when a state has an outstanding loan balance on January 1 for two consecutive years, the full amount of the loan must be repaid before November 10 of the second year, or the federal tax on employers in that state will be increased for that year and further increased for each subsequent year that the loan has not been repaid."

The data for the empirical work comes from the UI programs of the 48 mainland states. All states operate their UI program under a federal programmatic umbrella, with a segmented trust fund separate from each state's general fund. Each state chooses tax rates, benefit levels, criteria for UI eligibility, and manages a state specific savings account, the UI trust fund. The trust fund is on deposit with the U.S. Treasury, and is explicitly designed to allow states to increase UI expenditures during down parts of the business cycle without necessarily increasing taxes. All earmarked UI taxes on firms are deposited into this UI trust fund, and all UI benefits are paid out of the trust fund. Having a panel of observations for the 48 mainland U.S. state UI programs over 30 years delivers the degrees of freedom necessary to find the parameters of the savings model.

Government savings behavior may be indeterminate and matter little for welfare if Ricardian Equivalence holds, such that government saving is completely offset by household behavior. By studying state unemployment systems, we attack the dynamic budgeting problem in a setting where market failure in employment insurance mutes such potential issues.[6] A further advantage of this setting is that savings are credited with a fixed interest rate by the U.S. Treasury which helps us avoid issues related to capital gains and losses that the buffer stock model, in its current incarnation, ignores. Further, the features of the UI system allow us to map UI into the attributes of the buffer stock model: we define an "income" component and a "consumption" component of UI taxes and expenditures. We can do so even if all state governments address unemployment among full time workers well attached to the labor market, because there is considerable variation between states in choices of whether and to what extent UI benefits are available to part time workers, or to workers that are less fully attached to the labor market (Craig and Palumbo, 1999).[7] Our analysis therefore separates UI

[6]See Rothschild and Stiglitz (1976) for the basic asymmetric information problem underlying UI. It is also possible that unemployed agents have a lower ability to borrow during recessions.

[7]That is, we will distinguish discretionary benefits that arise from ambiguities in defining involuntary unemployment. There is considerable variation between states in determining which "laid off" workers are eligible for UI, including the length of time a worker needs to be employed before being UI eligible, the minimum number of weekly hours, as well as the circumstances that result in work separation being considered "involuntary unemployment."

benefits into a discretionary "consumption component," and a non-discretionary benefit component driven by changes in the unemployment rate. State governments also have policy discretion in choosing tax rates and we similarly split taxes into a discretionary "consumption" component and a non-discretionary "income" component.

Jappelli, Padula, and Pistaferri (2008) (hereafter JPP) devise an empirical test of the buffer stock model based on individuals' savings, but do not find empirical support using data for individuals. We nonetheless apply this methodology to government UI behavior and find it has substantial explanatory power for the level of saving of the state UI systems. We test the buffer stock model by comparing the level of savings of the UI systems to the level of savings predicted by the model and by comparing the results from regressions using actual UI data to similar regressions calculated using simulated data. For suitable parameter values, we find the simulation statistics closely match the empirical statistics—much closer than JPP found for individual data—and we conclude that government behavior can be well explained by buffer stock behavior with politicians being both risk averse and impatient.[8]

While we are not able to determine which part or parts of the institutional framework are responsible for generating the observed buffer stock behavioral pattern of savings, we believe we provide the first empirical support for a systematic framework of government behavior towards saving over time. Understanding if governments are forward looking and patient is a crucial input into the debate as to whether governments need more, or less, latitude for dealing with business cycles (Fatas and Mihov, 2003).

The remainder of the paper is laid out as follows. Section 2 describes the institutional setting for UI and the panel data for the 48 contiguous U.S. states from 1976-2008. Section 3 tests the PIH and tax smoothing models finding little systematic empirical support. Section 4 describes the buffer-stock model and explains how we map the UI institutional environment into the buffer stock model. Section 5 compares regres-

[8] We do not model the underlying reasons for such impatience, although impatience may be an implication of strategic behavior of governments facing intermittent elections (Persson and Svensson, 1989).

sions estimated on the UI data with regression on simulated data and reveals a good fit between simulated buffer stock behavior and actual state government saving, taxes, and benefit payments. Finally, Section 6 summarizes the evidence and concludes.

2 The UI System and the Data

Each of the 48 mainland U.S. states has a separate UI program, and eligibility rules and benefit amounts are allowed to vary within certain limits.[9] If a person has been working and loses his or her job because of "inadequate demand," that person may receive benefits from the state UI trust fund. Benefits are generally paid in an amount equal to about 60 percent of prior wages for full time workers. States finance their UI program with an earmarked tax paid into the UI trust fund by employers. The tax rate varies between firms because it is partially experience rated (higher for firms with more lay-offs in the past) and it is typically only levied against the first $9,000 in annual wages.[10] In this way, the tax is essentially an annual lump sum tax per employee. Recognizing that unemployment is cyclical, states maintain a saving account for UI, called the UI trust fund. The earmarked tax is paid into the UI trust fund while benefits are paid out of the UI trust fund. While in theory there is no interaction with the general fund of the state government as the UI program is administratively separate, in fact, there is a variety of state taxes on firms. State governments could raise or lower the level of UI taxation and compensate with reverse changes of firm taxation that is credited to the general fund to move money from the UI trust fund to the general fund or vice versa.

A non-zero probability of running out of money is an important determinant of behavior in the buffer stock model because risk averse agents strive to avoid low consumption near the borrowing limit. Specifically, while states' UI systems are able to borrow from the Treasury if their UI trust fund account goes to zero, there is an im-

[9]http://www.ows.doleta.gov/unemploy/uifactsheet.asp is the U.S. Labor Department website with facts about the program.

[10]The tax base varies between $7,000 and $16,000 in annual wages.

plicit constraint on that borrowing. State UI systems must be "fundamentally solvent" as determined by the Department of Labor (DOL) to be eligible for federal loans.[11] This suggests that the shadow price on borrowing for states could be very high and indeed, state borrowing from the Treasury is limited—our data suggests that no state goes beyond borrowing 5 percent of its covered wages.[12]

Table 1 presents means and standard deviations over time and across states for the main variables. Our panel of the 48 mainland U.S. states covers the years 1976-2008. The start date is dictated by the absence of state specific unemployment rates before 1976. The UI trust fund balances are reported as of the first day of each year. The UI benefit and tax amounts are those expended throughout the year. UI does not necessarily cover all wages earned in the economy; for example, self employed workers are not generally covered (unless incorporated), and there are often caps on the total wages covered by UI (since benefits are a function of covered wages). Nonetheless, covered wages (i.e., total wages of covered individuals) are over 90 percent of total wages.

In Table 1 we normalize all variables by covered wages (aggregate wages of workers covered by UI) to put the variables on a similar scale across states and time.[13] The UI program benefits and taxes are just under 1 percent of covered wages on average, although the share fluctuates with the business cycle. The trust fund balance averages about 16 months of UI taxes and so is substantial, although not large enough to forego taxation altogether for long periods. Interest earned by the trust fund averages 8 percent of the initial year balance for states. About 12 percent of states are in debt to the federal government at any point in time and, for those in debt, the debt levels are slightly above the average year's reserves, so debt is important but clearly not the modal behavior of states. Table 2 presents the statistics of Table 1 in dollars per

[11] In the environment of 2010-11, Congress passed a waiver on interest payment on loans for all states.

[12] While the law does not set a fixed limit on borrowing by the UI systems, neither is there a fixed limit on how much consumers can borrow, and in our view the "fundamentally solvent" borrowing constraint is at least as important for state UI systems as credit constraints are for consumers.

[13] For the data mapped into the model below, this normalization is defined as permanent income. All UI variables normalized by permanent income are found to be stationary, so the data is appropriate for testing the buffer stock model developed below.

capita. On average, UI benefits and taxes are around \$50 per capita while the trust fund balances average about \$71 per capita.

3 Regression Results: PIH and Tax Smoothing

We present the primary results assuming that the adjustment period for each state is two years. It turns out this assumption is not essential for the qualitative results (see the appendix), but it allows the data to fit the model somewhat better. The two year assumption is consistent with the few states that do two year budgeting, but also with states that budget annually because governments typically react slowly to shocks, adjusting tax and benefit rates only at the regularly scheduled budget deadlines.[14] Regressions are done using non-overlapping two-year periods to avoid adjusting the standard errors for the serial dependence one would generate using overlapping data.

The simplest model of forward looking government behavior is the Barro (1979) tax smoothing model where a government facing an exogenous stream of expenditures and an increasing convex cost of period-by-period tax collection will (under certainty) keep a constant tax rate such that the present value of taxes covers the present value of expenditures. Under uncertainty and quadratic costs, the optimizing government will display "certainty equivalence" and choose the current tax rate such that, if kept unchanged, the present value of taxes would equal the expected present value of expenditure. Barro shows that a simple testable implication is that the tax rate is a martingale (typically, if imprecisely, referred to as a random walk). A related model is Hall's celebrated PIH framework. If UI benefits can be freely adjusted, if politicians' utility from paying benefits can be approximated by a quadratic utility function, and if their discount rate is similar to the interest rate, UI expenditures will follow a martingale process.

If tax rates (benefits) are martingales, an autoregressive model fitted to tax rates (benefits) should be martingales. We therefore test whether governments manage their

[14] We do not have enough degrees of freedom to model states with different budgetary structures separately.

UI programs optimally in Barro's (Hall's) sense by testing whether UI tax rates (benefits) are approximately martingales by performing unit root tests. If states' UI taxes (benefits) are random walks it would be consistent with forward looking state governments which incorporate convex costs of taxation (linearly declining marginal utility) in their decisions.

Table 3 displays the results of first order autoregressive panel regressions of the form[15]

$$X_{st} = \mu_s + \alpha X_{s,t-1} + u_{st}\,. \tag{1}$$

The results of this regression are that taxes are quite persistent with an estimated α of 0.94 while benefits are less persistent with an estimated α of 0.87. These coefficients are precisely estimated and clearly different from the random walk value of unity. In the second panel of the table we display, for benefits and taxes, the test statistics and critical values for unit roots in a panel as suggested by Im, Pesaran, and Shin (2003). This test rejects unit roots in both series and, therefore, also random walks.[16] This suggests that neither tax smoothing optimizing behavior in the sense of Barro nor benefits smoothing in the sense of Hall describes well how state governments manage their UI savings accounts.

Models of impatient consumers who nonetheless have a strong aversion to exhausting their savings have been popularized by Carroll (1997) and Deaton (1991). A large number of papers have attempted to test a key implication of the model: that savings are larger when uncertainty is larger. Our empirical strategy is to instead test how the benefit and tax levels change over time with respect to the level of savings, and then examine by simulation how closely this pattern is consistent with behavioral parameters.

Figure 1 shows average (across states) trust fund balances normalized by covered

[15] State-by-state tests have very low power because we have few observations per state. The panel regression is valid if state governments have essentially similar tastes for managing their UI savings accounts.

[16] A number of papers have rejected the PIH model for state governments, and thus some have extended the model to include a "rule of thumb" non-forward looking aspect (see; e.g., Dahlberg and Lindstrom 1998) This, however, involves an unsatisfactory deviation from optimizing behavior and, besides, does not improve the model's fit by much.

wages over time. The grey shaded areas show national recessions. Trust fund balances fluctuate over time, tending to rise before recessions and decline during and after recessions. There is a clear tendency for the average level of trust fund balances to settle down in a relatively narrow range which suggests that policy makers have a target range for UI savings.

The average pattern in Figure 1 suggests that the savings behavior of politicians fruitfully can be mapped into the buffer stock model of Carroll (1997), and we undertake this endeavor in the rest of the paper. The only test of buffer stock savings behavior using savings data is the recent paper by JPP which directly examines if consumers are prone to spend more if their savings exceed their (self-reported) desired stock of savings. To our knowledge, we provide the first empirical evidence that the savings data of any set of economic agents fits the buffer stock model, as JPP were not able to match individuals well to the model. Further, we believe our demonstration of buffer stock behavior by governments may hold important insights into policy designs that aim at using governments to smooth economic fluctuations.

4 The Buffer Stock Model

The buffer stock model is an attractive mechanism for modeling government savings because it contains a direct trade-off between impatience and risk aversion in a situation where savings are desirable because of economic fluctuations. An impatient politician has an internal discount rate greater than the market rate of interest while risk aversion impacts behavior because resources may be exhausted in the face of adverse shocks. Our empirical investigation into the economic relevance of this model follows JPP, although our data differs in some important respects, not least of which is that we model government rather than individual behavior.

The JPP approach to empirically examining the buffer stock model is unusual because it directly focuses on the desired level of saving—i.e., the buffer stock. Our approach is similar except that, unlike their data on individuals, our data on state governments does not contain a self reported desired buffer stock. On the other hand, an advantage of our application of the JPP methodology is that for the UI system the stock of saving is measured perfectly—unlike individual savings.[17] We follow JPP by simulating the buffer stock model for a range of preference parameters, and compare the resulting level of buffer stock savings to the savings level that is actually in our data. The innovation in JPP is that they calculate a simple statistic which captures the propensity of agents to increase consumption when savings are high relative to the desired levels, "target savings," of the agents. We empirically estimate this statistic and compare to predicted results from the model. We further calculate average savings of state governments and compare those to predicted target savings of the model. The predicted propensity to increase consumption in response to above-target savings, and the target level of savings, are both shown to change with behavioral parameters describing the discount rate and the level of risk aversion. We find that the estimated values correspond closely to the simulated values for very reasonable levels of these behavioral parameters.

The buffer stock model applied to governments assumes the objective of the politician with respect to UI is to maximize the stream of "political consumption" arising from the provision of UI benefits over time.[18] The model therefore takes the form of a politician (consumer) maximizing:

$$\sum_{t=1}^{\infty} \beta^t \frac{1}{1-\rho} C_t^{1-\rho} \ , \tag{2}$$

where β is the time discount factor, C_t is consumption, and $\rho > 0$ is the coefficient of relative risk aversion. Key parameters in the model are the degree of risk aversion—high risk aversion induces a high level of savings—and the rate of time discounting—high time discounting induces a low level of savings. Our procedure below will simulate

[17]Problems with measuring individual savings balances include difficulties in measuring capital gains, inheritances, and other more obscure sources of wealth. Further, individual precautionary savings may be confounded with life cycle savings.

[18]We clearly are assuming this problem is separable from the provision of all other taxes and benefits.

results over a range of these preference parameters.

The dynamic budget constraint facing the state government is

$$W_{t+1} = R\left(W_t - C_t + Y_t\right) \ , \tag{3}$$

where R is an interest rate factor assumed constant over time, W_t is non-human wealth, and Y_t is "labor income" (i.e., income apart from interest income). Agents are assumed to be credit constrained and unable to borrow above a pre-determined limit; i.e., $W_t > 0$. The funds available for consumption during period t are savings at the beginning of the year plus the current year's income, $W_t + Y_t$ which we, following Carroll (1997), denote "cash-on-hand."

Income is modeled as the sum of a persistent (random walk) component and a temporary (white noise shock) component:

$$Y_t = P_t V_t \ , \tag{4}$$

$$P_t = G P_t N_t \ . \tag{5}$$

P_t is the permanent (unit root) component of income with log-normally distributed innovation N_t, where $\text{Var}\{\ln(N_t)\} = \sigma_N$ and $E\{\ln(N_t)\} = 0$. V_t is the transitory (white noise) component of income which is log-normally distributed with $\text{Var}\{\ln(N_t)\} = \sigma_V$ and $E\{\ln(V_t)\} = 0$. P_t is usually referred to as permanent income, although in the context of the PIH model, permanent income shocks would be $\Delta P_t + (R-1)N_t$—we will follow the convention of referring to P_t as permanent income. G is the deterministic growth rate of income.

Near-zero consumption implies very high (tending to minus infinity) disutility, and thus the marginal utility of consumption becomes very high as consumption approaches zero. Further, the loss in utility as consumption approaches zero depends on the risk aversion parameter ρ. The fear of extreme disutility causes the government to hedge against very low consumption by building a "buffer-stock" of saving denoted cash-on-hand. This feature balances the impatience that otherwise would cause politicians to spend all savings immediately to the extent their discount rate exceeds the market interest rate.

Income and consumption are obviously non-stationary because permanent income is non-stationary, so in order to solve the model it is reformulated with wealth, income, and consumption expressed as ratios to permanent income. We use lower-case letters to identify the transformed variables: $y_t = Y_t/P_t$ and $c_t = C_t/P_t$ and we refer to $x_t = (W_t + Y_t)/P_t$ as cash-on-hand or, alternatively, as the buffer stock of saving. JPP refer to the "wealth to permanent income ratio" but because the following is in terms of the variables normalized by permanent income we use the simpler notation here and we will refer to c_t simply as consumption from now on.

In the buffer stock model, consumption is a non-linear function of cash-on-hand which is particularly non-linear around the target level. The innovation in JPP is that they utilize a convenient covariance condition reflecting how consumption will change depending on deviations from the target buffer stock savings, called the target gap. The target gap is simply $x_t - x^*$, where x_t is current cash-on-hand and x^* is the target cash-on-hand. Agents would be expected to increase their consumption and draw down their buffer stock saving when the target gap is positive. Conversely, a negative gap where current buffer stock savings x_t is less than the target buffer stock x^* would lead agents to decrease their consumption to build up savings. The covariance condition takes the form

$$\mathrm{Cov}\{x_t - x^*, E_t(x_{t+1} - x_t)\} < 0 \; . \tag{6}$$

JPP rewrite equation (6) in terms of observable variables as

$$\theta = \frac{\mathrm{Cov}\{x_t - x^*, c_t\}}{\mathrm{Cov}\{x_t - x^*, x_t\}} \; . \tag{7}$$

Equation (7) is useful because the sample equivalent of θ is the standard IV estimator of c_t on x_t using the target gap as an instrument. θ, therefore, is a simple linear expression which predicts how UI consumption will change based on the current level of the UI trust fund, and which is straightforward to estimate from the data.

The covariance ratio (7) satisfies the theoretical constraint that it is larger than $[1-G/(Re^{\sigma_N^2})]$, but to find exact numerical values for θ as a function of preference and income parameters, one needs to simulate the model. We do so below for a range of values of the government agent's risk aversion parameter ρ and discount factor β. We also estimate the covariance ratio θ from our data on the UI program using equation (7). Together this allows us to compare the estimated θ with the simulated values to judge whether state governments trade off impatience and risk aversion as predicted by the model and, if so, for which levels of risk aversion and impatience.

4.1 Application of the Buffer Stock Model to UI

The utility maximization problem underlying buffer stock behavior specifies that politicians will maximize their utility from consumption subject to their budget constraint. This subsection defines political UI consumption as dependent, not on total UI benefits, but on discretionary UI benefits and discretionary UI taxes. This distinction reflects the ability of politicians to offer higher UI benefits to those on the margin of being UI recipients, or lowering UI taxes, while considering the basic UI program that constitutes the minimum federal requirements as being outside of state political purview.[19] UI income is defined to complement UI consumption, using non-discretionary UI taxes and benefits. Specifically, fluctuations in UI benefits and taxes in response to changes in the unemployment rate are defined as non-discretionary, and changes in UI benefits and taxes orthogonal to changes in unemployment are considered discretionary. We test the extent to which UI consumption as defined here fluctuates with the level of cash-on-hand defined from UI saving in the trust fund account plus UI income.

We determine non-discretionary UI benefits in two steps. First, we regress UI

[19] This distinction is consistent with the empirical findings in Craig and Palumbo (1999), who find that UI is a substitute for low income assistance cash spending.

benefits normalized by covered wages on the state unemployment rate.[20] and, second, we use the fitted value multiplied by covered wages (turning the numbers back into dollar values) as our estimate of non-discretionary benefits. Similarly, we determine non-discretionary taxes by regressing UI taxes on the state unemployment rates and use the fitted value multiplied by covered wages as our estimate of non-discretionary taxes. The regression for benefits takes the form:

$$\text{benefits/covered wages}_{st} = \mu_s + \nu_t + \alpha U_{st} + u_{st} \ , \tag{8}$$

where μ_s and ν_t denote state and time-fixed effects; respectively, and U is the unemployment rate. We allow taxes to have more lags based on unreported preliminary regressions, so:

$$\text{taxes/covered wages}_{st} = \mu_s + \nu_t + \beta_0 U_{st} + \beta_1 U_{st-1} + \beta_2 U_{st-2} + u_{st} \ . \tag{9}$$

Using the predicted (fitted) values from these regressions, we define non-discretionary benefits and taxes as

$$\text{non-disc. benefits}_{st} = \text{Predicted}\left[\text{benefits/covered wages}\right]_{st} * \text{covered wages}_{st} \ ,$$

and

$$\text{non-disc. taxes}_{st} = \text{Predicted}\left[\text{taxes/covered wages}\right]_{st} * \text{covered wages}_{st}.$$

Residuals from regressions (8) and (9) reflect benefit and tax changes which are not functions of unemployment, and thus we consider these discretionary UI payments as

[20] Benefits and taxes are normalized by covered wages in order to reduce the severe heteroscedasticity that would otherwise be present and it allows us to regress unit free variables of size between 0 and 1 on the unit free unemployment rate.

UI consumption. More precisely, we define

$$\text{discretionary benefits}_{st} = \text{benefits}_{st} - \text{non-disc. benefits}_{st} \ ,$$

and

$$\text{discretionary taxes}_{st} = \text{taxes}_{st} - \text{non-disc. taxes}_{st} \ .$$

We then define

$$\text{UI consumption} \equiv \text{mean UI benefits} + (\text{disc. benefits} - \text{disc. taxes}) \ . \tag{10}$$

We define UI income in an analogous manner. Specifically, UI political income is defined to depend on non-discretionary UI taxes, as well as the negative of non-discretionary benefits, as:

$$\text{UI income} \equiv \text{mean UI taxes} + (\text{non-disc. taxes} - \text{non-disc. benefits}) \ . \tag{11}$$

This definition adds to UI taxes any differences between non-discretionary taxes and non-discretionary benefits, which contains the implication that politicians could spend resources left over after provision of non-discretionary UI benefits on elements that provide "political utility;" i.e, the discretionary benefits that form part of UI consumption or the discretionary (lowering of) taxes that form the other part of UI consumption.[21] UI permanent income is defined as a three period moving average of UI income.

An informal test of whether UI consumption, as we have defined it, provides utility for politicians is to examine whether UI consumption displays evidence of a political business cycle (Aidt, Veiga, and Veiga, 2011). We run a regression of UI consumption (normalized by UI permanent income) on a dummy for years in which governors are

[21] Adding mean UI taxes/benefits allows the state specific mean over time of UI income and UI consumption to be in the range of typical UI taxes and benefits in the state. Without this normalization, these variables would fluctuate around zero.

up for election—in all states, some or all members of the legislature are up for election the same year. We find a positive coefficient of 0.16, significant with a t-statistic of 2.40, implying that UI consumption is higher in election years by 16 percent of UI permanent income compared to other years. This suggests our definition of UI consumption is appropriate.[22]

Our definitions of UI income and UI consumption are consistent with the state government's UI budget constraint as shown by setting equations (10) and (11) equal to each other. That is, the sum over time of UI income should equal the sum over time of UI consumption, as:

$$\sum_{t=0}^{\infty} \beta^t (\text{mean UI taxes}_s + \text{non-disc. taxes}_{st} - \text{non-disc. benefits}_{st}) =$$

$$\sum_{t=0}^{\infty} \beta^t (\text{mean UI benefits}_s + \text{disc. benefits}_{st} - \text{disc. taxes}_{st}) \quad .$$

This equation reduces to the state government's regular UI budget constraint as:

$$\sum_{t=0}^{\infty} \beta^t (\text{non-disc. taxes} + \text{disc. taxes})_{st} = \sum_{t=0}^{\infty} \beta^t (\text{non-disc. benefits} + \text{disc. benefits})_{st} \ ;$$

i.e., the discounted present value of taxes equals the discounted present value of benefits (ignoring any initial assets).[23] Thus, our definitions of UI consumption and UI income are consistent with state governments' regular budget constraints.

The results for estimating equations (8) and (9) are reported in Table 4 using data assuming two years is the decision time frame (Appendix Table A.1 displays estimates of the same regressions for alternative initial years and Table A.3 displays results obtained using a single year time frame). The first column in Table 4 shows, not surprisingly, that benefits are tightly connected to the unemployment rate while the second column shows that taxes react to unemployment instantly although the full

[22]In our model based regressions below the election year variation is relegated to the error term. We thank Søren Leth-Petersen for suggesting this calculation.

[23]Mean UI taxes are approximately equal to mean UI benefits, so those terms cancel out.

adjustment happens gradually with a similar reaction after one two year period and a, still significant, impact after another two-year period. This, of course, is direct evidence against the Barro tax smoothing model which predicts instant full adjustment of tax rates to changes in permanent income. Our application of the JPP approach to study buffer stock savings behavior is methodologically straightforward; however, there are substantial data and measurement differences, especially regarding the measurement of income, consumption, and savings. Further, the buffer stock model directly deals with consumption rather than our approach of using a measure of discretionary UI benefits, and they have access to self-reported target wealth observations which we do not.

5 Buffer Stock Regressions

Table 5 displays the descriptive statistics for the series constructed to match the model used in the simulation, using our data on two year periods. Following Carroll (1997), we normalize all of the variables by permanent income, using the definition of UI income and equation (4). Cash-on-hand is shown to be 1.85 times permanent income on average with a standard deviation of 0.60 when calculated as an average of states' standard deviations over time and 0.55 when calculated as the average of year-by-year cross-state deviations. As we showed above, cash-on-hand is defined as the sum of the UI trust fund balance and the year's UI income, so the means for each of these components are shown in the table. Perhaps surprisingly, the standard deviation across states for the trust fund Balance is almost as large as the standard deviation across time, showing that there is considerable heterogeneity across states.

More directly informative about buffer stock behavior is the behavior of the putative buffer stock itself. Figure 2 displays the average level of cash-on-hand over time. From the figure it appears that politicians target a ratio of around two; that is, savings at the beginning of the period including UI taxes over the period are about twice permanent UI income. The level is lower at the beginning of our sample, but that is in accordance with the model as many states suffered severe recessions in the late 70s and were drawing on their UI trust fund balances. Other upturns and downturns, such as the 1990-91 and 2001 recessions, are visible in the figure, showing that state governments allow their savings balances to fluctuate over time.

Table 6 reports on the central IV-regression, equation (7), suggested by JPP as a measure of how consumption fluctuates with the level of cash-on-hand relative to target savings. The parameter estimate of 0.48 has a small standard error, and powerfully suggests that when cash-on-hand is high, UI consumption is high. That is, when a political agent observes substantial resources in the UI trust fund, the tendency is to extend UI benefits to marginal recipient groups such as part-time workers, or to lengthen the time period over which UI benefits are paid given the work history, or in other ways to expand ways to pay out UI benefits. An alternative path would be to lower UI taxes on firms, which again can be accomplished in a variety of ways including shifting down the entire tax schedule, or adjusting only part of it by, for example, lowering the degree to which the tax rate is experience rated. Thus, the IV regression illustrates that UI consumption, as we have defined it here, is responsive to the level of cash-on-hand.

If the model is a valid description of the data, the covariance ratio reported in Table 6 should be consistent with reasonable parameter values describing political behavior. JPP show through simulations that, for the range of behavioral parameter values that they find reasonable, the covariance ratio is in a range from 0.485 to 0.757. This relationship depends on the probability of zero income, the internal discount rate of the political agent, and the agent's degree of risk aversion. JPP, based on their empirical analysis of individual savings behavior, reject the buffer stock model for their data finding an empirical estimate for θ of 0.025 for the highest sub-sample, but typically even lower. It is instantly clear from Table 6 that our estimated covariance ratio of 0.48 is in the range consistent with the model, albeit at the low end. Our finding that UI consumption varies positively and significantly with the level of buffer stock savings is a powerful initial indicator that the model has predictive power for UI consumption. We explore whether reasonable values of the discount factor and risk aversion parameters are consistent with the estimated value of θ, and we compare the simulated value for target cash-on-hand to the data values.

5.1 Calibration and Simulations

We simulate the buffer stock model for 50 *a priori* identical consumers (UI systems) living for 100 periods with identical discount factors β and identical coefficients of risk aversion ρ. The simulation model is calibrated such that the income processes match our data while interest rates and probability of default is chosen to be similar to the values used by JPP. They employ an interest rate r of 3 percent and an income growth g of 4 percent in their simulations and, because we use two years as a period, we calibrate r and g to 6 and 8 percent, respectively. We set the probability of zero income—capturing the risk of economic meltdown—at 1 percent.[24] The variance of permanent income, σ_N^2, is calculated directly from the growth rate of permanent UI income. We calculate transitory income as the difference between UI income and permanent UI income and directly calculate the variance, σ_V^2. We find σ_N=0.173 and σ_V=0.304. We explore how the statistics of interest varies with time discounting β and risk aversion ρ by simulating the model. We experiment with a range of parameter values for time discounting and risk aversion to explore the resulting values of both the buffer stock of savings, and of the response of UI consumption to cash-on-hand. We choose a grid of a priori reasonable values with $\beta = 0.86, 0.90$ or 0.94 and the risk aversion parameter taking values $1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5$ or 5. For our interest rate of 6 percent, a discount factor β lower than 0.94 (corresponding to a discount rate higher than 6 percent) implies impatience; the situation where present consumption is, everything else equal, preferred to waiting one period and consuming a fraction r more.

We calculate the median buffer-stock x^* (across the 50 simulated consumers, who theoretically have the same target savings) and the median (across time) covariance

[24] JPP use p=0.005. Results under this alternative calibration value for the probability of zero income are shown in the Appendix. It does not materially alter the results.

ratio θ, calculated cross-sectionally for each $t = 2, ..., T - 10$, from the simulated data.[25] The objective is to find which, if any, β, ρ combination matches the empirical counterparts from Table 5 for x^* and Table 6 for θ. The simulation results of the buffer stock model are shown in Table 7.

Figure 3 illustrates the effect of impatience by changing the value of β in the simulations for ρ fixed at 3, while Figure 4 shows the partial effect on target wealth of changing ρ for β fixed at 0.9. Not surprisingly, we find a clear pattern with target wealth increasing monotonically with patience; i.e., with larger values of β. Less impatient individuals are willing to postpone some consumption in order to hold a larger buffer stock. The results (not shown) are qualitatively similar for other values of ρ. Figure 4, illustrates, for β fixed at 0.9, the partial effect of changing risk aversion, ρ. More risk averse individuals are found to hold larger buffer stocks because they suffer relatively more in case they are hit by a series of bad shocks and they, therefore, hold more savings to insure (buffer) against such a risk.

The simulation results in Table 7 reveal a range for the covariance ratio, θ, between 0.32 and 0.70, spanning our empirical IV-estimate of 0.48. Target wealth over permanent UI income, x^*, is found to be between 1.13 and 2.05, again spanning the empirical counterpart of 1.85 displayed in Table 5. No (θ, x^*) pair matches up perfectly with the observed $(\theta, x^*) = (0.48, 1.85)$ but some, with relatively low impatience and high risk aversion are very close: for example, the pair $\beta = 0.90, \rho = 3$ delivers $(\theta, x^*) = (0.43, 1.64)$. Considering the reported standard errors for the estimated θ in Table 6 and the standard deviations for buffer stock in Table 5, it is obvious that the simulated values for these parameter combinations are within any reasonable confidence band. In other words, the buffer-stock model fits how state governments manage their UI savings accounts very well. We cannot for sure rule out that politicians are not somewhat more impatient (increasing the covariance ratio and lowering the buffer stock) or somewhat more risk averse, but our empirical results can clearly rule out

[25] We drop the last 10 observations because we use a finite lifetime version of the model. The results are unchanged if we instead drop the last observation only.

combinations such as low risk aversion combined with high impatience or very high risk aversion with little impatience. Overall, we conclude from our empirical results and model simulations that the savings behavior of the UI systems is well captured by the buffer stock model. The range of parameters where the simulations fit the data suggest politicians are mildly impatient and have a moderate degree of risk aversion.

5.2 Discussion

The finding that buffer stock behavior characterizes public sector savings behavior, at least for UI, suggests that governments are forward looking, impatient, and risk averse. The literature going back at least to Persson and Svensson (1989), where government regimes amass debt in an attempt to forestall the choices of the next regime, suggest forward looking governments. The buffer stock approach suggests two additional key attributes of policy makers. One is that forward looking politicians exhibit impatience. The other, which balances impatience, again with a forward looking perspective, is risk aversion.[26] Risk aversion would appear to depend on the politicians' loss function, and thus on the institutional environment. For example, raising unemployment insurance taxes is likely to be visible enough to entail political costs, thus policy makers may be motivated to avoid unpopular behavior. Alternatively, and empirically equivalent, it may be that the business community has sufficient leverage to motivate politicians to consider business interests.

Given this understanding, it is interesting to speculate whether institutions such as rainy day funds are likely to be successful as management tools for smoothing taxes.[27] Based on our work here, an aspect that might affect government savings would be whether the public holds politicians responsible if saved resources are seen as inadequate, thus providing an incentive for politicians to operate with a degree of risk aversion to offset their impatience. Another possibility is that an earmarked tax, long

[26] Whether impatience or risk aversion would mitigate behavior such as the debt increases of Persson and Svensson (1989) is unknown, but the buffer stock model suggests that understanding the trade-offs would be interesting.

[27] See Knight and Levinson (1999), who find that rainy day funds are a net increase in savings by state governments. They do not, however, analyze the behavioral consequences in response to economic cycles.

excoriated by economists for providing an administrative constraint that politicians can nonetheless circumvent, may be important for linking the management of savings to a specific function. Thus, it might be worth considering whether other government institutions which provide income or consumption "insurance" might be modeled on UI. One example would be low income assistance, such as Temporary Assistance to Needy Families (TANF) and Medicaid (low income health care). Separate trust funds for these activities, similar to those of the UI system, financed by a dedicated part of a state tax, might function more effectively than when all activities are pooled within the general fund. Clearly, more research is required, but the buffer stock model is an intriguing opening to building fruitful policy models of public savings.

To illustrate the effect of buffer stock behavior on government budgets, Table 8 shows the relative response of the UI system to a temporary 50 percent increase in the unemployment rate. Based on the estimated effect of the unemployment rate on UI benefits from Table 4, national UI benefits would increase by \$40.01 per capita, which is \$10.2 Billion nationwide. If UI is financed out of the general fund, assuming borrowing would be against the state balanced-budget constraints (Poterba, 1995), then UI taxes would have to increase by an equal amount, and there would be no net fiscal stimulus. On the other hand, if states exercise perfect tax smoothing in Barro's sense, there would be no marginal change in taxes except to the extent the shock represents a permanent decrease in income, so the net fiscal stimulus would be \$38.68 (\$40.01 per capita less an increase in taxes of \$1.33 per capita).[28] Based on the (linearized) change in UI consumption as predicted by the buffer-stock model, as estimated in Table 6, taxes would increase by \$13.34 to finance non-discretionary benefits, which is only about 1/3 of the expenditure increase. Further, state governments would cut their discretionary UI taxes by \$6.40 per capita, resulting in a net tax increase of only \$6.94 per capita ($13.34 - 6.40$). The net fiscal stimulus in the year of the recession therefore would be \$33.07 ($40.01 - 6.94$). Thus, the buffer stock model suggests that state governments

[28]The net present value of an increase in taxes of \$1.33 in the current and all future periods is \$40.01 under our parametric assumptions.

succeed in providing about 85 percent (33.07/38.68) as much net stimulus in the year of the recession as predicted by Barro-type tax smoothing.

6 Summary and Conclusion

The objective of this paper has been to examine how state governments manage the savings they accumulate to finance unemployment benefits. We believe this is an important institutional arrangement which is worthwhile to examine with respect to savings behavior. The public good justification for state intervention seems relatively well justified, thus private individual or firm actions are unlikely to counter the objectives of state government officials. Further, UI is clearly an institution that is designed to respond to economic fluctuations.

We find using our simulations that state government behavior can be well characterized by a buffer stock model, suggesting relatively small fluctuations in the stock of savings around a target level. We derive this conclusion by simulating Carroll's (1992) buffer stock model using the method derived in JPP, and finding that the policy results from the simulation closely match the pooled panel data over time of the U.S. state government UI systems. The implication is that state government officials are forward looking, impatient, and risk averse.

Politicians "spend"—mainly by lowering taxes—about 50 percent of available cash and while they do not follow Barro's advice to perfectly smooth taxes over time, we find about 85 percent as much fiscal stimulus in the year of recession as predicted by the Barro model.

At least in the case of UI, governments seem to be more forward looking than the individuals in JPP's data set, which might be inconsistent with the popular notion that government agents are "too present oriented."[29] The question which we have not yet addressed, but which would be crucial for understanding whether the UI institu-

[29] Another possibility is that private agents do exhibit buffer stock behavior but individual level data asset data are observed with too much error to pin down the model. For example, it is difficult for an econometrician to observe explicit and implicit savings (pensions, expected inheritance) in order to properly fit the model.

tional model could be extended more broadly to overall government expenditure, is the relative importance of specific institutional features for our behavioral findings. One implication of our findings; however, is that there is little government behavior that is "automatic," as in automatic stabilizers, rather governments continually make choices and these choices depend on the objectives and tastes of policy makers, captured here by the trade-off between impatience and risk aversion.

7 References

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Table 1: Summary Statistics By State

UI Benefits (percent)	Mean	0.92
(UI payments/covered wages)	std1	0.31
	std2	0.37
UI Taxes (percent)	Mean	0.90
(UI taxes/covered wages)	std1	0.31
	std2	0.35
Trust fund balance (percent)	Mean	1.23
(UI trust fund balance/covered wages)	std1	0.75
	std2	1.05
Federal loan balance (percent)	Mean	0.17
(Federal loan balance/covered wages)	std1	0.26
	std2	0.53
Federal loan balance (if >0)(percent)	Mean	1.39
(Federal loan balance/covered wages)	std1	0.84
	std2	0.77
Interest credited to trust fund (percent)	Mean	0.10
(Interest/covered wages)	std1	0.05
	std2	0.06
GSP (ratio)	Mean	2.97
(GSP/covered wages)	std1	0.34
	std2	0.15
Unemployment rate (percent)	Mean	5.79
	std1	1.06
	std2	1.65
Observations		$1,584$

Notes: The data covers 33 years from 1976 to 2008. "std1" (cross-section) is for any variable X, the time average of $\left[(1/n)\sum_i(X_{it}-\bar{X}_t)^2\right]^{1/2}$ where $\bar{X}_t$ is the period t average of X_{it} across states, and n is the number of states. "std2" (time-series): average over i of $\left[(1/T)\sum_t(X_{it}-\bar{X}_i)^2\right]^{1/2}$ where $\bar{X}_i$ is the time average of X_{it} for state i, and T is the number of years in the sample. Benefits, Taxes, UI trust fund balance, GSP, Federal loan balance, Interest credited to trust fund are all normalized by covered wages. Federal loan balance is positive for 12 percent of the observations.

Table 2: Summary Statistics (Real 1983 Dollars Per Capita)

Benefits	Mean	52.19
	std1	21.21
	std2	16.79
Taxes	Mean	51.16
	std1	21.51
	std2	15.33
Trust fund balance	Mean	71.28
	std1	39.85
	std2	62.40
GSP	Mean	17,153
	std1	2,733
	std2	2,570
Federal loan balance	Mean	9.13
	std1	14.69
	std2	28.26
Federal loan balance (if > 0)	Mean	75.29
	std1	44.66
	std2	38.85
Interest credited to trust fund	Mean	5.80
	std1	2.68
	std2	3.72
Population (millions)	Mean	5.32
	std1	5.61
	std2	1.02
Observations		1,584

Notes: The data covers 33 years from 1976 to 2008. "std1" (cross-section) is for any variable X, the time average of $\left[(1/n)\sum_i (X_{it} - \bar{X}_t)^2\right]^{1/2}$ where $\bar{X}_t$ is the period t average of X_{it} across states, and n is the number of states. "std2" (time-series): average over i of $\left[(1/T)\sum_t (X_{it} - \bar{X}_i)^2\right]^{1/2}$ where $\bar{X}_i$ is the time average of X_{it} for state i, and T is the number of years in the sample. Benefits, Taxes, Trust fund balance, GSP, Federal loan balance, Interest credited to trust fund are all deflated by the 1982-84 CPI. Federal loan balance is positive for 12 percent of the observations.

Table 3: Panel Unit Root Tests

	log(Taxes/Cov. Wages)	log(Ben./Cov. Wages)
Individual state ADF Unit Root Tests:		
Number of rejections:	12	24
Panel AR(1) estimation	0.94***	0.87***
(Std. error)	(0.01)	(0.01)
IPS panel unit root test (test-statistic)	−2.20	−2.34
(1 percent Critical Value for the IPS test)	−1.81	−1.81
Observations	1,536	1,536

Notes: The first row reports the number of rejections of unit roots in individual state Augmented Dickey-Fuller (ADF) tests on taxes and benefits series using the 33 years of data 1976-2008 for the 48 contiguous states. The ADF is estimated from the model: $\Delta X_{it} = \alpha_i + \rho_i X_{it-1} + \sum_{i=1}^{N} \delta_k \Delta X_{it-j}$ where the number of lags k is chosen endogenously. The second row reports the estimated coefficient from a standard panel AR(1) estimation with state fixed effects: $X_{it} = \mu_i + \alpha X_{it-1} + \epsilon_{it}$ with standard errors in parentheses. The last row reports the test-statistic from the Im-Pesaran-Shin (IPS) panel unit root test which performs ADF tests on individual states, and is based on averaging stat-by-state unit root t-test statistics; i.e., the test statistics is $\bar{t} = \frac{1}{N} \sum_{i=1}^{N} t_{\rho_i}$. A value smaller than the critical value fails to reject the unit root hypothesis. *, **, and *** refer to the 10 percent, 5 percent, and 1 percent significance levels, respectively.

Table 4: DETERMINATION OF NON-DISCRETIONARY UI BENEFITS AND TAXES

	Benefits/Covered Wages	Taxes/Covered Wages
Two-year periods		
Start period	1977-1978	1981-1982
Unemployment rate	0.15***	0.05***
	(0.01)	(0.01)
Unemployment rate$_{t-1}$		0.06***
		(0.02)
Unemployment rate$_{t-2}$		0.01
		(0.01)
State and Year fixed effects	Yes	Yes
Observations	768	672

Notes: In the regressions, we treat two consecutive years to be a period by summing each variable for two consecutive years. The predicted values from the regressions (multiplied by covered wages) define non-discretionary UI benefits and non-discretionary UI taxes. The data are for the 48 contiguous states over 16 periods from 1977-1978 to 2007-2008. The unemployment rate of any given period is the average rate over two years (e.g., the unemployment rate for the period 1979-1980 is the average unemployment rate of 1979 and 1980). Unemployment rate$_{t-1}$ and Unemployment rate$_{t-2}$ denote the first and second period lags of the unemployment rate, respectively. Robust std. errors clustered by state are in parentheses. *, **, *** reflect significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 5: Descriptive Statistics of Key Buffer Stock Model Variables by State

	Mean	std1 (cross-section)	std2 (time-series)
Two-year periods			
Cash-on-hand/Permanent income	1.85	0.55	0.60
UI income/Permanent income	0.97	0.02	0.29
UI consumption/Permanent income	1.07	0.12	0.32
Trust fund balance/Permanent income	0.89	0.56	0.59
Observations	576		

Notes: "std1" (cross-section): time average of $\left[(1/n)\sum_i (X_{it} - \bar{X}_t)^2\right]^{1/2}$ where $\bar{X}_t$ is the period t average of X_{it} across states, and n is the number of states. "std2" (time-series): average over i of $\left[(1/T)\sum_t (X_{it} - \bar{X}_i)^2\right]^{1/2}$ where $\bar{X}_i$ is the time average of X_{it} for state i, and T is the number of years in the sample. We treat two consecutive years to be a single period by summing the annual values. Non-discretionary taxes are the predicted values from the regression reported in Table 4 and discretionary taxes are the residuals, both scaled by covered wages. Similarly, non-discretionary benefits are the expected value from Table 4, while discretionary benefits are the residuals, both scaled by covered wages. UI consumption is average UI benefits plus discretionary benefits minus discretionary taxes. UI income is average UI taxes plus non-discretionary taxes minus non-discretionary benefits. Cash-on-hand is the trust fund balance plus UI income. Permanent income is defined as the 3 period moving average of UI income for the specification with 2 years as a period. The initial period—the first period for which permanent income can be calculated—is 1982-1983.

Table 6: Estimate of UI Consumption Responsiveness to Savings: The Covariance Ratio

IV regression: UI Consumption=$\alpha+\theta*$Cash-on-Hand. Instrument is (Actual – Target Cash-on-Hand).	
	UI Consumption
Two-year periods Start period 1983-1984	
θ (coefficient of cash-on-hand)	0.48^{***} (0.10)
State and year fixed effects	Yes
Observations	576

Notes: This regression is derived in Jappelli, Pistaferri, and Padula (2008), where the estimated parameter θ is labeled the "covariance ratio," see main text for details. The dependent variable is UI consumption [defined as (discretionary benefits – discretionary taxes + mean state UI benefits over time), see Table 4]. The right hand side variable is cash-on-hand minus target cash-on-hand, where cash-on-hand is defined as the UI trust fund balance plus the year's UI tax revenue. The instrument is (actual cash-on-hand – target cash-on-hand). Two years (summed) is treated as one period. We approximate target cash-on-hand by a 3 period moving average (thus six years) of cash-on-hand for the two-year periods. All variables are normalized by permanent income. We define UI permanent income as a 3 period moving average (thus six years) of UI income. Robust std. errors clustered by state are in parentheses. *, **, *** reflect significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 7: Simulated Covariance Ratio and Target Cash-on-Hand. Probability of Zero Income =0.01

	β=0.86	β=0.90	β=0.94
ρ=1	θ=0.70 x^*=1.13	θ=0.62 x^*=1.20	θ=0.52 x^*=1.32
ρ=1.5	θ=0.61 x^*=1.23	θ=0.55 x^*=1.31	θ=0.48 x^*=1.41
ρ=2	θ=0.54 x^*=1.35	θ=0.50 x^*=1.41	θ=0.44 x^*=1.53
ρ=2.5	θ=0.51 x^*=1.45	θ=0.46 x^*=1.53	θ=0.41 x^*=1.64
ρ=3	θ=0.46 x^*=1.58	θ=0.43 x^*=1.64	θ=0.38 x^*=1.75
ρ=3.5	θ=0.43 x^*=1.68	θ=0.40 x^*=1.76	θ=0.34 x^*=1.90
ρ=4	θ=0.40 x^*=1.80	θ=0.36 x^*=1.90	θ=0.32 x^*=2.04
ρ=4.5	θ=0.37 x^*=1.93	θ=0.34 x^*=2.03	*NA*
ρ=5	θ=0.35 x^*=2.05	*NA*	*NA*

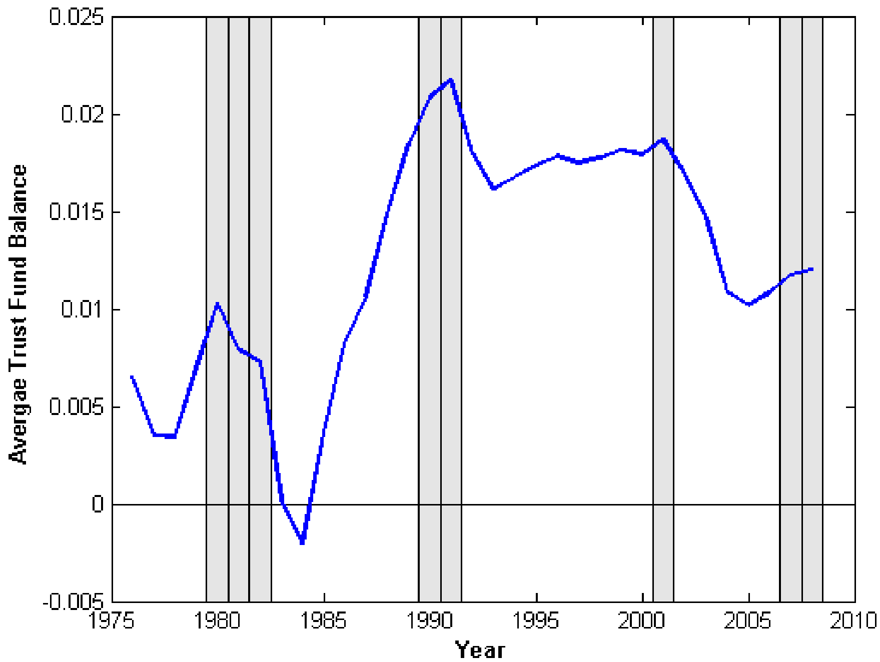
Notes: This table reports the median (across time) simulated covariance ratio θ and the cross-sectional median simulated target cash-on-hand to permanent income ratio x^*. The results are reported for a grid of coefficients for risk aversion and time discounting. The simulations for each pair of these parameters are done for 50 consumers (UI systems) with identical discount factors β and identical coefficients of risk aversion ρ living for 100 periods. Simulations are based on a standard deviation of permanent income shocks, σ_N, of 0.173, a standard deviation of transitory income shocks, σ_V, of 0.304, and a probability of zero income $p = 0.01$. Income growth and interest rate are set to 8 percent and 6 percent respectively. *NA* indicates that a fixed point solution does not exist (Carroll, 1997).

Table 8: Change in UI Budgets (per cap.) following a One-Period Recession

	Change in Non-Disc. Benefits	Change in Non-Disc. Taxes	Change in Discretionary Benefits	Change in Discretionary Taxes	Change in Savings End of Year
Buffer Stock Model:					
Yr of Recession	\$40.01	\$13.34	–\$6.40	–\$6.40	–\$13.87
Next Year	\$0.00	\$16.00	\$0.51	\$0.51	\$14.98
Following Yr	\$0.00	\$2.67	\$4.23	\$4.23	–\$5.80
Barro Tax Smoothing:					
Yr of Recession	\$40.01	\$1.33	*NA*	*NA*	–\$38.67
Next Year	\$0.00	\$1.33	*NA*	*NA*	\$1.33
Following Yr	\$0.00	\$1.33	*NA*	*NA*	\$1.33

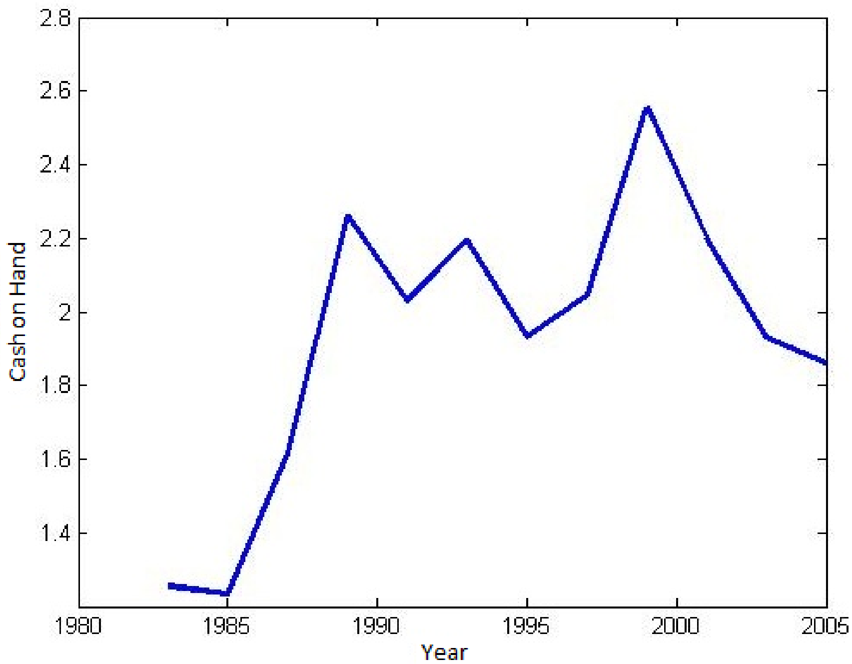
Notes: The table displays the change in taxes and benefits as predicted by the buffer stock model. (The model, as implemented in this article, is silent on the break down of UI consumption between discretionary taxes and discretionary benefits, so we here split the UI consumption response evenly over the two components.) We calculate the effect of a hypothetical 50 percent increase in the unemployment rate, from the average of 5.7 percent to 8.55 percent for one year, after which the unemployment rate is assumed to return to 5.7 percent.

Figure 1: Average Trust Fund Balance 1976-2008



Notes: The figure displays the yearly averages across states of state-level trust fund balances normalized by covered wages. The shaded areas indicate recession years.

Figure 2: Average Empirical UI Cash-on-Hand



Notes: The figure displays the period-by-period average over U.S. states of cash-on-hand (trust fund balance plus UI income divided by UI permanent income). A period is two years (with start period=1977-1978) and UI permanent income is the 3 period moving average of UI income defined in equation (11).

Figure 3: Average Simulated Target Ratio of Cash on Hand to Permanent Income with Varying Discount Factor ($p = 0.01$)

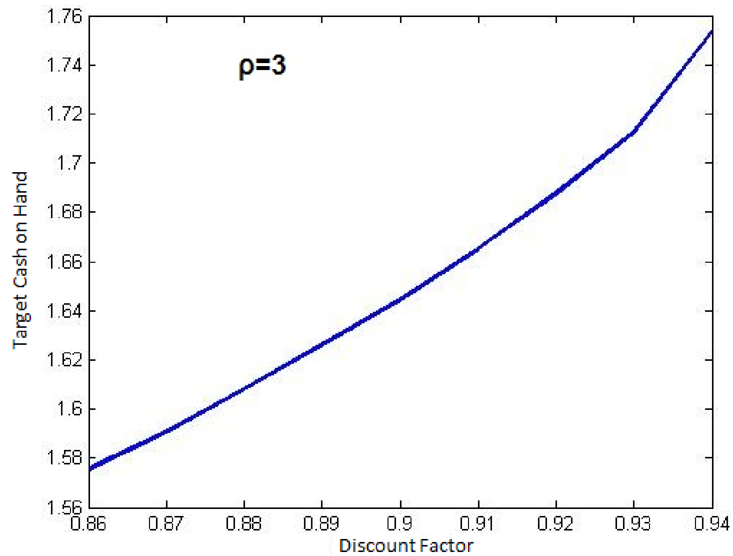
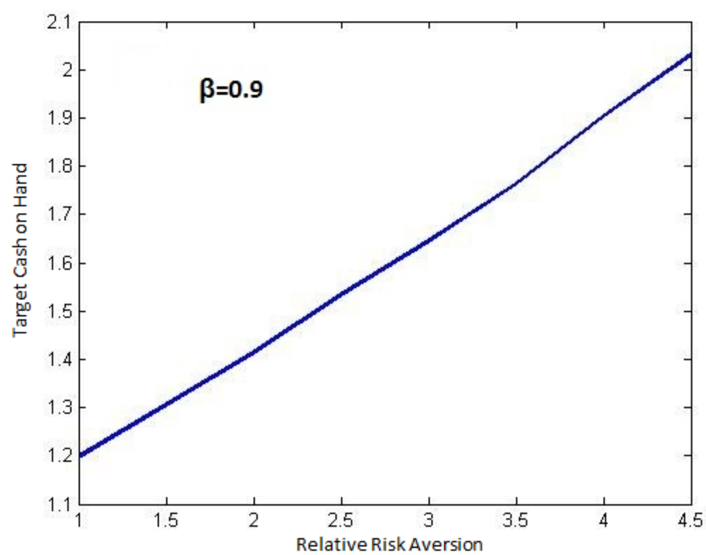


Figure 4: Average Simulated Target Ratio of Cash on Hand to Permanent Income with Varying Relative Risk Aversion ($p = 0.01$)



Notes: The figures display the average simulated target amount of cash-on-hand relative to permanent income for a buffer stock model with 50 homogeneous consumers (having the same relative risk aversion in Figure 3 and the same discount factor in Figure 4) living for 100 periods, having income growth of 8 percent, an interest rate of 6 percent, a probability of zero income of 0.01, and standard deviations of permanent and transitory shocks of 0.173 and 0.304, respectively. Figure 3 graphs the repeated simulations for different discount factors maintaining $\rho = 3$. Figure 4 graphs the repeated simulations for different relative risk aversion parameters maintaining $\beta = 0.9$.

A Appendix

We demonstrate that our qualitative findings are robust to using one versus two years as a period, to the starting year, and to the (model) probability of zero income. Table A.1 and Table A.2 re-estimate non-discretionary benefits/taxes and the covariance ratio, respectively, starting one year earlier than the corresponding tables in the main text. This does not change the results much. Table A.3 estimates non-discretionary benefits and taxes using single years as periods. Using UI consumption and UI income constructed from the regressions in Table A.3, Table A.4 and Table A.5 estimate the covariance ratio starting from 1981 and 1982, respectively. Overall, the results are qualitatively very robust: the largest difference to our preferred results are in Table A.5 where the estimated covariance ratio is only is 0.19, which is somewhat lower than the values found by simulation in Table 7. In Table A.6, we simulate the model calibrated to the standard deviations of the UI income components calculated using one year as a period. The simulated covariance ratios are quite similar to those simulated for two-year periods. Finally, Figures A.1 and A.2 show that the results are not very sensitive to which (low) probability of zero income we assume.

Table A.1: Determination of Non-Discretionary UI Benefits and Taxes. Alternative start year.

	Benefits/Covered Wages	Taxes/Covered Wages
Two-year periods		
Start period	1976-1977	1980-1981
Unemployment rate	0.15***	0.03**
	(0.01)	(0.01)
Unemployment rate$_{t-1}$		0.08***
		(0.01)
Unemployment rate$_{t-2}$		0.01
		(0.01)
State and year fixed effects	Yes	Yes
Observations	768	672

Notes: In the regressions above we treat two consecutive years as a period. We sum taxes, benefits, covered wages for two consecutive years and use that to be the value for a single period. The data consists of a panel of 48 states over 16 periods from 1976-1977 to 2006-2007. The unemployment rate of any given period is the average over two years (e.g., the unemployment rate for the period 1978-1979 is the average of unemployment rates for 1978 and 1979). Unemployment rate$_{t-1}$ and Unemployment rate$_{t-2}$ denote the first and second period lags of unemployment rate. Trust fund balance$_{t-1}$ denotes the year end trust fund balance of the previous year (for e.g., trust fund balance for the period 1978-1979 is the reserves as of December 31st 1977). Robust std. err. clustered by state are in parentheses. *, **, *** reflect significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table A.2: Estimate of UI Consumption Responsiveness to Savings: The Covariance Ratio. Alternative Starting Year.

IV regression: UI Consumption=α+$\theta *$ Cash-on-Hand) . Instrument is (Actual – Target Cash-on-Hand)	
	UI Consumption
Two-year periods Start period 1982-1983	
Estimated coefficient of cash-on-hand	0.58*** (0.10)
State and year fixed effects	Yes
Observations	576

Notes: In the above specification, we treat two consecutive years to be a period, where we sum the two annual values for each variable. We run an IV regression of UI consumption, [defined as (discretionary benefits – discretionary taxes + mean state benefits over time)] on cash-on-hand [defined as (trust fund balance + UI income)]. UI income is defined as [non-discretionary taxes – non-discretionary benefits + mean state taxes over time]. Non-discretionary taxes are the fitted values of taxes from the regression in column 2 of Table A.1 while discretionary taxes are the residuals from the regression in column 2 of Table A.1, both scaled by covered wages. Non-discretionary benefits are the fitted values from the regression in column 1 of Table A.1 while discretionary benefits as the residuals from the regression in column 1 of Table A.1, both scaled by covered wages. We use the deviation between cash-on-hand and the target ratio of cash-on-hand as the instrument. We approximate the target cash-on-hand by the 3 period moving average (thus six years) of cash-on-hand for the two-year periods (i.e. we use the moving average of 3 periods of the 2 year sums). All variables are normalized by permanent income. For the two-year period we define permanent income as a 3 period moving average (thus six years) of income. Robust std. err. clustered by state are in parentheses. *, **, *** reflect significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table A.3: DETERMINATION OF NON-DISCRETIONARY UI BENEFITS AND TAXES. ONE YEAR AS A PERIOD.

	Benefits/Covered Wages	Taxes/Covered Wages
One-year periods		
Start year=1977	1977	1981
Unemployment rate	0.15^{***}	0.03^{***}
	(0.01)	(0.01)
Unemployment rate$_{t-1}$		0.01
		(0.01)
Unemployment rate$_{t-2}$		0.04^{***}
		(0.01)
Unemployment rate$_{t-3}$		0.03^{***}
		(0.01)
Unemployment rate$_{t-4}$		-0.00
		(0.01)
State and year fixed effects	Yes	Yes
Observations	1,536	1,344

Notes: Robust standard errors clustered by state are in parentheses. In the regressions above we treat each year as a period. The data consists a panel of 48 states over 32 years from 1977 to 2008. Unemployment rate$_{t-1}$, Unemployment rate$_{t-2}$, Unemployment rate$_{t-3}$, Unemployment rate$_{t-4}$ denote the first, second, third, and fourth year lags of the unemployment rate, respectively. Robust std. err. clustered by state are in parentheses. *, **, *** reflect significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table A.4: Estimate of UI Consumption Responsiveness to Savings: The Covariance Ratio. One Year as a Period.

IV regression: UI Consumption=$\alpha+\theta*$Cash-on-Hand Instrument is (Actual – Target Cash-on-Hand)	
	UI Consumption
One-year periods Start year 1981	
Estimated coefficient of cash-on-hand	0.43*** (0.0007)
State and year fixed effects	Yes
Observations	1,248

Notes: In the above specification we treat a single year as a period. We run an IV regression of UI consumption, [defined as (discretionary benefits – discretionary taxes + mean state benefits over time)] on cash-on-hand [defined as (trust fund balance + UI income)]. UI income is defined as [non-discretionary taxes – non-discretionary benefits + mean state taxes over time]. Non-discretionary taxes are the fitted values from the regression in column 2 of Table A.3 while discretionary taxes are the residuals from the regression in column 2 of Table A.3, both scaled by covered wages. Non-discretionary benefits are the fitted values from the regression in column 1 of Table A.3 while discretionary benefits as the residuals from the regression in column 1 of Table A.3, both scaled by covered wages. We use the deviation between cash-on-hand and target cash-on-hand as the instrument. We approximate the target cash-on-hand to be a 3 year moving average of cash-on-hand for the one-year period. All variables are normalized by permanent income. Permanent income is defined as a 3 year moving average of UI income. Robust std. err. clustered by state are in parentheses. *, **, *** reflect significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table A.5: Estimate of UI Consumption Responsiveness to Savings: The Covariance Ratio. One Year as a Period. Alternative Start Year

IV regression: UI Consumption=α+θ*Cash-on-Hand Instrument is (Actual – Target Cash-on-Hand)	.
	UI Consumption
One-year periods Start Year 1982	
Estimated coefficient of cash-on-hand	0.19***
	(0.01)
State and year fixed effects	Yes
Observations	1248

Notes: In the above specification we treat a single year as a period. We run an IV regression of UI consumption, [defined as (discretionary benefits – discretionary taxes + mean state benefits over time)] on cash-on-hand [defined as (trust fund balance + UI income)]. UI income is defined as [non-discretionary taxes – non-discretionary benefits + mean state taxes over time]. Non-discretionary taxes are the fitted values from the regression in column 2 of Table A.3 while discretionary taxes are the residuals from the regression in column 2 of Table A.3, both scaled by covered wages. Non-discretionary benefits are the fitted values from the regression in column 1 of Table A.3 while discretionary benefits as the residuals from the regression in column 1 of Table A.3, both scaled by covered wages. We use the deviation between cash-on-hand and target cash-on-hand as the instrument. We approximate target cash-on-hand to be a 3 year moving average of cash-on-hand for the one-year period. All variables are normalized by permanent income. Permanent income is defined as a 3 year moving average of UI income. Robust std. err. clustered by state are in parentheses. *, **, *** reflect significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table A.6: Simulated Covariance Ratio and Target Cash-on-Hand. Alternative Probability of Zero Income. ($p = 0.005$)

	β=0.86	β=0.90	β=0.94
ρ=1	θ=0.73 x^*=1.10	θ=0.65 x^*=1.16	θ=0.55 x^*=1.26
ρ=1.5	θ=0.63 x^*=1.19	θ=0.59 x^*=1.24	θ=0.50 x^*=1.35
ρ=2	θ=0.57 x^*=1.28	θ=0.52 x^*=1.35	θ=0.47 x^*=1.43
ρ=2.5	θ=0.53 x^*=1.38	θ=0.50 x^*=1.43	θ=0.43 x^*=1.55
ρ=3	θ=0.49 x^*=1.47	θ=0.45 x^*=1.55	θ=0.41 x^*=1.65
ρ=3.5	θ=0.45 x^*=1.58	θ=0.42 x^*=1.65	θ=0.38 x^*=1.77
ρ=4	θ=0.43 x^*=1.68	θ=0.39 x^*=1.77	θ=0.34 x^*=1.91
ρ=4.5	θ=0.39 x^*=1.80	θ=0.35 x^*=1.90	*NA*
ρ=5	θ=0.36 x^*=1.92	*NA*	*NA*

Notes: The table reports the median (across time) simulated covariance ratio θ and the cross-sectional median simulated target cash-on-hand to permanent income ratio x^* under alternative parameterizations of a buffer stock economy populated by 50 consumers with the same discount factor β living for 100 periods. ρ is the coefficient of relative risk aversion. Simulations are calibrated with a standard deviation of permanent income shocks, σ_N, of 0.173, a standard deviation of transitory income shocks, σ_V, of 0.304, and a probability of zero income $p = 0.005$. Income growth and interest rate are set to 8 percent and 6 percent, respectively. *NA* is reported in the cases where a fixed point solution does not exist (Carroll, 1997).

Figure A.1: Average Simulated Target Ratio of Cash on Hand to Permanent Income with Varying Relative Risk Aversion. Alternative Probability of Zero Income. ($p = 0.005$)

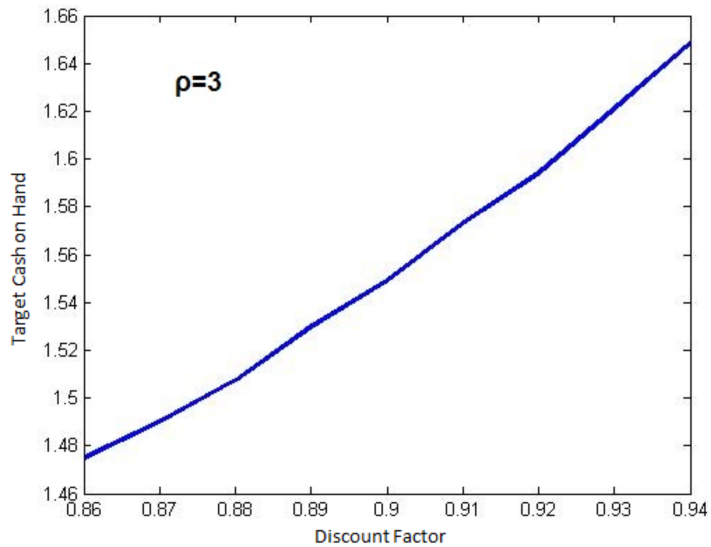
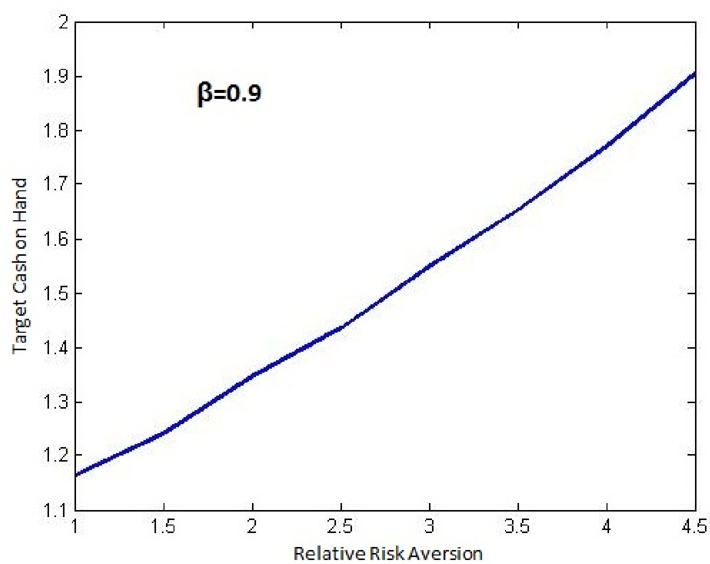


Figure A.2: Average Simulated Target Ratio of Cash-on-Hand to Permanent Income with Varying Discount Factor. Alternative Probability of Zero Income. ($p = 0.005$)



Notes: The figures display the average simulated target amount of cash-on-hand (relative to permanent income) for a buffer stock model with 50 homogeneous consumers (having the same relative risk aversion in Figure A.1 and the same discount factor in Figure A.2) living for 100 periods having income growth of 8 percent, an interest rate of 6 percent, a probability of zero income of 0.005, and standard deviations of permanent and transitory shocks of 0.173 and 0.304, respectively. Figure A.1 graphs repeated simulations for different discount factors maintaining $\rho = 3$. Figure A.2 graphs repeated simulations for different relative risk aversions maintaining $\beta = 0.9$.