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ABSTRACT

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

This paper successfully fits a model of forward looking government savings behavior to data from the U.S. state Unemployment Insurance (UI) programs 1976-2008. Specifically, we find states do not perfectly smooth tax rates in Barro's sense, but follow behavior consistent with a buffer stock model where politicians trade-off their desire to immediately expend all savings against the fear of running out of funds. We find that states increase benefits or lower taxes when savings balances are high. State UI budgets, as rationalized by the buffer stock model, display surpluses that are more pro-cyclical than Barro's model would imply but substantially less cyclical than contemporaneous budget balance.

JEL Classification: e21, h11 and h74
Keywords: forward looking politicians, impatience and precautionary saving

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1 Introduction

The latest recession has focused attention on the dynamic public policy management of taxes and expenditures. Policy proposals have spanned the possibilities for potential reform, from more restrictions on budget deficits (such as contemporaneous balanced budget rules for national governments), to accommodation of longer term budgeting through larger and more flexible savings accounts. Before these policies can be evaluated, it is important to understand how and whether governments exhibit forward looking behavior consistent with the ability to make inter-temporal trade-offs. On the one hand, it is easy to believe that politicians are more impatient than the general public and if so, it is likely that they will tend to under-save such that the intertemporal budget constraint will only be satisfied via occasional budget crises. On the other hand, governments are often sensitive to public opinion and may want to avoid the embarrassment of budget crises. It is not known, however, whether governments would maintain precautionary savings accounts sufficient to offset the effects of economic cycles even if they had the means to do so. One reason this is not known, is that we do not yet have a successful empirical model that explains dynamic planning by governments, nor one that explains whether governments might be sufficiently forward looking to manage savings accounts. In this paper, we attempt to redress this omission by proposing and testing a buffer stock model to explain government behavior. This model is attractive because it combines two powerful motivations for government actors, impatience and risk aversion (prudence).

Our empirical model uses the 48 mainland U.S. states as its "laboratory," because the states are subject to similar institutional and legal frameworks. This will circumvent some of the problems of applying structural models to national governments: samples of countries have small sizes and, with many and varied important actors, may not satisfy the homogeneity conditions for pooling. It is difficult, however, to estimate dynamic models of the savings behavior of U.S. state governments because of the contemporaneous balanced budget constraints which have long been a feature of the policy landscape in the United States. The general thrust behind these institutional restrictions has been to constrain the ability of governments to borrow, presumably out of fear they would do so irresponsibly, increasing the risk of crises. In contrast, coping with inter-temporal fluctuations has always been one source of opposition to balanced budget requirements, and essentially no state government in the U.S. faces balanced budget requirements for every part of its budget (Poterba, 1994).[1] In this vein, many states have recently created "rainy day" fund accounts that allow some inter-temporal substitution in the current account by allowing state governments to transfer funds from one year to another without violating their balanced-budget rules (Knight and Levinson, 1999). Nonetheless, economic research has not provided models of politicians' behavior which would help evaluate the desirability and optimal scope of such funds. Our goal in this paper is to commence the search for models which are useful for understanding forward looking government behavior, and in particular whether governments are likely to maintain sufficient amounts of assets in such funds that they can provide significant buffers against abrupt budget cuts in recessions.

One of the few empirically oriented models of government inter-temporal behavior is Barro's (1979) tax smoothing model, which describes the optimal dynamic path for tax-rates. Interestingly, one government program that is designed to allow state governments to behave as Barro proscribes is the Unemployment Insurance (UI) program. The UI context is particularly interesting because the system is designed with economic fluctuations as the underlying context. Each U.S. state manages its own UI program under a federal policy umbrella, where state governments select most major policy options including eligibility criteria, tax rates, and the level and duration (or schedule) of benefit payments. 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. The trust fund arrangement has meant that the UI program is not subject to the contemporaneous balanced budget requirements of state governments' general funds. We thus examine state governments' forward looking

[1]For example, capital expenditures are exempt from contemporaneous balanced budget requirements in most states.

behavior with respect to their UI program.

The key feature which leads us to study the state UI programs is that each state fully manages its own trust fund savings account, into which state UI taxes are paid and which is the exclusive source of UI benefit payments.[2] 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. At the same time, using tax money raised from firms without providing an immediate public expenditure benefit may 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.[3]

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 and taxes as endogenous. 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 more normal 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

[2]States are fully responsible for the first 26 weeks of UI payments, if benefits are extended the federal government is responsible for paying the remainder. We study here only behavior as it pertains to the portion about which state governments are responsible.

[3]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 business cycle, nor do they explain the management of the UI trust fund savings account.

Thus we turn to the buffer stock model in an attempt to explain how governments make forward looking decisions. Specifically, when the burden on UI savings is high during times of high unemployment, state governments have essentially three choices. First, state governments may allow the stock of UI savings to erode as benefits paid out exceed tax revenue coming in. Second, UI benefits could be cut: changes in UI benefits do not generally occur for full time workers firmly attached to the labor force, but states have flexibility over defining whether part time workers are eligible, whether workers with short work histories are eligible and, if so, the length of UI benefits such workers are allowed to receive. Third, state governments may adjust the tax rates on firms. Such adjustments could include taxes sufficient to pay all, or only part, of the higher payouts.

One way to characterize these adjustments is to consider the consequences of changes in benefits and taxes on the level of state government savings, and thus on policy decisions in the future. Determinants of these policy choices are political preferences, which we specify by considering the politicians' degree of impatience and their aversion to risk (of exhausting the trust fund). That is, impatient politicians would be expected to lower UI taxes and/or raise UI benefits and use all UI savings during their term in office. As a consequence, there would be no funds to support UI during down times in the economy. If politicians are risk averse, they may instead choose to maintain a level of savings so that funds are sufficient to moderate benefit cuts or tax increases during down times. The buffer stock model captures both of these forces, impatience and risk aversion. We find that while governments appear to be willing to maintain a stock of savings in good times, we also find taxes are increased during bad times and fall during good times suggesting that impatience is also part of the government decision making process.

The data for the empirical work comes from the UI programs for the 48 mainland U.S. states. We collect data on each state's UI program, including taxers, benefit payouts, and trust fund savings levels. 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.[4] 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. Additionally, 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 insure 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).[5]

Jappelli, Padula, and Pistaferri (2008) (hereafter JPP) devise an empirical test of the buffer stock model, but do not find empirical support using savings 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 model by comparing the level of savings of the UI systems to the level of savings predicted by a suitably calibrated version of the model. Our approach is two-pronged: first, we perform a regression analysis of how state governments adjust their savings in response to observed deviations from the desired savings level. Second, we simulate the buffer stock model using the state government data means and variances for a range

[4]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.

[5]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."

of preference parameters. Regressions with the simulated data are used to derive the UI policy responsiveness in the JPP specification. For suitable parameter values, we find that the simulation statistics closely match the actual empirical outcomes, and we conclude that government behavior can be well explained by buffer stock behavior with risk averse, impatient politicians.[6]

We believe we provide the first empirical support for a systematic framework of government behavior towards saving over time. Understanding whether governments are forward looking and quantifying the extent of their impatience is a crucial input into the debate as to whether governments need, or would use, more latitude for dealing with business cycles (Fatas and Mihov, 2003). In the conclusion, we briefly speculate on how institutional settings may affect risk aversion and impatience of governments.

The remainder of the paper is laid out as follows. Section 2 describes the institutional setting for UI, as well as the panel data for the 48 contiguous U.S. states from 1976-2008. Section 3 tests the PIH and tax smoothing models and documents the time-series properties of benefits and taxes in the process, finding little systematic empirical support for these idealized models. Section 4 describes the buffer-stock model and explains how we map the UI institutional environment into the buffer stock model. Section 5 presents the key results, which illustrate how states adjust their UI taxes and benefits in response to deviations of UI savings from the target level of savings. These regressions, suggested by JPP in the context of consumers, find that benefits rise and taxes fall when savings exceed the target level, and find that benefits fall and taxes rise when actual savings are lower than the target level. The regression results and actual savings behavior is then compared to the corresponding statistics calculated from a simulated version of the buffer stock model, calibrated to the empirical data. We find that levels of buffer stock savings, and responses of UI benefits and taxes to deviations of savings from the target, are consistent with the the model. Finally, Section 6 summarizes the evidence and speculates whether the particular institutional setting

[6] 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).

studied is important for our empirical results.

2 The UI System and the Data

Each of the 48 mainland U.S. states has a separate UI program where eligibility rules and benefit amounts are allowed to vary within certain limits.[7] 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.[8] In this way, the tax is essentially an annual lump sum tax per employee. While in theory there is no interaction between the UI trust fund and 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 in firm taxation that is credited to the general fund to move money from the UI trust fund to the general fund or vice versa.

Figure 1 shows average (across states) trust fund balances normalized by covered wages over time. The grey shaded areas show national recessions. Trust fund balances fluctuate over time, tending to rise in normal times 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 figure therefore suggests the buffer stock model may be useful because it uses deviation from target savings as the motivation for policy changes.

State governments are allowed to borrow to fund UI if they run out of savings, but

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

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

there is an implicit limit on their borrowing. Specifically, state UI systems must be "fundamentally solvent" as determined by the U.S. Department of Labor (DOL) to be eligible for federal loans.[9] 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.[10] 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.

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 (because 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.[11] 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 variables show higher cyclical (time-series) variation than variation between average levels across states. 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

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

[10] 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.

[11] 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.

trust fund averages 0.1 percent of covered wages. 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 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

One possible model that describes how state governments might manage their UI savings accounts is the forward looking tax smoothing model of Barro (1979). The objective function of the government is to minimize the efficiency losses from taxation over time. The basic idea is that 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 expenditures. 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 the willingness to pay for increased benefits is decreasing in their level such as can be approximated by a quadratic utility function, and if the politicians' discount rate is similar to the interest rate, UI expenditures will follow a martingale process. We therefore test whether governments manage their UI programs optimally in both Barro's and 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. There are several reasons to not be surprised if the empirical work rejects both Barro's and Hall's models. One reason is that governments may not be forward looking at all, but only value current consumption. Other reasons can be that politicians in state governments may not have full flexibility in setting benefits, have short effective time horizons (high time-discount rates), or have more complicated utility functions.

We present results for the Barro and Hall views, and for the buffer stock model, 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 decision period of 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.[12] We use non-overlapping two-year periods to avoid adjusting the standard errors for the serial dependence one would generate using overlapping data.

Table 3 displays the results of first order autoregressive panel regressions of the form[13]

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

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.[14] 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

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

[13] Individual state tests have very low power because we have few observations per state.

[14] 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.

their UI savings accounts.

It may not be surprising that these simple models are rejected; however, the UI program appears to be designed with tax smoothing in mind. That is, the program parameters clearly allow states to fix their tax at a constant rate over time if they so choose, and the existence of the UI trust fund allows the build up of resources during good times to weather economic downturns without tax increases. That the designers of the program were cognizant that such behavior is outside of the norm for government budgeting rules is consistent with the trust fund design with an earmarked tax and separate trust fund savings account outside of the state government general fund. Finding that the data rejects Barro-style inter-temporal tax efficiency as the behavioral model, however, does not necessarily mean that state governments do not do dynamic planning. We, therefore, explore an alternative model that allows two additional motivations. Specifically, while state government policy makers may want to avoid being blamed for exhausting funds to pay UI benefits in bad times, they also desire to receive as many political benefits in the current period as possible. The trade-off between these two motivations suggests a buffer stock model in the sense of Carroll (1997), but applied to government behavior.

The central tenet of the buffer stock models of Carroll (1997) and Deaton (1991) is that consumers are impatient, but nonetheless have a strong aversion to exhausting their savings. A large number of papers have attempted to test a key implication of the model, which is that savings are larger when uncertainty is larger. We do not follow this research strategy, in part because it is difficult to develop a model of how state government officials might estimate the level of uncertainty. Our empirical strategy is to instead test how the benefit and tax levels change over time with respect to the level of savings. The idea behind this approach is that if savings are high, the government is better able to withstand an economic downturn and thus may be more likely to express impatience by spending down some of its saved resources. On the other hand, when savings are low the government may act with more prudence and attempt to grow the savings account due to precautionary concerns. We test this idea by, first, estimating an equation as specified by JPP (2008) to empirically test the response of governments to deviation in savings from the target level and, second, simulating the buffer stock model and estimating the same equation on simulated data to see if the estimations on empirical versus simulated data match up for reasonable values of the behavioral parameters. We further compare the average stock of savings in the data with the average stock of savings in the simulated data.

4 The Buffer Stock Model

We specify our version of the buffer stock model as applied to governments by assuming the objective of the politician with respect to UI is to maximize the stream of "political consumption" arising from the providing large UI benefits and/or low UI taxes over time.[15] Below, we statistically define UI consumption as the discretionary part of UI benefits minus the discretionary part of UI taxes where we assume that benefits and taxes explained by unemployment are non-discretionary. Discretionary increases in UI benefits and discretionary cuts in UI taxes are assumed to be the variables that politicians use to generate political benefits within the limits of the unemployment systems. UI benefits need to be financed from exogenous UI income which we define to be the part of UI taxes explained by unemployment minus the part of UI benefits explained by unemployment. We will provide more details after presenting the model.

The buffer stock model of government behavior takes the form of maximizing:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\rho} C_t^{1-\rho} \ , \tag{2}$$

where β is the time discount factor, C_t is UI consumption, and $\rho > 0$ is the coefficient of relative risk aversion. Key behavioral 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. The question we

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

seek to answer is whether political management of the state government UI funds is consistent with a utility maximization story that involves dynamic planning with an intertemporal planning horizon.

The dynamic budget constraint facing the state government includes a potential savings component, so that

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

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

UI 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.

In this model, 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 which, along with current tax income, is denoted cash-on-hand. This fear of extreme disutility balances the impatience that otherwise would cause politicians to spend all savings immediately.

UI income and UI consumption are non-stationary because permanent income is non-stationary, so 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. We refer to c_t simply as consumption.

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 (or desired) level of 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. State governments are expected increase UI consumption and draw down their buffer stock trust fund saving when the target gap is positive. Conversely, a negative gap where current buffer stock savings x_t is less than target buffer stock savings x^* would lead the state government to decrease its consumption to build up savings. The covariance condition takes the form

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

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

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

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

This subsection explicitly defines UI consumption and UI income as functions of the state government UI variables. Our definition of UI consumption reflects the willingness of politicians to offer higher UI benefits to those on the margin of being UI recipients and/or to lower UI taxes. We model these consumption, or discretionary, benefits and taxes as being outside of the federal minimums that constitute the basic UI program.[16] UI income is defined 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 define the target level of cash-on-hand as the average level of UI trust fund savings during the entire period of our data across all states—this is consistent with our assumption that all states have identical risk aversion, time discount factor, volatility of income shocks, etc. Target cash-on-hand is the overall average of savings at the

[16] 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.

beginning of the period plus UI income during the year. Using a shorter period moving average and/or state-specific averages to define x^* yields similar results to those reported below.

Non-discretionary UI benefits are determined in two steps. First, we regress UI benefits normalized by covered wages on the state unemployment rate.[17] 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

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

[17]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.

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 "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, for each state, define

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

That is, UI consumption reflects UI benefits and taxes that do not fluctuate with unemployment rates. We term these amounts discretionary, because fluctuations in these variables are likely politicians' choices to raise UI benefits or lower UI taxes while the non-discretionary part captures changes in benefits and taxes caused by the condition of the state economy.

UI income is defined 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 reflects 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.[18] UI per-

[18]Adding mean UI taxes (UI 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

manent income is defined as a three period moving average of (two-year) UI income.[19]

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 up for election—in all states, some or all members of the legislature are up for election that 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 correlated with political discretion.[20]

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:

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

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

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).[21] Thus, our definitions of UI consumption and UI income are consistent with state governments' regular budget constraints.

around zero.

[19] Our results are quite robust to using longer periods to define permanent income until the loss of data becomes high.

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

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

The results for estimating equations (8) and (9) are reported in Table 4 under the assumption that 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 majority of the adjustment takes place during the second (two year) period.[22]

5 Buffer Stock Regressions

Table 5 displays descriptive statistics for the data we use to estimate equation (7). Following Carroll (1997), all of the variables have been normalized by permanent income, using the definition of UI income and equation (4). Cash-on-hand, including beginning of period savings plus UI income, is 2.17 times permanent income on average over time and states. The standard deviation over time for the trust fund balance is not as large as the standard deviation across states which suggests that states do not desire to veer too far from their target savings level.

Our key regression result is presented in Table 6. It reports on the IV-regression, equation (7), to show how consumption varies with deviations in the level of savings from the target level. Table 6 also reports the level of target cash-on-hand calculated as the average over all states. The behavioral idea is that as realized savings differ from target savings, agents will change their consumption to bring actual savings closer to the target. From Table 6, the parameter estimate of 0.25 is precisely estimated and the value 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

[22] This provides a second piece of evidence that state governments do not follow the Barro tax smoothing model in which taxes adjust instantaneously to changes in permanent income.

history. Alternatively, politicians could 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.

We briefly explore whether our results depend on potential taste variables. That is, the response of the state government to variation in savings from the target depends on both the internal discount rate as well as risk aversion. One potential correlate to tastes in these dimensions is the political ideology of the politicians. Using an index of political ideology due to Erikson, Wright and McGiver (1989) weighted by the political shares in each house of the legislature, we find an estimate of θ equal to 0.28 for conservative states, and 0.21 for liberal states. While these estimates are not statistically distinct from each other, and we therefore elect not to tabulate them, they suggest potential behavioral differences in political preferences may manifest themselves in how states dynamically plan.[23]

To test if our application of the buffer stock model to government behavior can be rationalized by the model, we simulate the responsiveness to deviations from target savings, as well as the target savings level, and compare to our empirical estimates. For any given preference parameters for time discounting, β, and risk aversion, ρ, and with a given probability of zero income, p, the simulation yields both the covariance ratio θ as well as the target level of savings x^*. If the buffer stock model is a reasonable approximation to how governments manage their savings accounts, the simulated value of these parameters should be close to those reported in Table 6. JPP find through simulations, for the range of behavioral parameter values that they find reasonable, a covariance ratio in a range from 0.485 to 0.757. They reject the buffer stock model for their data, because their empirical estimate for θ is 0.025 or lower. It is instantly clear from Table 6 that our estimated covariance ratio of 0.25 is in the range consistent with the model, albeit at the low end. Our finding that UI consumption varies positively and

[23]We leave further exploration of political and institutional aspects of political preferences to future work.

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, x^*, to the data values.

We simulate the buffer stock model for 50 *a priori* identical consumers (UI systems) with identical discount factors and identical coefficients of risk aversion for $T = 100$ periods. This process generates a data set of comparable size so that the simulation results can be compared to the actual statistical results.

5.1 Model Calibration.

We calibrate the real interest rate and growth to the corresponding averages, over two years periods, in our data, resulting in a real interest rate of 8 percent and and a growth rate of UI income of 9 percent. We set the probability of zero income—capturing the risk of economic meltdown—at 0.001 and 0.01 percent and explore higher probabilities in the appendix.[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.

5.2 Simulation Results.

The simulation results in a calculation of the median buffer-stock x^* (across the 50 simulated agents with the same target savings) and the median (across time) covariance 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 6 for θ and x^*. We experiment with a range of parameter

[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.

[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.

values for time discounting and risk aversion to explore the resulting values of both the target buffer stock of savings x^* , and of the response of UI consumption to cash-on-hand θ. 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 $1, 2, 3, 4, 4.5$ and 5. For our interest rate of 8 percent, a discount factor β lower than 0.92 (corresponding to a discount rate higher than 8 percent) implies impatience; the situation where present consumption is, everything else equal, preferred to waiting one period and consuming a fraction r more. Because there is positive growth, the model delivers a target buffer stock even if the discount rate is somewhat lower than the interest rate. Further, the simulation shows that alternative values of the discount rate and risk aversion can trade-off to effect target cash-on-hand.

Figure 2 illustrates the effect of impatience by changing the value of β in the simulations for ρ fixed at 3, while Figure 3 shows the partial effect on target wealth of changing ρ for β fixed at 0.9. Not surprisingly, we find in Figure 2 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 3 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 are illustrated in Table 7. We find values of the covariance ratio, θ, between 0.32 and 0.73 while the target wealth over permanent UI income, x^*, is found to be between 1.10 and 2.09. The best fit is (β, ρ)=(0.94, 4.5), with p=0.01, for which the simulated (θ, x^*)=(0.32, 2.09). These values are very close to the observed $(\theta, x^*) = (0.25, 2.17)$ given that the standard error is 0.05 for the estimated θ and given the standard error for target saving is 0.87 (see Table 6). It is therefore 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 combinations of low risk aversion combined with high 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 quite risk averse.

5.3 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, suggests 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

[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.

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 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. This suggests that a rainy fund might be more effective if either its funding, or its use, is tied to a visible measure. It might also 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 one period 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 count 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. In this case, as shown by the lower panel in the table, the net fiscal stimulus would be $37.05 ($40.01 per capita less an increase in taxes of $2.96 per capita).[28] Finally, the top panel shows the buffer stock

[28]The net present value of an increase in taxes of $2.96 in the current and all future periods is $40.01 under our parametric assumptions.

behavior. The non-discretionary tax change based on the change in unemployment is \$8.00 The buffer-stock model includes an additional complication, however, as shown in the estimates from Table 6. UI consumption decreases because cash-on-hand at the beginning of the recession drops due to the non-discretionary outlay of unemployment benefits. UI consumption therefore drops by \$8.00 which, as the model is silent on the breakdown, we have allocated as a \$4.00 drop in benefits and \$4.00 increase in UI taxes. The net fiscal stimulus in the year of the recession based on the decrease in savings would therefore be \$24.01 (\$40.01 - \$8.00 - \$8.00). In the following period, taxes react to the previous periods's jump in unemployment, and discretionary benefits are curtailed and discretionary taxes are increased because of the decrease in the trust fund (buffer stock), leading to savings of \$22.40. In the third period, the model predicts savings of \$2.86 after which the buffer stock is fully replenished and no more savings take place after this in the absence of further unemployment shocks.

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.

Our empirical analysis proceeds by first rejecting simple versions of the Barro tax smoothing and the Hall PIH models. These unsurprising results suggest that welfare maximization needs to be understood in the context of political behavior, which then suggests that taste parameters affecting political behavior might be important. We therefore introduce the buffer stock model to potentially explain the extent to which state governments might be forward looking, and to motivate how state governments might manage their saved resources. The attractive feature of the buffer stock model in the context of the UI program is that impatience by political actors is modeled, yet the model also allows the dissavings associated with impatience to be tempered by risk aversion, which is the negative consequences of having insufficient savings when needed. We bring two pieces of empirical evidence to bear on the appropriateness of the buffer stock model to state government behavior. First, we show that state governments respond to deviations of their saving from the target level by spending about 25 percent of the deviation from the target level during each two-year period. This finding is statistically significant and we show through simulations that this magnitude can be rationalized by the model for reasonable values of risk aversion and discount rates. Second, we show that the average size of the trust fund is consistent with the prediction of the model. An implication of the model is that while politicians do not follow the prescription of Barro's tax smoothing model, to perfectly smooth taxes over time, our implementation of the buffer stock model predicts about 65 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 institutional model could be extended more broadly to overall government expenditure, is the relative importance of specific institutional features for our behavioral findings. An implication of our findings 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.

[29] Another possibility is that private agents do exhibit buffer stock behavior but individual level 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.

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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: $\Delta X_{it} = \alpha_i + \rho_i X_{it-1} + \sum_{k=1}^{K} \delta_k \Delta X_{it-j}$ 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	1981-1982	1985-1986
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	672	576

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 14 periods from 1981-1982 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 1981-1982 is the average unemployment rate of 1981 and 1982). 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	2.17	0.71	0.52
UI income/Permanent income	0.99	0.03	0.28
UI consumption/Permanent income	1.17	0.18	0.29
Trust fund balance/Permanent income	1.18	0.72	0.59
Observations	480		

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 1987-1988.

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 1987-1988	
θ (coefficient of cash-on-hand)	0.25***
	(0.05)
Target cash-on-hand	2.17***
	(0.87)
State and year fixed effects	Yes
Observations	480

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) are treated as one period. We approximate target cash-on-hand by the mean cash-on-hand over time for each state. 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 =0.001 AND 0.01

	p=0.001			p=0.01		
	β=0.86	β=0.90	β=0.94	β=0.86	β=0.90	β=0.94
ρ=1	θ=0.73 x^*=1.10	θ=0.66 x^*=1.14	θ=0.55 x^*=1.26	θ=0.68 x^*=1.15	θ=0.61 x^*=1.21	θ=0.49 x^*=1.36
ρ=2	θ=0.61 x^*=1.20	θ=0.57 x^*=1.24	θ=0.50 x^*=1.34	θ=0.55 x^*=1.35	θ=0.51 x^*=1.42	θ=0.44 x^*=1.53
ρ=3	θ=0.53 x^*=1.34	θ=0.50 x^*=1.39	θ=0.45 x^*=1.47	θ=0.47 x^*=1.56	θ=0.44 x^*=1.63	θ=0.40 x^*=1.72
ρ=4	θ=0.48 x^*=1.49	θ=0.44 x^*=1.56	θ=0.40 x^*=1.66	θ=0.42 x^*=1.77	θ=0.38 x^*=1.86	θ=0.34 x^*=1.98
ρ=4.5	θ=0.44 x^*=1.58	θ=0.42 x^*=1.65	θ=0.37 x^*=1.76	θ=0.38 x^*=1.90	θ=0.36 x^*=1.98	θ=0.32 x^*=2.09
ρ=5	θ=0.42 x^*=1.66	θ=0.39 x^*=1.74	NA	θ=0.36 x^*=2.01	θ=0.34 x^*=2.08	NA

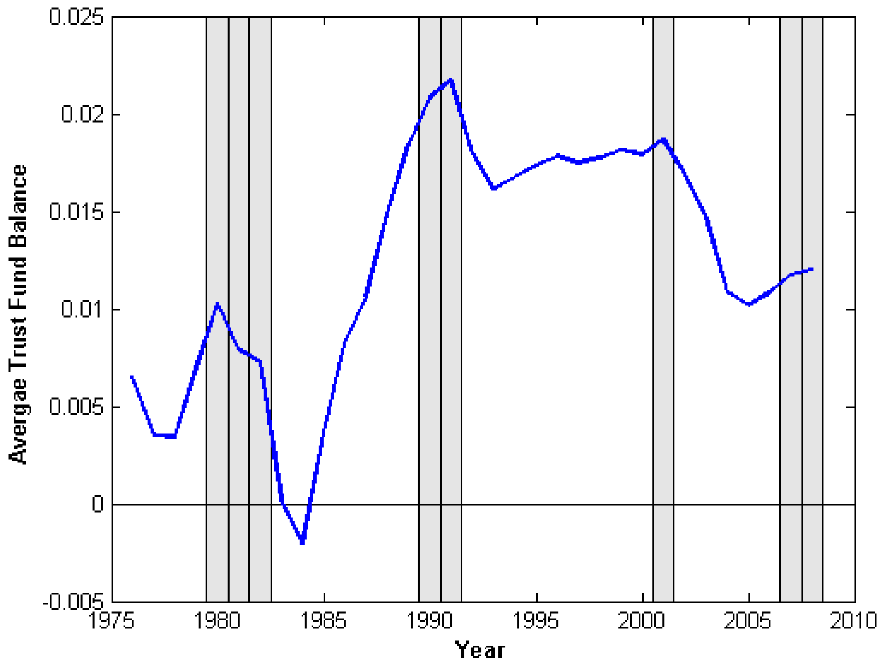
Notes: This table reports the median (across time) simulated covariance ratio θ and the cross-sectional median simulated target cash-on-hand to permanent income ratio x^*. The results are reported for a grid of coefficients for risk aversion and time discounting. The simulations for each pair of these 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 $p = 0.001$ or $p = 0.01$. Income growth and interest rate are set to 9 percent and 8 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	$8.00	–$4.00	$4.00	–$24.01
Next Year	$0.00	$21.34	-$0.57	$0.57	$22.40
Following Yr	$0.00	$2.67	-$0.10	$0.10	$2.86
Barro Tax Smoothing:					
Yr of Recession	$40.01	$2.96	*NA*	*NA*	–$37.05
Next Year	$0.00	$2.96	*NA*	*NA*	$2.96
Following Yr	$0.00	$2.96	*NA*	*NA*	$2.96

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.

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Figure 2: Average Simulated Target Ratio of Cash on Hand to Permanent Income with Varying Discount Factor ($p = 0.01$)

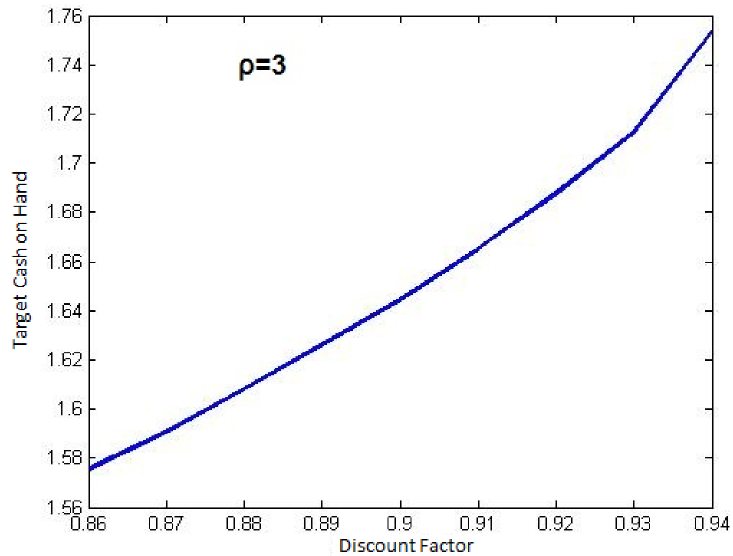
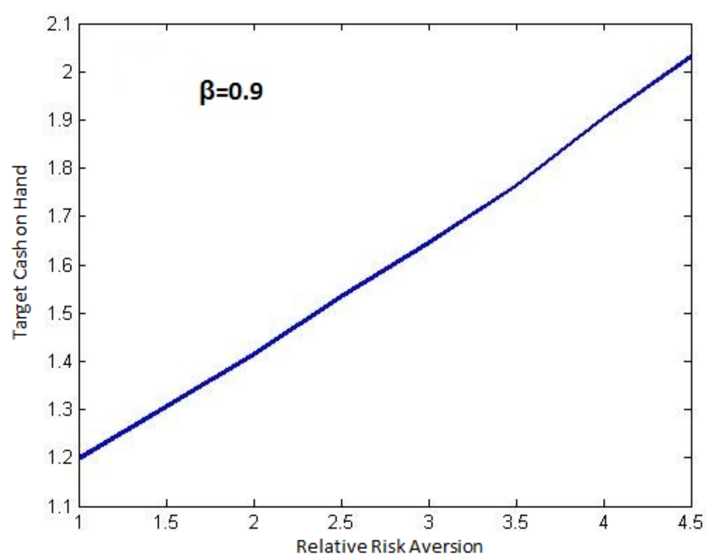


Figure 3: Average Simulated Target Ratio of Cash on Hand to Permanent Income with Varying Relative Risk Aversion ($p = 0.01$)



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 2 and the same discount factor in Figure 3) 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 2 graphs the repeated simulations for different discount factors maintaining $\rho = 3$. Figure 3 graphs the repeated simulations for different relative risk aversion parameters maintaining $\beta = 0.9$.

A Appendix

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	1980-81	1984-1985
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	672	576

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 14 periods from 1980-1981 to 2006-2007. The unemployment rate of any given period is the average over two years (e.g., the unemployment rate for the period 1980-1981 is the average of unemployment rates for 1980 and 1981). Unemployment rate$_{t-1}$ and Unemployment rate$_{t-2}$ denote the first and second period lags of unemployment rate. 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+θ* Cash-on-Hand) . Instrument is (Actual – Target Cash-on-Hand)	
	UI Consumption
Two-year periods Start period 1986-1987	
Estimated coefficient of cash-on-hand	0.26*** (0.06)
Target cash-on-hand	2.09*** (0.86)
State and year fixed effects	Yes
Observations	480

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 mean cash-on-hand over time for each state . 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=1981	1981	1985
Unemployment rate	0.15***	0.01
	(0.01)	(0.01)
Unemployment rate$_{t-1}$		0.03***
		(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	1,344	1,152

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 28 years from 1981 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=α+θ∗Cash-on-Hand Instrument is (Actual – Target Cash-on-Hand)	
	UI Consumption
One-year periods Start year 1986	
Estimated coefficient of cash-on-hand	0.15***
	(0.04)
Target cash-on-hand	3.32*
	(2.04)
State and year fixed effects	Yes
Observations	960

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 the mean cash-on-hand over time for each state. All variables are normalized by permanent income. Permanent income is defined as a 5 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 1987	
Estimated coefficient of cash-on-hand	0.17***
	(0.03)
Target cash-on-hand	3.44*
	(2.21)
State and year fixed effects	Yes
Observations	960

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 the mean cash-on-hand over time for each state. All variables are normalized by permanent income. Permanent income is defined as a 5 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. Probability of Zero Income =0.02 and 0.05

	p=0.02			p=0.05		
	β=0.86	β=0.90	β=0.94	β=0.86	β=0.90	β=0.94
ρ=1	θ=0.65 x^*=1.20	θ=0.57 x^*=1.28	θ=0.47 x^*=1.45	θ=0.59 x^*=1.33	θ=0.53 x^*=1.43	θ=0.41 x^*=1.66
ρ=2	θ=0.52 x^*=1.44	θ=0.47 x^*=1.53	θ=0.42 x^*=1.65	θ=0.47 x^*=1.64	θ=0.43 x^*=1.73	θ=0.36 x^*=1.91
ρ=3	θ=0.45 x^*=1.68	θ=0.41 x^*=1.76	θ=0.37 x^*=1.89	θ=0.39 x^*=1.95	θ=0.36 x^*=2.05	θ=0.32 x^*=2.19
ρ=4	θ=0.38 x^*=1.94	θ=0.36 x^*=2.03	θ=0.33 x^*=2.13	θ=0.34 x^*=2.26	θ=0.31 x^*=2.38	θ=0.28 x^*=2.53
ρ=4.5	θ=0.36 x^*=2.06	θ=0.34 x^*=2.13	θ=0.30 x^*=2.29	θ=0.31 x^*=2.42	θ=0.29 x^*=2.54	θ=0.26 x^*=2.68
ρ=5	θ=0.34 x^*=2.17	θ=0.31 x^*=2.29	NA	θ=0.29 x^*=2.57	θ=0.28 x^*=2.68	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 $p = 0.02$ or $p = 0.05$. Income growth and interest rate are set to 9 percent and 8 percent respectively. *NA* indicates that a fixed point solution does not exist (Carroll, 1997).