This is to certify that the

dissertation entitled

PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE: THEORETICAL INSIGHTS AND THEIR EMPIRICAL RELEVANCE

presented by

KELVIN ROBERT UTENDORF

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Economics

Lorenzo Kuchenino
Major professor

Date 6/2/93

PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE: THEORETICAL INSIGHTS AND THEIR EMPIRICAL RELEVANCE

By

Kelvin Robert Utendorf

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Economics

1993

ABSTRACT

PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE:
THEORETICAL INSIGHTS AND THEIR EMPIRICAL RELEVANCE

By

Kelvin Robert Utendorf

This dissertation examines the behavior of precautionary saving in the presence of unemployment insurance. Given that others have found that precautionary saving could account for fifty percent of the aggregate life cycle capital accumulation in the United States, any factor which influences private precautionary saving has a potentially large effect on capital accumulation and future productivity growth.

In chapter one, a precise link is developed between precautionary saving and unemployment insurance. A theoretical model is presented in which risk averse agents save as a precaution against the possibility of future unemployment. Two different types of unemployment insurance schemes are examined: a forced-saving plan with characteristics similar to those found in the U.S. unemployment insurance system; a pay-as-you-go plan possessing attributes similar to unemployment insurance systems found throughout much of the rest of the world. Precautionary saving is shown to be decreasing in the level of unemployment insurance benefits, and in fact is replaced by unemployment insurance benefits by more than one-to-one in the forced-saving model.

Chapter two extends the theoretical model by giving agents the ability to borrow or lend. Previous work on precautionary saving assumes that loan markets are closed so that saving is the only means of intertemporal consumption smoothing. Opening credit markets provides agents with a second method of transferring resources across time periods. The addition of a forced-saving unemployment insurance plan is shown to harm non-covered workers by increasing the interest rate they must pay to borrow.

Chapter three tests the relationship between unemployment insurance and precautionary saving using panel data from the National Longitudinal

Surveys of men. Wealth-based measures of precautionary saving are regressed on an unemployment insurance generosity index and other determinants of precautionary saving. Precautionary saving is generally found to be positively related to the generosity of unemployment insurance, especially for union members, which may indicate that a greater than optimal portion of wages are replaced by unemployment insurance benefits.

This dissertation is dedicated to my parents, Robert and Agnes Utendorf, whose constant love and support enabled me to complete it.

ACKNOWLEDGMENTS

Writing a dissertation is a long, arduous process. Without the aid, support, and encouragement of many individuals, I never would have finished mine. Although words seem inadequate to express the extent of my appreciation, I am happy to have this opportunity to thank some of the people who played a part in my graduate education.

I would not be writing these words were it not for my dissertation committee chair, Professor Rowena Pecchenino. Without her advice, her prodding, her patience, her experience, and her wisdom I could not have finished this work. Even though she was very busy with her own work and responsibilities, she always found time to listen to my problems, to answer my questions, to suggest improvements for the numerous drafts of this dissertation, and to offer words of encouragement. I am forever indebted to her for the time and effort she has given to me and to my work. Thank you, Rowena!

I have also had the good fortune of working closely with the other two members of my dissertation committee, Professors Paul Menchik and Larry Martin, whose guidance and direction have been invaluable in completing this dissertation. They spent many hours working with me on drafts of this work and provided many valuable comments and suggestions. I have learned much from them and have benefitted greatly from their knowledge and advice. In addition, I would like to express my gratitude to Professors Jeffrey Wooldridge, Jack Meyer, and Dan Hamermesh who read parts of this dissertation and offered many helpful suggestions.

There are so many other people, both professors and graduate students, who have been important to me as I progressed through the Ph.D. program at Michigan State University. I am especially grateful to my good

friends Tony (Black Sox) Creane and Steve (Dream Team) DeLoach who have provided many hours of needed distraction from the rigors of the dissertation process and much good advice along the way. I also want to express appreciation to my fellow PADsters at the Institute for Public Policy and Social Research, Andrea Ranval, Dan Kashawlic, and Donna Anderson, who, in addition to providing computer facilities and financial support for the past two years, helped me to smile even when things seemed to be crashing all around me and provided a nearly infinite stream of encouraging words.

No one has given me more encouragement and support than my best friend and confidant Margie Tieslau. Margie has shared in all of my victories and picked me up after all of my defeats. She helped me get through many, many rough times by listening to my problems and offering sound advice. Simply put, without her friendship, I probably would not have gotten my Ph.D. Margie, YOU ARE!!!

Finally, to my family, THANK YOU!! Without the love and support of the "Utendorf Clan," I would not have enjoyed the success that I did throughout graduate school. My mother and father have always offered their unconditional support and love, without which I would not have had the courage to undertake the Ph.D. process. The rest of my family, too, have always given me their full support, even though my workload often prevented me from participating in family events. This support has been invaluable to me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I: PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE: A SIMPLE THEORETICAL MODEL

CHAPTER I

PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE: A SIMPLE THEORETICAL MODEL

1. Introduction

A great deal of theoretical and empirical work studies the effects of unemployment insurance (UI) on various aspects of worker behavior. Topics such as duration of unemployment, rate of unemployment, the intensity of job search, and acceptable reservation wage have all been linked in various ways to the existence of unemployment insurance.[1] In addition, increases in the level of provision of unemployment insurance benefits have been shown theoretically to lead to decreases in the level of private saving.[2] Presumably, agents change their saving behavior in these models because unemployment insurance benefits alter the need for self-insurance, or precautionary saving, although previous work has failed to make explicit that connection.

Any program which has an effect on precautionary saving has a potentially large effect on aggregate life cycle capital accumulation. Hall and Mishkin (1982) and MaCurdy (1982) find that consumers face substantial uncertainty about lifetime resources which could lead to large levels of precautionary savings. Zeldes (1989) states that precautionary saving could account for a substantial portion of the capital accumulation in the U.S. while Skinner (1988, p. 238) argues that "precautionary savings are therefore calculated to be substantial, accounting for up to 56 percent of aggregate life cycle capital accumulation."

An unemployment insurance program which decreases precautionary saving could therefore have a tremendous impact on capital accumulation, particularly if "forced" saving under the auspices of the government is

---

[1]See, for example, papers by Feldstein (1974, 1975), Chapin (1971), Ehrenburg and Oaxaca (1976), Baily (1978), and Fleming (1978).

[2]See Baily (1978) and Flemming (1978).

not as efficient in producing capital as is private saving. With high administration costs and an emphasis on "low-risk" investments, saving in a governmental program may lead to lower capital accumulation and lower potential for future growth than would private saving.

Unlike previous work in the unemployment insurance or precautionary savings literatures, this chapter specifically explores the link between precautionary saving and unemployment insurance. I present a theoretical model which can be solved for an exact level of precautionary saving under two different types of unemployment insurance schemes: one with characteristics similar to those found in the U.S. unemployment insurance system, a second possessing attributes similar to unemployment insurance systems found throughout much of the rest of the world. Within the framework of the U.S. model, I find precautionary saving is decreasing in the level of unemployment insurance benefits, and in fact may be replaced by unemployment insurance benefits by more than one-to-one. The theoretical model provides testable hypotheses for an empirical examination of precautionary saving and unemployment insurance.

This chapter is arranged as follows. Section two describes the basic model before the introduction of unemployment insurance and provides a solution to the agent's problem. I also derive an expression for precautionary saving and detail the reaction of precautionary saving to changes in the parameters in section two. Section three introduces a forced-saving unemployment insurance scheme as well as the optimal unemployment insurance taxes for the model. I describe a pay-as-you-go unemployment insurance tax and disbursement scheme and solve for the optimal unemployment insurance taxes under that scheme in section four. Section five explores the reactions of precautionary saving in the models presented to changes in the parameters. Section six concludes the chapter by discussing possible extensions and by presenting testable hypotheses for the empirical work found in chapter three.

2. The Model

In the base model[3], a finite-horizon (two-period) economy is populated by N two-period lived agents. In any period $i=1,2$, pN agents receive a high endowment, e_{iE}, at the beginning of the period, where p, assumed to be constant across periods, is the probability of receiving the high endowment. The remaining (1-p)N agents receive a low endowment, e_{iU}, at the beginning of period i. All agents receive utility from consumption in each period of their lives. An agent maximizes expected, discounted life-time utility with complete knowledge of her first-period endowment but without knowing her second-period endowment. An agent with a high first-period endowment, in other words one who begins life "employed," solves the following problem:

$$\max_{C} E_1 \sum_{i=1}^{2} \delta^{i-1} U_{i,j}(c_{i,j}) \tag{1}$$

subject to

$$\begin{aligned} &\text{Period 1:} \quad e_{1E} = c_{1E} + s_{1E} \\ &\text{Period 2:} \quad e_{2E} + r_1 s_{1E} = c_{2E} \\ &\phantom{\text{Period 2:}} \quad e_{2U} + r_1 s_{1E} = c_{2U} \end{aligned} \tag{2}$$

where $j=E,U$ for high endowment (employed) or low endowment (unemployed), respectively, E_1 is the first-period expectations operator, $\delta \in [0,1]$ is the subjective discount rate, c_{2E} is the second-period consumption level of an agent who receives a high second-period endowment while c_{2U} is the second-period consumption level for an agent who receives a low second-period endowment, s_{1E} is the amount saved by a high-endowment agent in the first period, and r_1 is the gross rate of return on savings. Throughout this chapter it is assumed that loan markets are closed, prohibiting agents from borrowing against future income. Thus, saving is the only avenue

---

[3]This model is similar to the model used by Leland (1968).

available to agents who desire to smooth consumption.[4] The additively-separable utility function is assumed to be thrice differentiable, with $U'()\geq 0$, $U''()\leq 0$, and $U'''()>0$.[5] An agent with a low first-period endowment, an agent who begins life "unemployed," solves a very similar problem, maximizing (1) subject to

$$\begin{aligned} \text{Period 1:}\quad & e_{1U} = c_{1U} + s_{1U} \\ \text{Period 2:}\quad & e_{2E} + r_1 s_{1U} = c_{2E} \\ & e_{2U} + r_1 s_{1U} = c_{2U} \end{aligned} \tag{3}$$

where s_{1U} represents the first-period savings of an unemployed agent and the other variables are as defined above.

The agents can take advantage of the very simple storage technology present in the economy if they so choose. An agent who saves s_{1j} in period one, $j=E,U$, receives $r_1 f(s_{1j})$ in period two, where, for simplicity, it is assumed that $f(s_{1j})=s_{1j}$. As stated earlier, r_1 is the gross rate of return on savings in the economy. The use of a storage technology, rather than a production technology with capital and labor, allows for a sharper focus on the topics of precautionary saving, unemployment insurance, and the relationship, if any, between the two.

An agent whose preferences are represented by a utility function exhibiting constant absolute risk aversion[6] (CARA) will engage in precautionary saving behavior since such a function meets the requirements set out in Leland (1968). The CARA functional form given by

$$U_{i,j}(c_{i,j}) = \frac{-1}{\gamma} e^{-\gamma c_{i,j}} , \tag{4}$$

is used throughout this dissertation. Although it might be argued that the reaction to risk generated by this type of utility function is

---

[4]Nearly all models which examine precautionary saving assume either explicitly or implicitly that loan markets are closed. Relaxing the closed loan market assumption is examined in chapter two.

[5]Given the additive separability of the model, a positive third derivative of the utility function is sufficient for the existence of precautionary saving. Leland (1968) proves that a positive third derivative of the utility function is sufficient for the existence of precautionary saving under weaker assumptions.

[6]The Arrow-Pratt measure of absolute risk aversion is $R(x)=(-U''(x)/U'(x))$, where an agent is considered to be risk averse, risk seeking, or risk neutral as $R(x)>0$, $R(x)<0$, or $R(x)=0$, respectively.

somewhat unrealistic[7], the CARA-type utility function is used heavily in the literature to portray risk-averse behavior. By using a CARA utility function, the results in this chapter can be more readily compared to previous work in the field. The other functional form used in the precautionary saving literature, the constant relative risk aversion (CRRA) utility function, does not allow for closed-form solutions for saving or for precautionary saving and is therefore less satisfactory for this type of study. Furthermore, the exponential utility function used can be thought of as belonging to the increasing relative risk aversion (IRRA) class of utility functions. IRRA utility functions are considered to be more realistic than the CRRA utility functions by Arrow (1974), Pratt (1964), and others. Therefore, although the exponential utility function may belong to the less reasonable CARA class of utility functions, it also is a member of the IRRA class of utility functions and as such merits attention.

The Agent's Problem

An agent who receives a high endowment in the first period of life solves the following problem[8], in which the equations of (2) have been substituted into (4):

$$\max_{s_{1E}} \frac{-1}{\gamma} e^{-\gamma(e_{1E}-s_{1E})} - \frac{\delta p}{\gamma} e^{-\gamma(e_{2E}+r_1 s_{1E})} - \frac{\delta(1-p)}{\gamma} e^{-\gamma(e_{2U}+r_1 s_{1E})} \ . \tag{5}$$

The first-order condition for the above maximization problem is

$$-e^{-\gamma(e_{1E}-s_{1E})} + \delta p r_1 e^{-\gamma(e_{2E}+r_1 s_{1E})} + \delta(1-p) r_1 e^{-\gamma(e_{2U}+r_1 s_{1E})} = 0 \ . \tag{6}$$

Equation (6) is the very familiar condition which indicates that an agent's utility is maximized where her marginal rate of substitution (MRS) is equal to the marginal rate of transformation (MRT) she faces in the economy. The agent's MRS is equal to the ratio of her marginal utility

[7]Arrow, Pratt, and others have argued that utility functions which exhibit decreasing absolute risk aversion (DARA) are more realistic. However, DARA utility functions tend to be much less tractable than are the CARA utility functions. Pratt (1964) gives examples of DARA utility functions.

[8]An agent "unemployed" in the first period solves a similar problem, maximizing (4) with respect to the constraints given in (3).

from first period consumption to the linear combination of her possible marginal utilities from consumption in the second period. The MRT in the economy is simply δr_1, the subjective discount rate times the rate of return to saving.

The second-order condition for utility maximization,

$$-\gamma e^{-\gamma(e_{1E}-s_{1E})}-\gamma\delta p r_1^2 e^{-\gamma(e_{2E}+r_1 s_{1E})}-\gamma\delta(1-p)r_1^2 e^{-\gamma(e_{2U}+r_1 s_{1E})} < 0 \tag{7}$$

holds for all risk-averse agents, i.e. those for whom $\gamma>0$.

Precautionary saving by an agent in this model, undertaken because of uncertainty with regards to future income, is the difference between the level of saving by the agent under uncertainty and the level of saving under certainty, $s_{1E}-s_{1E}^c$. Equation (7) can be solved explicitly for the level of saving under uncertainty by the employed consumer, s_{1E}, which is given by

$$s_{1E} = \frac{1}{\gamma(1+r_1)}\left[\ln(\delta r_1)+\gamma e_{1E}+\ln(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})\right]. \tag{8}$$

Saving under uncertainty by an agent unemployed in period one is found in a similar fashion to be

$$s_{1U} = \frac{1}{\gamma(1+r_1)}\left[\ln(\delta r_1)+\gamma e_{1U}+\ln(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})\right]. \tag{9}$$

For reasonable values of r_1, i.e. less than a 200% rate of return to storage, s_{1U} as given by (9) would be negative. The unemployed agent in the first period would like to borrow but is unable to do so. Since storage must be non-negative, an agent unemployed in period one saves zero and consumes all of her endowment when facing uncertain second-period income.

Throughout the dissertation, certainty means that an agent knows with probability one that her income in the second period will be the expected value of her random second-period income. In the model without an unemployment insurance scheme, the expected value of second-period income is $pe_{2E}+(1-p)e_{2U}$. Under certainty, therefore, saving by an agent employed in period one is

$$s_{1E}^{c} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1) + \gamma e_{1E} - \gamma(pe_{2E} + (1-p)e_{2U})] . \tag{10}$$

Similarly, saving under certainty by an unemployed agent in the first period is given by

$$s_{1U}^{c} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1) + \gamma e_{1U} - \gamma(pe_{2E} + (1-p)e_{2U})] . \tag{11}$$

Again, for reasonable values of r_1, the expression for s_{1U}^{c} in (11) is negative, meaning the unemployed agent saves nothing in the first period.

Precautionary saving by an employed agent in the base model with no unemployment insurance scheme is

$$PS_{E}^{NO\ UI} = \frac{1}{\gamma(1+r_1)}[\ln\xi + \gamma(pe_{2E} + (1-p)e_{2U})] , \tag{12}$$

where for simplicity

$$\xi = pe^{-\gamma e_{2E}} + (1-p)e^{-\gamma e_{2U}} > 0.$$

Precautionary saving, as given in (12), will be positive as long as the high endowment in the second period is greater than the low endowment in the second period, a condition which I assume throughout the chapter.

Aggregate precautionary saving in this model is the summation of the precautionary saving by the employed agents only. Since the unemployed agents do not save anything, they do not save as a precaution against an uncertain future. Aggregate precautionary saving is therefore

$$PS_{a}^{NO\ UI} = \frac{pN}{\gamma(1+r_1)}[\ln\xi + \gamma(pe_{2E} + (1-p)e_{2U})] . \tag{13}$$

Comparative Statics on Precautionary Saving Under CARA

Differentiating the expression for aggregate precautionary saving (13) with respect to the parameters of the model (r_1, p, e_{2E}, and e_{2U}) yields the following comparative static results

$$\begin{aligned} \frac{\partial PS_{a}^{NO\ UI}}{\partial e_{2U}} &= \frac{pN(1-p)}{1+r_1}\left(1 - \frac{e^{-\gamma e_{2U}}}{\xi}\right) < 0 \\ \frac{\partial PS_{a}^{NO\ UI}}{\partial e_{2E}} &= \frac{p^2 N}{1+r_1}\left(1 - \frac{e^{-\gamma e_{2E}}}{\xi}\right) > 0 \end{aligned} \tag{14}$$

and

$$\frac{\partial PS_s^{NO\ UI}}{\partial r_1} = \frac{pN\left(-\ln(\xi) - \gamma(pe_{2E} + (1-p)e_{2U})\right)}{\gamma(1+r_1)^2} < 0$$

$$\frac{\partial PS_s^{NO\ UI}}{\partial p} = \frac{N\left[\ln\xi + \gamma(pe_{2E} + (1-p)e_{2U} + p\left(\frac{e^{-\gamma e_{2E}} - e^{-\gamma e_{2U}}}{\xi} + \gamma(e_{2E} - e_{2U})\right)\right]}{\gamma(1+r_1)} \lessgtr 0 . \tag{15}$$

The effect of a change in the coefficient of absolute risk aversion on precautionary saving is not shown. In models with agents whose preferences satisfy the von Neumann-Morgenstern axioms, the coefficient of risk aversion is constrained to be related to the reciprocal of the elasticity of intertemporal substitution.[9] Any effects on precautionary saving which come about from changing Υ may be a reflection of changing elasticity of intertemporal substitution rather than changing risk aversion.[10] In the certainty model with no unemployment insurance plan in place, for example, increasing Υ causes saving to fall, which reflects the strength of the intertemporal substitution effect. Given the difficulty of separating the intertemporal substitution effect from the risk aversion effect, nothing definitive can be said about the effect of changing Υ on precautionary saving in this framework. Therefore, the effect of changes in the coefficient of absolute risk aversion are left unexplored throughout the rest of the chapter.

That precautionary saving is negatively related to low second-period endowment and positively related to high second-period endowment, as shown by the inequalities of (14), may at first seem counter-intuitive. However, increasing e_{2E} while holding everything else constant increases the variability of second-period income in this model. This increased variability causes a risk-averse agent to increase her level of precautionary saving. Similarly, decreasing e_{2U} will increase the

---

[9]The elasticity of intertemporal substitution for consumption between any two time periods s and t is given by

$$\sigma(c_t) = \frac{-U'(c_s)/U'(c_t)}{c_s/c_t} \frac{d(c_s/c_t)}{d[U'(c_s)/U'(c_t)]} .$$

[10]See papers by Weil (1990), Farmer (1990), Selden (1978, 1979), Kreps and Porteus (1979), and Johnsen and Donaldson (1985) for theoretical and empirical evidence of this difficulty.

variability of second-period income, which in turn means that precautionary saving increases in the model.

The first inequality in (15) shows that precautionary saving and the rate of return to storage in the economy are inversely related. This is true despite the fact that the effects of changes in the rate of return on total saving under uncertainty and on total saving under certainty are generally indeterminate without strong conditions on the parameters. Increasing the rate of return to saving allows an agent to provide an adequate "buffer" against variations in income with a lower level of precautionary saving. The agent is able to attain some desired "self-insurance coverage" goal with lower levels of precautionary saving, thus giving the inverse relationship between precautionary saving and the rate of return to storage.

The reaction of precautionary saving to changes in the probability of receiving the high endowment in the second period cannot be determined as shown by the second expression of (15). For an individual agent, increasing the probability of receiving the high endowment, or of being "employed," decreases the variability of income in the second period of life, which in turn reduces the need to save for precautionary reasons. However, increasing p increases the number of agents engaging in precautionary saving which counters the effect of individual agents reducing precautionary saving.

3. The Forced-Saving Unemployment Insurance Model

Two different types of unemployment insurance (UI) funding and disbursement schemes are examined in this section and the next. The first of these, a "forced-savings" plan, has two characteristics similar to the UI system which exists in the United States.[11] In order to be eligible to receive unemployment benefits in the United States, one is generally required to have worked for some minimum specified time at some minimum

[11]For a thorough discussion of the unemployment insurance system in the U.S. see Hansen and Byers (1990).

wage level prior to the period of unemployment. Also, the UI system in the U.S. was originally designed to be "trust fund" type system in which the individual states built up large enough fund balances in the U.S. Treasury during periods of low unemployment to weather periods of high unemployment. In this system, unemployment insurance is often seen as a form of forced saving in which the money paid into the fund for agent A is disbursed to agent A should she experience unemployment in a future period. Both of the properties described above are captured in the model of unemployment insurance in this section.

The second model of unemployment insurance, presented in the next section, more closely resembles UI systems which exist in countries such as Great Britain[12] in that it has a "pay-as-you-go" funding scheme. Perhaps more properly termed "social insurance," one is not required to have prior work experience to qualify for the UI benefits in this system. In addition, current payments into the system by the employed are immediately disbursed to the unemployed in the period.[13] In this type of system, the idea of unemployment insurance as forced saving is absent. The second model of unemployment insurance incorporates both features of the pay-as-you-go UI system.

The Forced-Saving Model

This model encompasses two aspects of the UI system present in the U.S.: (1) only unemployed agents in the second period who were employed in the first period are eligible to receive benefits, and (2) payments made by employed agents in the first period are placed in an interest-earning fund from which disbursements are made to those unemployed agents

---

[12]See, for example, Reubens (1990), M^cLaughlin, Millar, and Cooke (1989), or Beenstock and Brasse (1986) for details on the assistance available to the unemployed in Great Britain.

[13]Great Britain actually has two programs for the unemployed. One program pays unemployment benefits out of a fund created by employer and employee contributions. Benefits are paid out of this fund to the eligible unemployed for a maximum of one year. The second program is a means-tested income support program for the unemployed which is of unlimited duration payable to people sixteen years and older who are not working full-time and whose income from all sources falls below established standards. Prior work experience is not necessary to receive income support benefits. M^cLaughlin et al. (1989) report that over 60% of the unemployed claimants receive income support rather than the unemployment benefit.

in the second period who were previously employed. Agents who were unemployed in period one, i.e. those without a "work history," are not eligible to receive unemployment insurance benefits in period two.

In the first period, the endowments of employed agents are taxed at rate $t_1 \in [0,1]$.[14] Given that there are pN employed agents in the economy in period one each receiving the high endowment of e_{1E}, the total tax revenue generated for the unemployment insurance fund is pNt_1e_{1E}. This tax revenue is placed in a trust fund held by a "government" whose sole function is to collect, hold, and disburse the UI tax revenue. It is assumed that the government has access to the same storage technology available to individual agents, meaning monies in the fund earn a gross rate of return r_1. During period two, therefore, $pNr_1t_1e_{1E}$ is available for disbursement to the unemployed of the period.[15] Of the pN agents employed in the first period, 1-p will be unemployed in the second. Therefore, p(1-p)N agents will be eligible to receive UI benefits during the second period of their lives, implying a per capita disbursement of $r_1t_1e_{1E}(1-p)^{-1}$ to those who are eligible.

The addition of this unemployment scheme does not affect the budget constraints of the agent who is unemployed in the first period of life. Being unemployed, such an agent would pay no UI tax in the first period and would not be eligible to receive UI benefits in case of unemployment in the second period since she would not meet the prior-work requirement. Therefore, agents who begin life unemployed are constrained by (3) and solve the same type of problem as they solved in the model with no unemployment insurance plan. These agents do not save under either certainty or uncertainty and therefore are not precautionary savers.

---

[14]It is generally true that employees do not, in the strictest sense, pay an unemployment insurance tax in the U.S. However, much of the burden of such a tax falls on wage earners. Furthermore, if their total wages include benefits paid for by their employers, then an unemployment insurance tax can be considered a tax on employees' total wages. Such a tax on total wages is similar to the endowment tax of the model.

[15]The rather trivial government budget constraint is that the tax revenues collected in period one multiplied by the gross rate of return on trust fund monies must equal the unemployment insurance disbursement in period two.

The budget constraints faced by the agent employed in the first period become

$$\begin{aligned} &\text{Period 1:} \quad e_{1E}(1-t_1) = c_{1E} + s_{1E} \\ &\text{Period 2:} \quad e_{2E} + r_1 s_{1E} = c_{2E} \\ &\qquad\qquad\quad e_{2U} + r_1 t_1 e_{1E}(1-p)^{-1} + r_1 s_{1E} = c_{2U} \end{aligned} \tag{16}$$

where the variables are as defined above or as defined in section two. The agent employed in period one now receives a smaller first-period net endowment and, if unemployed in the second period, receives the unemployment insurance payment of $r_1 t_1 e_{1E}(1-p)^{-1}$.

Under the assumption of constant absolute risk aversion, an agent facing the constraints in (16) would solve the following problem

$$\max_{s_{1E}} \frac{-1}{\gamma} e^{-\gamma(e_{1E}(1-t_1)-s_{1E})} - \frac{\delta p}{\gamma} e^{-\gamma(e_{2E}+r_1 s_{1E})} - \frac{\delta(1-p)}{\gamma} e^{-\gamma(e_{2U}+r_1 t_1 e_{1E}(1-p)^{-1}+r_1 s_{1E})} \tag{17}$$

where the constraints have been substituted into the utility function. Performing the above maximization yields the following first-order condition

$$-e^{-\gamma(e_{1E}(1-t_1)-s_{1E})} + \delta p r_1 e^{-\gamma(e_{2E}+r_1 s_{1E})} + \delta(1-p) r_1 e^{-\gamma(e_{2U}+r_1 t_1 e_{1E}(1-p)^{-1}+r_1 s_{1E})} = 0 \tag{18}$$

which shows that the optimal level of period-one saving by an employed agent is that which equates her marginal rate of substitution with the marginal rate of transformation she faces in the economy. The second-order condition for utility maximization holds for all $\gamma > 0$ (i.e., all risk averse agents). Solving (18) for the optimal level of saving under uncertainty, s_{1E}, yields

$$s_{1E} = \frac{\ln(\delta r_1) + \gamma e_{1E}(1-t_1) + \ln\Psi}{\gamma(1+r_1)} \tag{19}$$

where

$$\Psi = p e^{-\gamma e_{2E}} + (1-p) e^{-\gamma(e_{2U}+r_1 t_1 e_{1E}(1-p)^{-1})} .$$

The Optimal Tax Rate in the Forced-Saving Model

In order to determine the optimal tax rate t_1, the optimal consumption allocations[16] must be determined by solving a constrained social planner's problem. A social planner in the forced-saving model is only concerned with maximizing the lifetime welfare of agents employed in the first period because the unemployment insurance redistribution scheme in this system deals only with those who are employed during the first period. A planner, therefore, maximizes the expected lifetime utilities of the agents employed in the first period subject to feasibility constraints. The planner maximizes the following function

$$\frac{-pN}{\gamma} e^{-\gamma c_{1E}} - \frac{\delta ppN}{\gamma} e^{-\gamma c_{2E}} - \frac{\delta p(1-p)N}{\gamma} e^{-\gamma c_{2U}} \qquad (20)$$

subject to the feasibility constraints

$$\begin{aligned} &pNc_{1E}+pNs_{1E}+pNs^{*} = pNe_{1E} \\ &ppNc_{2E} = ppNe_{2E}+ppNr_1 s_{1E} \\ &p(1-p)Nc_{2U} = p(1-p)Ne_{2U}+p(1-p)Nr_1 s_{1E}+pNr_1 s^{*} \end{aligned} \qquad (21)$$

where all variables, except s^*, are as defined earlier. s^* is the per capita saving by the planner set aside solely for payment to the unemployed in period two, and is therefore equivalent to the tax payments made by the employed in period one, i.e. $s^* = t_1 e_{1E}$. The constrained social planner's problem presented above captures the forced-saving aspect of this UI system by ignoring the unemployed of the first period, since they do not qualify to receive unemployment insurance benefits, and by placing the saving undertaken for the second-period unemployed, s^*, in a fund which grows at the rate of storage available in the economy. Only those agents employed in period one but unemployed in period two are eligible to receive unemployment insurance payment from the fund, as indicated by the third feasibility constraint in (21). Solving the constrained social planner's problem given above yields the following first-order conditions which can be solved for s_{1E} and s^*. The solution implies that the planner

---

[16]Optimal in the sense that these allocations maximize the expected, lifetime utilities only of the agents employed in the first period. The planner is unable to affect the welfare of those agents unemployed during the first period given the constraints of the system being examined.

$$
\begin{aligned}
s_{1E}: \quad & -e^{-\gamma(e_{1E}-s_{1E}-s^*)} + \delta p r_1 e^{-\gamma(e_{2E}+r_1 s_{1E})} \\
& + \delta(1-p) r_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+(1-p)^{-1} r_1 s^*)} = 0 \\
s^*: \quad & -e^{-\gamma(e_{1E}-s_{1E}-s^*)} + \delta r_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+(1-p)^{-1} r_1 s^*)} = 0
\end{aligned}
\tag{22}
$$

allocates resources so as to eliminate the second-period income uncertainty for an employed agent.[17] The planner reduces the first-period incomes of all employed agents by an amount large enough to just equate the income received by an agent unemployed in the second period (low endowment plus unemployment insurance disbursement) with the income of the agent employed in the second period (high endowment). s^* is given by the following

$$s^* = \frac{(e_{2E}-e_{2U})(1-p)}{r_1}, \tag{23}$$

meaning the optimal tax, t_1^*, under the forced-saving UI plan is

$$t_1^* = \frac{(e_{2E}-e_{2U})(1-p)}{r_1 e_{1E}}. \tag{24}$$

The optimal tax in this model is therefore increasing in the second-period high endowment, decreasing in the second-period low endowment, decreasing in the probability of employment, decreasing in the rate of return to the unemployment insurance trust fund, and decreasing in the first-period high endowment.

Precautionary Saving in the Forced-Saving Model

Certainty, as described in section two, means that an agent knows with probability one that she will receive the expected value of her random second-period income. Under the forced-saving plan, the expected value of second-period income is $pe_{2E}+(1-p)e_{2U}+t_1 r_1 e_{1E}$. In the second period, an agent is employed with probability p, in which case she receives e_{2E}, or she is unemployed with probability 1-p and receives the

---

[17]This analysis assumes that the planner is restricted to an interior optimum. If second-period income disparity is great enough and there is large endowment growth from period one to period two, it may be the case that first-period income is not great enough to eliminate period-two income uncertainty without taxing away all of the first-period endowment. Given slow endowment growth, however, such a situation will not arise.

low endowment of e_{2U} plus the unemployment insurance benefit (provided she was employed in period one) of $t_1 r_1 e_{1E}(1-p)^{-1}$. Using this definition, the agent's saving with second-period certain income in the forced-saving model is given by

$$s_{1E}^{c} = \frac{\ln(\delta r_1) + \gamma e_{1E}(1-t_1(1+r_1)) - \gamma(pe_{2E}+(1-p)e_{2U})}{\gamma(1+r_1)} \ . \tag{25}$$

Using equations (19) and (25), the optimal level of precautionary saving for an agent employed in the first period in the forced-saving model is found by subtracting s_{1E}^{c} from s_{1E} to obtain the result

$$PS_{E}^{F} = \frac{\ln\Psi + \gamma t_1 r_1 e_{1E} + \gamma(pe_{2E}+(1-p)e_{2U})}{\gamma(1+r_1)} \ , \tag{26}$$

where Ψ is as defined earlier in this section. Precautionary saving will be positive under this definition of certainty as long as $t_1 \neq t_1^{*}$.[18] Since there is no precautionary saving by unemployed agents, aggregate precautionary saving in the forced-saving model is given by

$$PS_{s}^{F} = \frac{pN(\ln\Psi + \gamma t_1 r_1 e_{1E} + \gamma(pe_{2E}+(1-p)e_{2U}))}{\gamma(1+r_1)} \tag{27}$$

Comparative statics for precautionary saving in the forced-saving model are contained in section five. A comparison of equation (27) with the equation for the level of aggregate precautionary saving without unemployment insurance, equation (13), yields the following proposition:

Proposition 1: *There exist tax rates such that the introduction of a forced-saving unemployment insurance scheme promotes lower levels of precautionary saving than found in the model with no unemployment insurance scheme. Any tax rate less than the optimal tax rate will cause PS_{s}^{F} to be less than $PS_{s}^{NO\ UI}$.*

Proof: As shown by equations (1A.3) and (1A.4) in Appendix 1A and footnote 18, the figure on the following page approximates the relationship between precautionary saving in the model with no unemployment insurance scheme and precautionary saving found in the forced-saving model. For all values of t_1 less than

---

[18] $PS_{E}^{F}=0$, its minimum, at $t_1=t_1^{*}$ and is equal to $PS_{E}^{NO\ UI}$ at $t_1=0$. Over the range $[0, t_1^{*})$, PS_{E}^{F} is decreasing in t_1, while over the range $(t_1^{*}, 1)$, PS_{E}^{F} is increasing in t_1. At $t_1=1$, PS_{E}^{F} again falls (discontinuously) to zero as the agent is unable to save because all of her income is being taxed away.

the optimal tax rate t^*, PS_s^F is less than $PS_s^{NO\ UI}$. In addition, for some values of t_1 greater than t^*, PS_s^F is less than $PS_s^{NO\ UI}$. The exact value of t_1 at which PS_s^F becomes the greater of the two depends on the parameter values chosen.

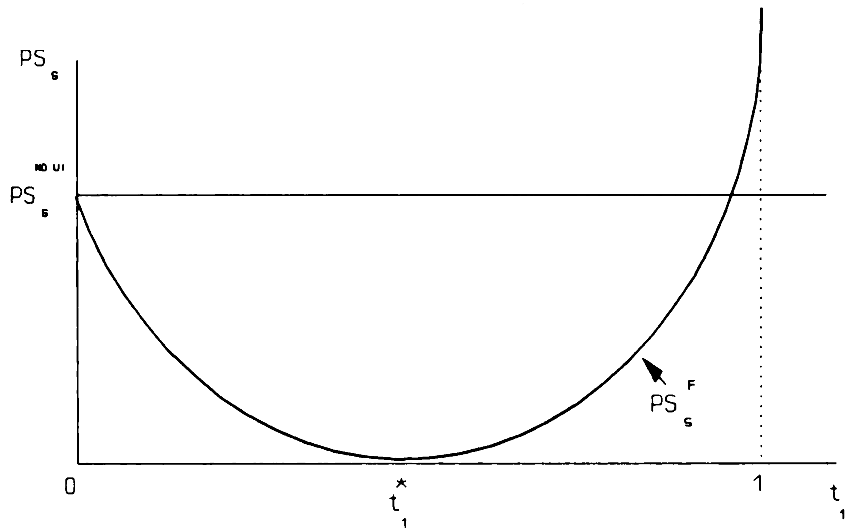

Figure 1

Q.E.D.

Thus, in the forced-saving model of unemployment insurance, imposing an unemployment insurance tax generally reduces the level of precautionary saving undertaken by agents below that found in a model with no UI plan. At the optimal tax level, public saving in the form of forced saving completely eliminates precautionary saving due to uncertain future employment for those eligible for the unemployment insurance plan. This has a potentially important empirical implication in that if the unemployment taxes imposed on firms in the U.S. are near "optimal" levels, then it certainly could be the case that the decreased impact of future income uncertainty has greatly reduced the levels of precautionary saving, possibly making it very difficult to detect empirically.

4. The Pay-As-You-Go Unemployment Insurance Model

Two features of the type of UI systems present in much of the world (other than in the U.S.) are captured in the following model: (1) unemployed agents are not required to have a prior work history to be eligible to receive benefits, and (2) the system is funded in a pay-as-you-go method in that taxes collected from the employed agents in period one are disbursed to the unemployed agents in period one, and similarly for period two.

The endowments of agents employed in the first or second periods are taxed at the rates t_1 or t_2, respectively, where $t_1, t_2 \epsilon [0,1]$. Given that there are pN employed agents who are each receiving e_{1E} in period one, the total tax revenue collected for unemployment insurance purposes in period one is pNt_1e_{1E}. Similarly, the total tax revenue generated for unemployment insurance use in period two is pNt_2e_{2E}. The tax revenue is collected by a government whose only function is to gather and disburse the UI tax revenue in each period.[19] In each of the periods, (1-p)N agents will be unemployed and therefore will be eligible to receive UI benefits, meaning there is a per capita disbursement of $p(1-p)^{-1}t_1e_{1E}$ to agents unemployed in the first period and a per capita disbursement of $p(1-p)^{-1}t_2e_{2E}$ to unemployed agents in the second period.

The budget constraints faced by an agent employed in the first period become

$$\begin{aligned} &\text{Period 1:} \quad e_{1E}(1-t_1) = c_{1E} + s_{1E} \\ &\text{Period 2:} \quad e_{2E}(1-t_2) + r_1 s_{1E} = c_{2E} \\ &\qquad\qquad\;\; e_{2U} + p(1-p)^{-1}t_2 e_{2E} + r_1 s_{1E} = c_{2U} \end{aligned} \tag{28}$$

where the variables are as defined earlier. An agent unemployed in the first period faces the following budget constraints

[19]The government budget constraint requires that tax revenues collected in any specific period equal unemployment insurance disbursements in that period.

$$\begin{aligned}\text{Period 1:}\quad & e_{1U} + p(1-p)^{-1}t_1e_{1E} = c_{1U} + s_{1U} \\ \text{Period 2:}\quad & e_{2E}(1-t_2) + r_1s_{1U} = c_{2E} \\ & e_{2U} + p(1-p)^{-1}t_2e_{2E} + r_1s_{1U} = c_{2U}\ .\end{aligned} \tag{29}$$

An employed agent receives a smaller net endowment in the first and second periods and an unemployed agent receives an unemployment insurance payment to supplement her low endowment during her period(s) of unemployment. The transfers from employed to unemployed in the pay-as-you-go model are intraperiod transfers rather than interperiod transfers characteristic of the forced-saving model.

Under the assumption of constant absolute risk aversion, an agent employed in the first period solves the problem

$$\max_{s_{1E}} \frac{-1}{\gamma}e^{-\gamma(e_{1E}(1-t_1)-s_{1E})} - \frac{\delta p}{\gamma}e^{-\gamma(e_{2E}(1-t_2)+r_1s_{1E})} - \frac{\delta(1-p)}{\gamma}e^{-\gamma(e_{2U}+p(1-p)^{-1}t_2e_{2E}+r_1s_{1E})} \tag{30}$$

where the budget constraints given in (28) have been substituted into the utility function. Solving the above maximization problem yields the first-order condition

$$-e^{-\gamma(e_{1E}(1-t_1)-s_{1E})} + \delta pr_1e^{-\gamma(e_{2E}(1-t_2)+r_1s_{1E})} + \delta(1-p)r_1e^{-\gamma(e_{2U}+p(1-p)^{-1}t_2e_{2E}+r_1s_{1E})} = 0 \tag{31}$$

which shows that the optimal level of saving in the first period by an employed agent is that which equates her marginal rate of intertemporal substitution with the marginal rate of transformation she faces in the economy. The second-order condition for maximization holds for all risk averse agents. Solving (31) for the optimal level of saving under uncertainty yields

$$s_{1E} = \frac{\ln(\delta r_1) + \gamma e_{1E}(1-t_1) + \ln\Omega}{\gamma(1+r_1)} \tag{32}$$

where

$$\Omega = pe^{-\gamma e_{2E}(1-t_2)} + (1-p)e^{-\gamma(e_{2U}+p(1-p)^{-1}t_2e_{2E})}\ .$$

Solving a similar problem for an agent unemployed in period one gives the following expression for s_{1U}

$$s_{1U} = \frac{\ln(\delta r_1) + \gamma(e_{1U} + p(1-p)^{-1} t_1 e_{1E}) + \ln\Omega}{\gamma(1+r_1)} \quad . \tag{33}$$

When facing uncertain second-period incomes, employed agents will save if

$$t_1 < \frac{\ln(\delta r_1 \Omega) + \gamma e_{1E}}{\gamma e_{1E}} \tag{34}$$

which is also a sufficient condition for unemployed agents to save nothing in period one.[20] If the first-period tax on employed agents is great enough so that

$$t_1 > \frac{-(1-p)(\gamma e_{1U} + \ln(\delta r_1 \Omega))}{\gamma p e_{1E}} \quad , \tag{35}$$

then employed agents in period one would save nothing while the unemployed would be savers.[21]

The Optimal Tax Rates in the Pay-As-You-Go Model

Determining the optimal tax rates, t_1 and t_2, in the model requires solving the social planner's problem relevant to this framework for the optimal consumption allocations. Unlike in the forced-saving unemployment insurance scheme, under which the planner is unable to affect the utility of those initially unemployed, in the pay-as-you-go plan, the planner allocates resources so as to maximize the welfare of all agents in each time period. Thus, the planner under this UI system is not limited to only interperiod transfers as in the forced-saving unemployment insurance system. Once the optimal consumption allocations are obtained, a tax scheme which brings about those optimal allocations is determined from the budget constraints and the maximizing saving choices.

---

[20]A necessary condition for the first-period unemployed to demand "negative" storage is $t_1 < \frac{-(1-p)(\gamma e_{1U} + \ln(\delta r_1 \Omega))}{\gamma p e_{1E}}$, which is satisfied if (34) holds.

[21](35) is sufficient to cause employed agents to desire to borrow, but they are prohibited from negative storage.

The social planner maximizes the following function

$$\frac{-pN}{\gamma}e^{-\gamma c_{1E}} - \frac{(1-p)N}{\gamma}e^{-\gamma c_{1U}} - \frac{\delta pN}{\gamma}e^{-\gamma c_{2E}} - \frac{\delta(1-p)N}{\gamma}e^{-\gamma c_{2U}} \qquad (36)$$

subject to the feasibility constraints

$$\begin{aligned} &pNc_{1E}+(1-p)Nc_{1U}+pNs_{1E}+(1-p)Ns_{1U} = pNe_{1E}+(1-p)Ne_{1U} \\ &pNc_{2E}+(1-p)Nc_{2U} = pNe_{2E}+(1-p)Ne_{2U}+pNr_1s_{1E}+(1-p)Nr_1s_{1U} \end{aligned} \qquad (37)$$

in order to determine the optimal consumption allocations for this economy. Solving the constrained maximization problem given above yields the following first-order conditions

$$\begin{aligned} c_{1E}:&\quad pNe^{-\gamma c_{1E}} - \lambda pN = 0 \\ c_{2E}:&\quad \delta pNe^{-\gamma c_{2E}} - \lambda\frac{pN}{r_1} = 0 \\ c_{1U}:&\quad (1-p)Ne^{-\gamma c_{1U}} - \lambda(1-p)N = 0 \\ c_{2U}:&\quad \delta(1-p)Ne^{-\gamma c_{2U}} - \lambda\frac{(1-p)N}{r_1} = 0 \end{aligned} \qquad (38)$$

from which it can be shown that the social planner allocates resources so that

$$\begin{aligned} c_{1E} &= c_{1U} \\ c_{2E} &= c_{2U}\ . \end{aligned} \qquad (39)$$

The equalities in (39) show that the planner under the pay-as-you-go system equates the marginal utility of consumption (and given the functional form, actual consumption) in both periods across states. In the forced-saving scheme of the previous section, the constrained planner equates only the marginal utility of consumption from period two across states since in that system the planner is unable to allocate resources to those initially unemployed.

The optimal tax rate for each period may be determined by finding that t_i, i=1,2, using the budget constraints (28) and (29), which brings about the equalities given in (39). The optimal tax rates for the pay-as-you-go model of unemployment insurance are similar in form to the optimal tax rate from the forced-saving model and are given by the following

$$t_1^* = \frac{(e_{1E}-e_{1U})(1-p)}{e_{1E}} \qquad (40a)$$

and

$$t_2^* = \frac{(e_{2E}-e_{2U})(1-p)}{e_{2E}} . \tag{40b}$$

In both periods, these rates are increasing in own-period high endowment, decreasing in own-period low endowment, and decreasing in the probability of being employed, p. In the pay-as-you-go model, the rate of return to storage plays no role in the unemployment insurance taxation process because tax revenues collected in period one are immediately disbursed to the unemployed in period one and there is no "funding" involved in the process. Also in the pay-as-you-go model, the tax rates do not depend on the parameter values present in the other period, i.e. t_1 does not depend on any period-two parameters. This is not the case for the forced-saving model in that, due to the interperiod nature of the forced-saving scheme, the ratio of the endowment difference in period two to the employed endowment in period one plays an important part in determining the level of the optimal tax.

Precautionary Saving in the Pay-As-You-Go Model

As with the previous two models, certainty in the pay-as-you-go model again signifies that an agent knows with probability one that she will receive the expected value of her random second-period income. In the pay-as-you-go model, an agent will be employed with probability p in the second period, in which case she receives $e_{2E}(1-t_2)$, or will be unemployed with probability (1-p) in the second period, meaning she receives the low endowment e_{2U} plus the unemployment insurance benefit (whether employed or unemployed in period one) $p(1-p)^{-1}t_2e_{2E}$. The expected income she receives with probability one in the second period is therefore $pe_{2E}(1-t_2)+(1-p)e_{2U}+pt_2e_{2E}$. The level of saving under certainty by an employed agent, s_{1E}^c, is given by

$$s_{1E}^c = \frac{\ln(\delta r_1)+\gamma(e_{1E}(1-t_1)-pe_{2E}-(1-p)e_{2U})}{\gamma(1+r_1)} . \tag{41}$$

Saving by an agent unemployed in period one when facing second-period income certainty is

$$s^c_{1U} = \frac{\ln(\delta r_1) + \gamma\left(e_{1U} + p(1-p)^{-1}t_1)e_{1E} - pe_{2E} - (1-p)e_{2U}\right)}{\gamma(1+r_1)} \,. \tag{42}$$

If t_1 is such that both

$$t_1 < \frac{\ln(\delta r_1) - \gamma(pe_{2E} + (1-p)e_{2U}) + \gamma e_{1E}}{\gamma e_{1E}} \tag{43}$$

and

$$t_1 < \frac{-(1-p)[\ln(\delta r_1) - \gamma(pe_{2E} + (1-p)e_{2U}) + \gamma e_{1U}]}{\gamma pe_{1E}} \,, \tag{44}$$

then an agent employed in period one will save while an unemployed agent in period one, who would like to dissave but cannot, saves nothing. If the inequalities in (43) and (44) are reversed, the roles of saver and non-saver are reversed.

Precautionary saving by an employed agent when (43) and (44) are true[22] is the difference between total saving under uncertainty, (32), and total saving under certainty, (41), and is given by

$$PS^P_E = \frac{\ln\Omega + \gamma(pe_{2E} + (1-p)e_{2U})}{\gamma(1+r_1)} \,, \tag{45}$$

where Ω is as defined earlier in the section. Precautionary saving by an employed agent will be greater than zero as long as $t_2 \neq t^*_2$ (and $t_1 \neq 1$).[23] Since the unemployed agents, when (43) and (44) hold, are saving zero, aggregate precautionary saving in this case is

$$PS^P_s = \frac{pN\left(\ln\Omega + \gamma(pe_{2E} + (1-p)e_{2U})\right)}{\gamma(1+r_1)} \quad \text{(employed)} \,. \tag{46}$$

When (43) and (44) do not hold, precautionary saving by an unemployed agent is again given by (45). Aggregate precautionary saving when only the unemployed are saving is

$$PS^P_s = \frac{(1-p)N\left(\ln\Omega + \gamma(pe_{2E} + (1-p)e_{2U})\right)}{\gamma(1+r_1)} \quad \text{(unemployed)} \,. \tag{47}$$

Comparative static results on the versions of precautionary saving given

---

[22]Note that if t_1 is such that (43) is true, then (34) will also be true.

[23]PS^P_E is minimized (=0) at $t_2 = t^*_2$. At $t_2 = 0$, $PS^P_E = PS^{NO\ UI}_E$, over the range $[0, t^*_2)$, precautionary saving is decreasing in t_2 and positive, and in the range $(t^*_2, 1]$ precautionary saving is increasing in t_2 and positive.

by (46) and (47) are contained in section five. As in the forced-saving model, comparisons of equations (46) and (47) with the equation for precautionary saving in the model with no unemployment insurance yield the following proposition:

Proposition 2: ***There exist tax rates such that the introduction of a pay-as-you-go unemployment insurance scheme promotes lower levels of precautionary saving than found in the model with no unemployment insurance scheme. Any tax rate less than the optimal tax rate will cause PS_s^P to be less than $PS_s^{NO\ UI}$.***

Proof: **As seen from (1A.16) and (1A.17) in Appendix 1A and footnote 23, the figure below approximates the relationship between precautionary saving in the model with no UI system and PS_s^P when the employed agents are saving. For all $t_2 \epsilon (0, t_2^*)$, precautionary saving in the pay-as-you-go model is less than that in a model with no UI scheme. The value of t_2 greater than the optimal tax rate at which PS_s^P becomes greater than $PS_s^{NO\ UI}$ depends on the parameters of the model. Since aggregate precautionary saving by unemployed agents is less than that by employed agents in the pay-as-you-go model, the above argument also holds in the case of unemployed saving.**

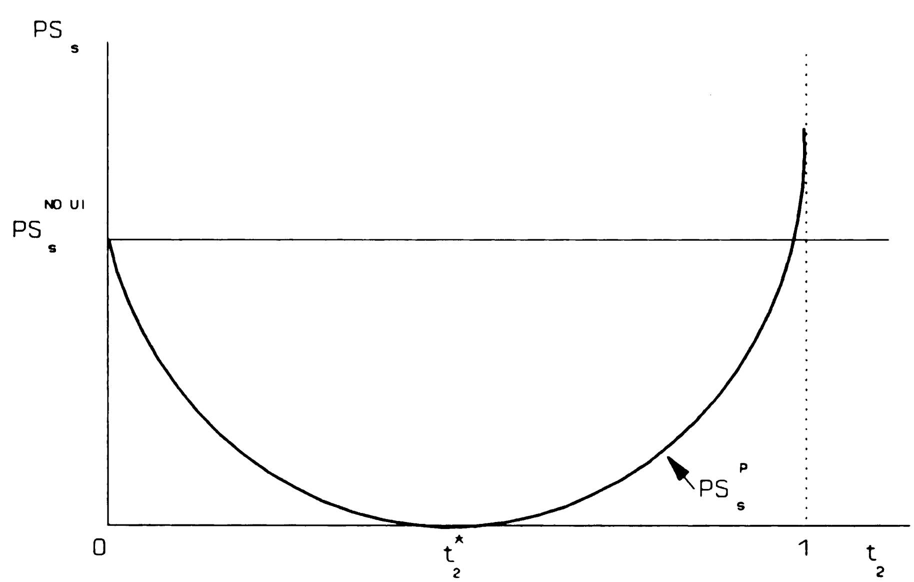

Figure 2

Q.E.D.

5. Comparative Statics on Precautionary Saving

This section presents and discusses the comparative static results for the three models of precautionary saving given in this chapter: the model without an unemployment insurance scheme, the forced-saving model, and the pay-as-you-go model. Table 1.1 below summarizes the comparative static results on aggregate precautionary saving for the various models.[24]

Table 1.1
Comparative Static Results for Precautionary Saving[1]

	r_1	p	e_{2E}	e_{2U}	t_1e_{1E}	t_2
$PS_s^{No\ UI}$	−	?	+	−	N/A	N/A
PS_s^F	−[2]	?[2] +[3]	+[2] −[3]	−[2] +[3]	−[2] +[3]	N/A
PS_s^P (employed)	−	?[4] +[5]	+[4,7] −[6]	−[4] +[5]	N/A	−[4] +[5]
PS_s^P (unemployed)	−	−[4] ?[5]	+[4,7] −[6]	−[4] +[5]	N/A	−[4] +[5]

[1]Blocks with N/A inside indicate that either the expression for precautionary saving does not contain that variable or that the variable is examined jointly with another variable (i.e., t_1 and e_{1E} were examined as one variable, t_1e_{1E}, in the instances where they always appeared together). Any assumptions used to sign a partial derivative are noted and explained in the other footnotes below. All signs are determined under the assumption that parameter values are such that the applicable precautionary saving is non-negative. A question mark indicates a partial derivative whose sign is indeterminate.
[2]If t_1 is less than the optimal tax rate, t_1^*.
[3]If t_1 is greater than the optimal tax rate, t_1^*.
[4]If t_2 is less than the optimal tax rate, t_2^*.
[5]If t_2 is greater than the optimal tax rate, t_2^*.
[6]If t_2 is greater than t_2^* but less than 1-p.
[7]If t_2 is greater than 1-p.

When the UI tax rate is below its optimal value in the case of the forced-saving model, and for all tax rates in the other models, precautionary saving is inversely related to the rate of return to storage. In the forced-saving model, increasing r_1 has three effects: (1) substitution: saving, including precautionary saving, is more attractive since the same investment now yields a relatively higher return; (2)

[24]The complete derivations for the comparative static results are given in Appendix 1A.

income a: since a lower level of precautionary saving provides the same level of "insurance coverage," precautionary saving tends to decrease; and (3) income b: a higher rate of return means a larger disbursement to the unemployed, reducing the need for precautionary saving. For the forced-saving model, income effects (2) and (3) dominate so that precautionary saving and r_1 are inversely related. In the pay-as-you-go model, there is no effect (3). The income effect given by (2) alone, however, dominates the substitution effect, again implying an inverse relationship between precautionary saving and the rate of return to storage.

Proposition 3: *A change in the rate of return to storage in the economy causes a smaller response in precautionary saving in the pay-as-you-go model than in the model without an unemployment insurance scheme when parameter values are such that* $PS_*^P < PS_*^{NO\ UI}$.

Proof: Given that $PS_*^P < PS_*^{NO\ UI}$, multiplying both sides by $-(1+r_1)^{-1}$ reverses the sign and yields the respective derivatives. Since the derivative of PS_*^P with respect to r_1 is a negative value closer to zero than is the derivative of $PS_*^{NO\ UI}$ with respect to r_1, precautionary saving changes less in the pay-as-you-go model with a change in r_1 than it does in the model with no unemployment insurance scheme.

Q.E.D.

A pay-as-you-go unemployment insurance system tends to dampen the effects on precautionary saving of changes in the rate of return to storage in the economy. The same cannot be said with the forced-saving unemployment insurance scheme because the scheme is funded. The fact that changing r_1 changes the disbursement in the forced-saving plan through changing the growth rate of the fund, in addition to the other two effects detailed above, means that precautionary saving in the forced-saving model may be more responsive or less responsive to changes in r_1 than is precautionary saving in the model without an unemployment insurance plan, depending on the parameter values of the model.

Altering the probability of being employed in period two affects aggregate precautionary saving in three distinct ways in the models of UI in this chapter: (1) as in the model without an unemployment insurance scheme, increasing the probability of receiving a high endowment reduces the income uncertainty faced by an agent in the second period and therefore reduces the agent's need for precautionary saving; (2) increasing p increases the unemployment insurance disbursement in the UI models which also decreases the agent's need to save for precautionary reasons; and (3) in the aggregate, increasing p increases precautionary saving (when the employed are the ones who are saving) by increasing the numbers of employed agents. Specifically, in the forced-saving plan with the UI tax rate less than the optimal rate, a higher probability of being employed in period two causes individual agents to decrease their levels of precautionary saving because of effects (1) and (2) but also means more employed agents in the second period, leaving the net effect on aggregate precautionary saving unclear. Interestingly, if $t_1 > t_1^*$ in the forced-saving model, an increase in the probability of being employed in the second period actually increases the individual agent's desired precautionary saving and this, combined with the increase in the number of employed agents, causes an increase in aggregate precautionary saving. The agent insures herself against the possibility of being *employed* if the tax rate is high enough because with $t_1 > t_1^*$, her income would be higher were she to be unemployed. At high unemployment insurance tax rates (high relative to the optimal rate), an increasing unemployment rate may therefore actually decrease aggregate precautionary saving in an economy with a forced-saving UI plan.

When the employed are saving in the pay-as-you-go plan, the analysis of the effects of a change in p on precautionary saving is similar to that given for the forced-saving plan. However, in the case of first-period UI tax rates great enough that the unemployed become savers in the pay-as-you-go plan, the relationship between p and aggregate precautionary saving changes. When p increases, there are fewer unemployed savers which means lower levels of aggregate precautionary saving due to effect (3) above. The individual agents still react to changes in the probability of being employed in the second period as they did in the no insurance and forced saving models. If $t_2 < t_2^*$, an individual unemployed agent decreases her precautionary saving when p increases because of effects (1) and (2) above. Also, an increase in p means that there are fewer unemployed agents in the economy. The combination of the effects means that aggregate precautionary saving falls with an increase in p when the second-period tax rate is less than the optimal tax rate.

Precautionary saving is positively related to the high endowment in the second period for the model with no UI system and for both models with UI plans if the respective tax rates are less than optimal. For both models, with a tax rate less than optimal, increasing e_{2E} widens the gap between income when employed in period two and income when unemployed in period two. This increased second-period income variance causes an agent to increase precautionary saving. If the tax rate is greater than optimal in the forced-saving model, an unemployed agent receives a larger second-period income than does an employed agent. Therefore, increasing e_{2E} in this case *decreases* the gap between employed and unemployed incomes, reduces the variance of second-period income, and induces an agent to save less for precautionary reasons. In the pay-as-you-go model, t_2 larger than the optimal rate but less than 1-p causes an increase in e_{2E} to decrease the variance of second period income, thereby reducing the agent's desire for precautionary saving.

An increase in e_{2U} will decrease the level of precautionary saving by an agent in the model with no UI plan and in both models with unemployment insurance schemes provided that in the latter the UI tax rates are less than optimal. The greater e_{2U}, the lower the income uncertainty faced by agents in the second period and the lower their demand for self-insurance in the form of precautionary saving. In both UI models with $t_i > t_i^*$, i=1,2, precautionary saving is positively related to the second-period low endowment because an increase in e_{2U} in that situation causes an *increase* in income disparity which drives the agents to increase their precautionary saving. One can think of e_{2U} as a basic, subsistence level of service available to all agents. Any increase in aid from programs such as welfare, AFDC, or a national health care plan reduces the need for agents to undertake precautionary saving (if unemployment insurance tax rates are below the optimal rates) to protect against job loss since programs like the above will suffice to maintain an agent's life. As indicated by the models, increasing such aid could decrease the level of precautionary saving by an agent.

Proposition 4: *A change in second-period endowments causes a smaller magnitude change in precautionary saving in the forced-saving model than in the model with no unemployment insurance.*

Proof: To show that proposition 4 holds for e_{2E} in the case of the forced-saving model vs. the no UI model, it must be shown that the partial derivative in the no insurance case is larger than that in the forced-saving model (since precautionary saving is positively related to e_{2E}). This will be true if $\Psi < \xi$, which can easily be shown. In the low second-period endowment case, the partial derivative in the no insurance model will be smaller than in the forced-saving model (and hence larger in magnitude) if the term $\gamma r_1 t_1 e_{1E}(1-p)^{-1}$ is non-zero.

Q.E.D.

An increase in e_{2E} or a decrease in e_{2U} causes a larger increase in precautionary saving in the model without an unemployment insurance scheme than in the forced-saving model. Thus in an economy in which expected wages are quickly increasing or quickly decreasing, according to this model one would expect to find higher levels of precautionary saving if there were no unemployment insurance scheme. If future labor income is expected to be highly variable, the presence of unemployment insurance may actually hinder capital accumulation in the aggregate.

The second-period tax on endowments is found only in the pay-as-you-go model. Whether the level of precautionary saving is positively or negatively related to changes in t_2 depends on whether t_2 is greater than or less than the optimal tax rate in the economy. At a high enough tax rate (i.e., at a tax rate greater than the optimal tax rate), so much income is being transferred from the employed to the unemployed in the second-period that an agent facing the saving/consumption decision in the first period would save to insure herself against the possibility of *being employed* in the second period. Further increases in the tax rate beyond the optimal rate would induce further precautionary saving on the part of an agent. For tax rates smaller than the optimal tax rate, increasing the tax rate towards the optimal rate would decrease the income uncertainty faced by an agent during the second period and would therefore lead to a decrease in precautionary saving.

Precautionary saving is inversely related to the amount of unemployment insurance tax paid in the first period, $t_I e_{IE}$, in the forced-saving model if $t_I < t_I^*$ and is positively related to $t_I e_{IE}$ if $t_I > t_I^*$. Increasing $t_I e_{IE}$ has two effects: (1) it decreases the resources available to the agent for consuming and saving in the first period; and (2) it leads to higher UI disbursements in the second period. In both cases, effect (1) reduces the level of precautionary saving undertaken by an agent under the assumption that saving and precautionary saving are normal goods. If $t_I < t_I^*$, then effect (2) reinforces effect (1) by decreasing the income uncertainty faced by an agent and therefore reducing the desire for precautionary saving. If $t_I > t_I^*$, then increasing t_I causes a widening of the income disparity in period two and causes an agent to desire higher levels of precautionary saving. In this case, effect (1) and effect (2) conflict, with effect (2) dominating, so that the net result of an increase in t_I if $t_I > t_I^*$ is an increase in precautionary saving. One failing of this simple model is that it does not distinguish clearly between the tax effects and the disbursement effects of unemployment insurance in the forced-saving model since all monies collected by the government in the model are disbursed to unemployed agents. In the 1980's in the U.S. we observed a period during which the taxes collected for unemployment insurance increased while the levels of benefit provision fell. In part this was an attempt by states to replenish their UI fund accounts held by the U.S. Treasury after the periods of high unemployment during the late 1970's and early 1980's. A richer model which allowed for greater independence between UI tax levels and benefit levels, however, might not allow for the clear exposition afforded by the present framework.

Proposition 5: *There exist tax rates t_l less than the optimal tax rate such that an increase in $t_l e_{lE}$ leads to a proportionately greater decrease in precautionary saving in the forced-saving model.*

Proof: In the forced-saving model, the partial derivative of precautionary saving with respect to $t_l e_{lE}$ will be less than -1 if

$$t_1 < \frac{(e_{2E}-e_{2U})(1-p)}{r_1 e_{1E}} - \frac{1-p}{\gamma r_1 e_{1E}} \ln\left(\frac{p(1+2r_1)}{p(1+2r_1)-(1+r_1)}\right) \qquad (48)$$

which means t_l must be less than the optimal tax rate. If the right hand side of the inequality above is greater than zero, then there exist feasible values for t_l for which the statement in proposition 5 holds. The right hand side of the inequality will be greater than zero if

$$e^{\gamma(e_{2E}-e_{2U})} > \frac{p(1+2r_1)}{p(1+2r_1)-(1+r_1)} \qquad (49)$$

which depends on the parameter values chosen. However, there are certainly reasonable values for e_{2E} and e_{2U} for which (49) could be true, meaning a feasible t_l exists for which (48) is a true statement.

Q.E.D.

Thus, it is possible for UI benefits to "more than replace" precautionary saving in the forced-saving model, which has definite policy ramifications. If greater capital accumulation is desired in order to spur investment, the forced-saving model presented here indicates that an increase in unemployment insurance benefits could be counterproductive. Therefore, even in the unlikely event that "saving" with the government produces capital as efficiently as private precautionary saving, the levels of precautionary saving could still decrease in the aggregate because of this more than one-to-one offset, with the end result being a reduction in capital growth and a deterioration in the infrastructure of the country.

6. Conclusion

This chapter presents two different models of unemployment insurance in a simple framework. In both models, one a forced-saving plan with features common to the UI system found in the U.S., the other a pay-as-you-go plan with characteristics found in unemployment insurance schemes found in other parts of the world, the reactions of precautionary saving to changes in various parameter values are derived.

The level of precautionary saving is found to be inversely related to the level of unemployment insurance benefits provided if the unemployment insurance tax rate is less than the optimal tax rate and directly related to the level of UI benefits provided otherwise. Furthermore, UI benefits are found to replace precautionary saving by more than one-to-one in the forced-saving model for certain feasible UI tax rates. In chapter three, both of the above effects will be tested empirically.

In addition, tests will be done to determine whether the relationships between precautionary saving and the probability of being employed and between precautionary saving and the rate of return in the economy found in this chapter can be shown empirically.

Besides the empirical chapter, chapter two presents an extension to the model used in this chapter. Nearly all of the work on precautionary saving (including this chapter) assumes that loan markets are closed, meaning the only avenue available for consumption smoothing is saving. In chapter two, the model is extended by opening loan markets to allow agents to borrow against future incomes and the effect this has on precautionary saving is examined.

APPENDIX 1A

APPENDIX 1A

Derivatives for the Forced-Saving Model

Aggregate precautionary saving in the forced-saving model is given by

$$PS_s^F = \frac{pN\left(\ln\Psi + \gamma t_1 r_1 e_{1E} + \gamma\left(pe_{2E} + (1-p)e_{2U}\right)\right)}{\gamma(1+r_1)} \tag{1A.1}$$

where

$$\begin{aligned}\Psi &= pe^{-\gamma e_{2E}} + (1-p)e^{-\gamma\mu} \\ \mu &= e_{2U} + r_1 t_1 e_{1E}(1-p)^{-1}\ .\end{aligned} \tag{1A.2}$$

Proposition 1 utilizes (1A.3) and (1A.4), which examine the relationship between PS_s^F and t_1, in order to show the relationship between precautionary saving in the forced-saving model and precautionary saving in the model with no unemployment insurance scheme. The optimal tax rate t_1^* is the solution when (1A.3) is set equal to zero, and given that (1A.4) is always greater than or equal to zero, is the minimum point for PS_s^F in the PS_s^F, t_1 plane.

$$\frac{\partial PS_s^F}{\partial t_1} = \frac{pNr_1e_{1E}}{1+r_1}\left(1 - \frac{e^{-\gamma\mu}}{\Psi}\right) \tag{1A.3}$$

$$\frac{\partial^2 PS_s^F}{\partial t_1^2} = \frac{pN\gamma r_1^2 e_{1E}^2}{1+r_1}\left(\frac{e^{-\gamma\mu}}{(1-p)\Psi} - \frac{e^{-2\gamma\mu}}{\Psi^2}\right) \tag{1A.4}$$

(1A.5) through (1A.9) give the partial derivatives of PS_s^F with respect to r_1, e_{2E}, e_{2U}, p, and t_1e_{1E}:

$$\frac{\partial PS_s^F}{\partial r_1} = \frac{-pN\left(\ln\Psi + \gamma t_1 r_1 e_{1E} + \gamma\left(pe_{2E} + (1-p)e_{2U}\right)\right)}{\gamma(1+r_1)^2} + \frac{pNt_1e_{1E}}{1+r_1}\left(1 - \frac{e^{-\gamma\mu}}{\Psi}\right) \tag{1A.5}$$

$$\frac{\partial PS_s^F}{\partial e_{2E}} = \frac{p^2N}{1+r_1}\left(1 - \frac{e^{-\gamma e_{2E}}}{\Psi}\right) \tag{1A.6}$$

$$\frac{\partial PS_s^F}{\partial e_{2U}} = \frac{pN(1-p)}{1+r_1}\left(1 - \frac{e^{-\gamma\mu}}{\Psi}\right) \tag{1A.7}$$

$$\frac{\partial PS_s^F}{\partial p} = \frac{N}{\gamma(1+r_1)}[\ln\Psi + \gamma t_1 r_1 e_{1E} + \gamma(pe_{2E} + (1-p)e_{2U})] + \frac{pN\left(e^{-\gamma e_{2E}} - (1+\gamma r_1 t_1 e_{1E}(1-p)^{-1})e^{-\gamma\mu}\right)}{\gamma(1+r_1)\Psi} + \frac{pN(e_{2E} - e_{2U})}{1+r_1} \qquad (1A.8)$$

$$\frac{\partial PS_s^F}{\partial(t_1 e_{1E})} = \frac{pNr_1}{1+r_1}\left(1 - \frac{e^{-\gamma\mu}}{\Psi}\right) \qquad (1A.9)$$

Derivatives for the Pay-As-You-Go Model

Aggregate precautionary saving when the employed agents are saving in the pay-as-you-go model is given by

$$PS_s^P = \frac{pN(\ln\Omega + \gamma(pe_{2E} + (1-p)e_{2U}))}{\gamma(1+r_1)} \quad \text{(employed)} \qquad (1A.10)$$

where

$$\Omega = pe^{-\gamma e_{2E}(1-t_2)} + (1-p)e^{-\gamma\omega}$$
$$\omega = e_{2U} + p(1-p)^{-1}t_2 e_{2E} \qquad (1A.11)$$

(1A.12) through (1A.16) give the partial derivatives of PS_s^P for the employed agents with respect to the parameters r_1, e_{2E}, e_{2U}, p, and t_2:

$$\frac{\partial PS_s^P}{\partial r_1} = \frac{pN(-\ln\Omega - \gamma(pe_{2E} + (1-p)e_{2U}))}{\gamma(1+r_1)^2} \qquad (1A.12)$$

$$\frac{\partial PS_s^P}{\partial e_{2E}} = \frac{p^2 N}{1+r_1}\left(1 - \frac{(1-t_2)e^{-\gamma e_{2E}(1-t_2)} + t_2 e^{-\gamma\omega}}{\Omega}\right) \qquad (1A.13)$$

$$\frac{\partial PS_s^P}{\partial e_{2U}} = \frac{pN(1-p)}{1+r_1}\left(1 - \frac{e^{-\gamma\omega}}{\Omega}\right) \qquad (1A.14)$$

$$\frac{\partial PS_s^P}{\partial p} = \frac{N}{\gamma(1+r_1)}[\ln\Omega + \gamma(pe_{2E} + (1-p)e_{2U})] + \frac{pN(e_{2E} - e_{2U})}{1+r_1} + \frac{pN\left(e^{-\gamma e_{2E}(1-t_2)} - (1 + \gamma t_2 e_{2E} + \gamma p(1-p)^{-1}t_2 e_{2E})e^{-\gamma\omega}\right)}{\gamma(1+r_1)\Omega} \qquad (1A.15)$$

$$\frac{\partial PS_s^P}{\partial t_2} = \frac{p^2 N e_{2E}\left(e^{-\gamma e_{2E}(1-t_2)} - e^{-\gamma\omega}\right)}{(1+r_1)\Omega} \qquad (1A.16)$$

Proposition 2 makes use of (1A.16) above and (1A.17) below in order to determine the relationship between PS_s^P and t_2. This information is then used to contrast precautionary saving in the pay-as-you-go model with precautionary saving in the model with no unemployment insurance plan. Setting (1A.16) equal to zero and solving for t_2 yields t_2^*, and since the expression in (1A.17) is always non-negative, t_2^* is the minimum point for PS_s^P in the PS_s^P, t_2 plane.

$$\frac{\partial^2 PS_s^P}{\partial t_2^2} = \frac{\gamma p^2 N e_{2E}^2\left(e^{-\gamma e_{2E}(1-t_2)} + p(1-p)^{-1} e^{-\gamma\mu}\right)}{(1+r_1)\,\Omega} - \frac{p^2 N e_{2E}\left(e^{-\gamma e_{2E}(1-t_2)} - e^{-\gamma\mu}\right)^2}{(1+r_1)\,\Omega^2} \tag{1A.17}$$

Aggregate precautionary saving when the unemployed agents are saving in the pay-as-you-go model is given by

$$PS_s^P = \frac{(1-p)N\left(\ln\Omega + \gamma\left(pe_{2E} + (1-p)e_{2U}\right)\right)}{\gamma(1+r_1)} \quad \text{(unemployed)} \tag{1A.18}$$

(1A.19) through (1A.23) give the partial derivatives of PS_s^P for the unemployed agents with respect to the parameters r_1, e_{2E}, e_{2U}, p, and t_2:

$$\frac{\partial PS_s^P}{\partial r_1} = \frac{(1-p)N\left(-\ln\Omega - \gamma\left(pe_{2E} + (1-p)e_{2U}\right)\right)}{\gamma(1+r_1)^2} \tag{1A.19}$$

$$\frac{\partial PS_s^P}{\partial e_{2E}} = \frac{p(1-p)N}{1+r_1}\left(1 - \frac{(1-t_2)e^{-\gamma e_{2E}(1-t_2)} + t_2 e^{-\gamma\omega}}{\Omega}\right) \tag{1A.20}$$

$$\frac{\partial PS_s^P}{\partial e_{2U}} = \frac{N(1-p)^2}{1+r_1}\left(1 - \frac{e^{-\gamma\omega}}{\Omega}\right) \tag{1A.21}$$

$$\frac{\partial PS_s^P}{\partial p} = \frac{-N}{\gamma(1+r_1)}\left[\ln\Omega + \gamma\left(pe_{2E} + (1-p)e_{2U}\right)\right] + \frac{(1-p)N\left(e_{2E} - e_{2U}\right)}{1+r_1} + \frac{(1-p)pN\left(e^{-\gamma e_{2E}(1-t_2)} - \left(1 + \gamma t_2 e_{2E} + \gamma p(1-p)^{-1} t_2 e_{2E}\right)e^{-\gamma\omega}\right)}{\gamma(1+r_1)\,\Omega} \tag{1A.22}$$

$$\frac{\partial PS_s^P}{\partial t_2} = \frac{p(1-p)Ne_{2E}\left(e^{-\gamma e_{2E}(1-t_2)} - e^{-\gamma\omega}\right)}{(1+r_1)\,\Omega} \tag{1A.23}$$

REFERENCES

Abel, A. and O. Blanchard, 1983, "An Intertemporal Model of Saving and Investment," *Econometrica*, 51:675-92.

Arrow, K., 1974, *Essays in the Theory of Risk-Bearing*, Amsterdam: North-Holland.

Baily, M., 1978, "Some Aspects of Optimal Unemployment Insurance," *Journal of Public Economics*, 10:379-402.

Barsky, R., Mankiw, N. and S. Zeldes, 1986, "Ricardian Consumers with Keynesian Propensities," *American Economic Review*, 76:676-91.

Beenstock, M. and V. Brasse, 1986, *Insurance for Unemployment*, London: Allen & Unwin Ltd.

Caballero, R., 1990, "Consumption Puzzles and Precautionary Savings," *Journal of Monetary Economics*, 25:113-36.

Caballero, R., 1991, "Earnings Uncertainty and Aggregate Wealth Accumulation," *American Economic Review*, 81:859-71.

Carroll, C. and A. Samwick, 1992, "How Important Is Precautionary Saving?" mimeo (December), Federal Reserve Board.

Carroll, C. and A. Samwick, 1992, "The Nature and Magnitude of Precautionary Wealth," *Economic Activity Section Working Paper Series No. 124*, Board of Governors of the Federal Reserve System.

Chapin, G., 1971, "Unemployment Insurance, Job Search and the Demand for Leisure, *Western Economic Journal*, 9:102-06.

Dardanoni, V., 1988, "Optimal Choices Under Uncertainty: The Case of Two-Argument Utility Functions," *The Economic Journal*, 98:429-50.

Dynan, K., 1991, "How Prudent are Consumers?" mimeo (October), Harvard University.

Ehrenberg, R. and R. Oaxaca, 1976, "Unemployment Insurance: Duration of Unemployment and Subsequent Wage Gain," *American Economic Review*, 66:754-66.

Farmer, R., 1990, "RINCE Preferences," *Quarterly Journal of Economics*, 105:43-60.

Feldstein, M., 1974, "Unemployment Compensation: Adverse Incentives and Distributional Anomalies," *National Tax Journal*, 27:231-44.

Feldstein, M., 1975, "The Importance of Temporary Layoffs: An Empirical Analysis," *Brookings Papers on Economic Activity*, 3:725-45.

Flemming, J., 1978, "Some Aspects of Optimal Unemployment Insurance: Search, Leisure, Savings and Capital Market Imperfections," *Journal of Public Economics*, 10:403-25.

Hall, R. and F. Mishkin, 1982, "The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Households," *Econometrica*, 50:461-81.

Hansen, W. and J. Byers, eds., 1990, *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press.

Johnsen, T. and J. Donaldson, 1985, "The Structure of Intertemporal Preferences Under Uncertainty and Time-Consistent Plans," *Econometrica*, 53:1451-58.

Kimball, M., 1990, "Precautionary Saving in the Small and in the Large," *Econometrica*, 58:53-73.

Kreps, D. and E. Porteus, 1979, "Temporal von Neumann-Morgenstern and Induced Preferences," *Journal of Economic Theory*, 20:81-109.

Leland, H., 1968, "Saving and Uncertainty: The Precautionary Demand for Saving," *Quarterly Journal of Economics*, 82:153-63.

Levhari, D. and T. Srinivasan, "Optimal Savings Under Uncertainty," *Review of Economic Studies*, 36:153-63.

Machina, M., 1984, "Temporal Risk and the Nature of Induced Preferences," *Journal of Economic Theory*, 33:199-231.

MaCurdy, T., 1982, "The Use of Time Series Processes to Model the Error Structure of Earnings in a Longitudinal Data Analysis," *Journal of Econometrics*, 18:83-114.

McLaughlin, E., Millar, J. and K. Cooke, 1989, *Work and Welfare Benefits*, Brookfield, VT: Gower Publishing Co.

Merton, R., 1969, "Lifetime Portfolio Selection Under Uncertainty: The Continuous-Time Case," *The Review of Economics and Statistics*, 51:247-57.

Pratt, J., 1964, "Risk Aversion in the Small and in the Large," *Econometrica*, 32:122-36.

Reubens, B., 1990, "Unemployment Insurance in Western Europe: Responses to High Unemployment, 1973-1983," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 173-206.

Rubin, M., 1990, "Federal-State Relations in Unemployment Insurance," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 207-43.

Selden, L., 1978, "A New Representation of Preferences of 'Certain x Uncertain' Consumption Pairs: The 'Ordinal Certainty Equivalent' Hypothesis," *Econometrica*, 46:1045-60.

Selden, L., 1979, "An OCE Analysis of the Effect of Uncertainty on Saving Under Risk Independence," *Review of Economic Studies*, 45:73-82.

Skinner, J., 1988, "Risky Income, Life Cycle Consumption, and Precautionary Savings," *Journal of Monetary Economics*, 22:237-255.

Summers, L. and C. Carroll, 1987, "Why is U.S. National Saving So Low?" *Brookings Papers on Economic Activity*, 2:607-35.

Topel, R., 1990, "Financing Unemployment Insurance: History, Incentives, and Reform," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 108-35.

Vroman, W., 1990, *Unemployment Insurance Trust Fund Adequacy in the 1990s*, Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

Weil, P., 1990, "Nonexpected Utility in Macroeconomics," *Quarterly Journal of Economics*, 105:29-42.

Zeldes, S., 1989, "Optimal Consumption with Stochastic Income: Deviations from Certainty Equivalence," *Quarterly Journal of Economics*, 104:275-98.

CHAPTER II: PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE IN A MODEL WITH FUNCTIONING CREDIT MARKETS

CHAPTER II

PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE IN A MODEL WITH FUNCTIONING CREDIT MARKETS

1. Introduction

This chapter extends the model of precautionary saving and unemployment insurance developed in chapter one by incorporating a functioning credit market into the economy. Previous work in the area of precautionary saving, including chapter one of this work, assumes that credit markets are closed, meaning the only avenue open to agents who desire to shift resources from one period to another is through some form of saving.

The opening of credit markets provides another avenue for agents to transfer wealth between periods. In particular, in the models of this chapter, the unemployed can borrow against future income in order to smooth their consumption path. Some might argue that those who are unemployed would have great difficulty borrowing against anticipated future income. However, there are many examples of this phenomenon in the world.[1]

This chapter examines three models of precautionary saving in an economy in which agents both can store and can borrow or lend as a way to transfer resources from one period to the next: a model with no unemployment insurance plan, a forced-saving plan with characteristics similar to the unemployment insurance system found in the United States, and a pay-as-you-go plan which has similarities to unemployment insurance plans throughout the rest of the world.

Two main ideas come out of this work. The first is that when the rate of interest in the loan market is equal to the rate of return to

[1]Consider, for example, the case of a graduate student who, upon learning that he or she has a new job lined up after completion of the Ph.D., purchases a new car with the expectation that future income will suffice to make the payments. This is certainly a case in which borrowing by an unemployed individual is used to smooth consumption.

storage in the economy, aggregate precautionary saving in each of the models with functioning credit markets is identical to aggregate precautionary saving in the models without functioning credit markets--only the portfolio of saving instruments changes. When loan markets open up, agents who would be limited to storing in a model without credit markets are able to lend and therefore divide their saving between lending and storage.

The second main idea to come out of this chapter is that the addition of a forced-saving unemployment insurance plan, while directly financed by the agents who are covered by the plan and who might benefit from the plan, costs those agents who are not covered by the plan in the form of higher interest rates in the economy. In a sense, public borrowing under the guise of an unemployment insurance system "crowds out" private borrowing, making it more expensive for those agents not covered under the plan, the borrowers in the model, to smooth consumption. In addition, this increase in the interest rate in the loan market further aids those covered by the forced-saving plan since they are the lenders in the model and receive a higher return to their lending.

This chapter is arranged as follows. Section two describes the basic model without an unemployment insurance plan but with the functioning credit market extension. In section three I introduce the forced-saving unemployment insurance scheme into the model and examine the problem of deriving the optimal unemployment insurance tax in this framework. I describe the pay-as-you-go unemployment insurance plan and solve for the optimal unemployment insurance taxes in section four. Section five examines the reactions of precautionary saving in the models presented to changes in the parameters. The final section concludes the chapter.

2. The Extended Model Without Unemployment Insurance

The model in this chapter is similar to the model presented in chapter one except that in the economy presented in this chapter credit markets are open, providing an additional method (besides storage) for agents to shift resources from one period to another. This open credit market (OCM) economy is a finite-horizon (two-period) economy populated by N two-period lived agents. In any period i, where i=1,2, pN agents receive a high endowment, e_{iE}, at the beginning of the period, where p, assumed to be constant across periods, is the probability of receiving the high endowment. The remaining (1-p)N agents receive a low endowment, e_{iU}, at the beginning of period i. All agents receive utility from consumption in each period of their lives. An agent maximizes expected, discounted life-time utility with complete knowledge of her first-period endowment but without knowing her second-period endowment. An agent with a high first-period endowment, in other words one who begins life "employed," solves the following problem:

$$\max_{C} E_1 \sum_{i=1}^{2} \delta^{i-1} U_{i,j}(c_{i,j}) \tag{1}$$

subject to

$$\begin{aligned}
&\text{Period 1:} \quad && e_{1E} = c_{1E} + s_{1E} + l_{1E} \\
&\text{Period 2:} \quad && e_{2E} + r_1 s_{1E} + x_1 l_{1E} = c_{2E} \\
& && e_{2U} + r_1 s_{1E} + x_1 l_{1E} = c_{2U} \\
& && c_{1E},\ c_{2E},\ c_{2U},\ s_{1E} \geq 0
\end{aligned} \tag{2}$$

where j=E,U for high endowment (employed) or low endowment (unemployed), respectively, E_1 is the first-period expectations operator, $\delta \epsilon [0,1]$ is the subjective discount rate, c_{2E} is the second-period consumption level of an agent who receives a high second-period endowment while c_{2U} is the second-period consumption level for an agent who receives a low second-period endowment, s_{1E} is the amount stored by a high-endowment agent in the first period, r_1 is the gross technological rate of return on storage, x_1 is the gross interest rate paid by borrowers to lenders for the privilege of borrowing, and l_{1E} is the amount the agent lends or borrows in period one. An agent with a low first-period endowment, an agent who begins life "unemployed," solves a very similar problem, maximizing (1) subject to

$$\text{Period 1:} \quad e_{1U} = c_{1U} + s_{1U} + l_{1U}$$

$$\text{Period 2:} \quad \begin{array}{l} e_{2E} + r_1 s_{1U} + x_1 l_{1U} = c_{2E} \\ e_{2U} + r_1 s_{1U} + x_1 l_{1U} = c_{2U} \\ c_{1U},\ c_{2E},\ c_{2U},\ s_{1U} \geq 0 \end{array} \tag{3}$$

where s_{1U} represents the first-period storage of an unemployed agent, where l_{1U} represents the borrowing or lending of the unemployed agent in the first period, and where the other variables are as defined above.

The credit market operates through a "bank" which facilitates all lending and borrowing transactions at no cost to the individual agents[2]. An agent who borrows l_{1j} in period one, j=E,U, repays the bank either $x_1 l_{1j}$ or all of her second-period assets (endowment plus any savings), whichever is smaller. An agent who lends l_{1j} to the bank in period one receives $x_1 l_{1j}$ in period two as payment for the use of her funds. It is assumed that agents do not default on loans, meaning $x_1 l_{1j} < e_{2U}$[3].

In addition to borrowing or lending, agents are able to take advantage of the simple storage technology present in the economy to transfer resources across periods. An agent who stores s_{1j} in period one, j=E,U, receives $r_1 f(s_{1j})$ in period two, where, for simplicity, it is assumed that $f(s_{1j}) = s_{1j}$. As in chapter one, the use of a storage technology, rather than a production technology with capital and labor, allows for a sharper focus on the interaction of precautionary saving, unemployment insurance, and lending and borrowing in the model.

Since an agent whose preferences are represented by a utility function exhibiting constant absolute risk aversion (CARA) will engage in precautionary saving behavior, the CARA functional form given by

$$U_{i,j}(c_{i,j}) = \frac{-1}{\gamma} e^{-\gamma c_{i,j}} , \tag{4}$$

is used throughout the chapter. As detailed in chapter one, the exponential utility function is widely used in the precautionary saving

---

[2] The bank does not earn a profit and serves only to costlessly match borrowers with lenders. All monies paid back to the bank in period two by borrowers is disbursed in period two to those agents who were lenders in period one.

[3] The specific condition will be given for each of the cases as they are presented.

literature and allows for a closed-form solution to the agent's problem, which is important to this analysis.

The Agent's Problem

An agent who receives a high endowment in the first period of life solves the following problem[4], in which the equations of (2) have been substituted into (4)

$$\max_{s_{1E},\, l_{1E}} \frac{-1}{\gamma} e^{-\gamma(e_{1E}-s_{1E}-l_{1E})} - \frac{\delta p}{\gamma} e^{-\gamma(e_{2E}+r_1 s_{1E}+x_1 l_{1E})} - \frac{\delta(1-p)}{\gamma} e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E})} \tag{5}$$

subject to the restriction $s_{1E} \geq 0$. The maximization problem yields the following first-order conditions:

$$-e^{-\gamma(e_{1E}-s_{1E}-l_{1E})} + \delta p r_1 e^{-\gamma(e_{2E}+r_1 s_{1E}+x_1 l_{1E})} + \delta(1-p) r_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E})} \leq 0, \quad =0 \text{ if } s_{1E}>0 \tag{6a}$$

$$-e^{-\gamma(e_{1E}-s_{1E}-l_{1E})} + \delta p x_1 e^{-\gamma(e_{2E}+r_1 s_{1E}+x_1 l_{1E})} + \delta(1-p) x_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E})} = 0 \tag{6b}$$

where (6a) is the Kuhn-Tucker condition obtained from the partial differentiation of (5) with respect to s_{1E} and (6b) is the partial derivative of (5) with respect to l_{1E}.[5] Similar first-order conditions exist for the agent initially unemployed, with the variables s_{1E}, l_{1E}, and e_{1E} of (6a and 6b) replaced by s_{1U}, l_{1U}, and e_{1U}, respectively. Taken together, (6a) and (6b) indicate that $r_1 \leq x_1$, meaning that two cases must be considered in determining possible agent behavior.

Case 1: $r_1 < x_1$

If the rate of return to storage is less than the interest rate paid for lending, an agent faced with a choice between lending or storing will elect to store nothing. This can be seen by examining (6a). For $r_1 < x_1$, the expression in (6a) is strictly less than zero, meaning that it must be the case that $s_{1E}=0$. Similarly, for the agent unemployed in the first

---

[4] An agent "unemployed" in the first period solves a similar problem, maximizing (4) with respect to the constraints given in (3).

[5] Appendix 2A contains a proof showing that the second-order conditions for maximization hold.

period, $r_1 < x_1$ implies that $s_{1U}=0$[6]. Thus, if r_1 is less than x_1, agents will transfer wealth between periods only by borrowing or lending.

Given $r_1 < x_1$, the employed agent's choice of l_{1E} can be determined from the following, which is (6b) with $s_{1E}=0$:

$$-e^{-\gamma(e_{1E}-l_{1E})}+\delta p x_1 e^{-\gamma(e_{2E}+x_1 l_{1E})}+\delta(1-p)x_1 e^{-\gamma(e_{2U}+x_1 l_{1E})} = 0 . \tag{7}$$

Equation (7) is the familiar condition which indicates that an agent's utility is maximized where her marginal rate of substitution (MRS) is equal to the marginal rate of transformation (MRT) she faces in the economy. The agent's MRS is equal to the ratio of her marginal utility from first period consumption to the linear combination of her possible marginal utilities from potential consumption in the second period. The MRT in the economy is δx_1, the subjective discount rate times the interest rate on borrowing and lending. Equation (7) can be solved explicitly for the level of l_{1E} under uncertainty:

$$l_{1E} = \frac{1}{\gamma(1+x_1)}\left[\ln(\delta x_1)+\gamma e_{1E}+\ln(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})\right] . \tag{8}$$

For agents unemployed in period one, a similar expression for l_{1U} under uncertainty is obtained:

$$l_{1U} = \frac{1}{\gamma(1+x_1)}\left[\ln(\delta x_1)+\gamma e_{1U}+\ln(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})\right] . \tag{9}$$

In equilibrium, the loan market must clear, which in this model means that $pNl_{1E}+(1-p)Nl_{1U}=0$. The amount lent (or borrowed) by those agents who are employed in period one, pNl_{1E}, must equal the amount borrowed (or lent) by the agents who are unemployed in period one, i.e. $(1-p)Nl_{1U}$. Substituting the right-hand sides of (8) and (9) into the loan market clearing condition for l_{1E} and l_{1U}, respectively, and solving for x_1 yields the following market clearing interest rate

$$x_1^* = \frac{e^{-\gamma(pe_{1E}+(1-p)e_{1U})}}{\delta(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})} . \tag{10}$$

---

[6]The agent unemployed in the first period would actually like to "borrow" through "negative" storage ($s_{1U} < 0$) because her payback in period two would be lower, but storage is constrained to be non-negative.

Using this market clearing interest rate in (8) and (9) and simplifying yields the equilibrium values for l_{1E} and l_{1U} given below:

$$l_{1E}^{*} = \frac{1-p}{1+x_1^{*}}[e_{1E}-e_{1U}] \tag{11}$$

and

$$l_{1U}^{*} = \frac{p}{1+x_1^{*}}[e_{1U}-e_{1E}] \ . \tag{12}$$

l_{1E}^{*} represents lending (saving) by the employed agent in the first period, when second-period income is uncertain, since the expression in (11) is clearly greater than zero ($x_1^{*}>0$), while l_{1U}^{*} is the amount borrowed (dissaved) in equilibrium by an agent unemployed in the first period and facing uncertain second-period income. To prevent the possibility of default by agents borrowing in the first period, it is assumed that the following condition holds

$$e_{1E} < e_{1U} + \frac{1+x_1^{*}}{px_1^{*}}e_{2U} \ . \tag{13}$$

It is easily seen that there exist parameter values for which this condition is satisfied.

Throughout the chapter, certainty means that an agent knows with probability one that her income in the second period will be the expected value of her random second-period endowments. In the model without an unemployment insurance scheme, the expected value of second-period income is $pe_{2E}+(1-p)e_{2U}$. Under certainty, therefore, the level of l_{1E} chosen by an employed agent in the first period is

$$l_{1E}^{c} = \frac{1}{\gamma(1+x_1)}[\ln(\delta x_1)+\gamma e_{1E}-\gamma(pe_{2E}+(1-p)e_{2U})] \ . \tag{14}$$

Similarly, under certainty an agent unemployed in the first period chooses l_{1U} such that

$$l_{1U}^{c} = \frac{1}{\gamma(1+x_1)}[\ln(\delta x_1)+\gamma e_{1U}-\gamma(pe_{2E}+(1-p)e_{2U})] \ . \tag{15}$$

Loan market clearing again requires that $pNl_{1E}+(1-p)Nl_{1U}=0$. Substituting into this expression for l_{1E} and l_{1U} from (14) and (15), respectively, and solving the resulting expression for x_1 gives the following market clearing interest rate in the certain second-period income case

$$x_1^{*c} = \frac{e^{-\gamma(p(e_{1E}-e_{2E})+(1-p)(e_{1U}-e_{2U}))}}{\delta} . \tag{16}$$

The equilibrium expressions for lending and borrowing in the certainty case are found by substituting x_1^{*c} into (14) and (15) to obtain

$$l_{1E}^{*c} = \frac{1-p}{1+x_1^{*c}}[e_{1E}-e_{1U}] \tag{17}$$

and

$$l_{1U}^{*c} = \frac{p}{1+x_1^{*c}}[e_{1U}-e_{1E}] . \tag{18}$$

Again, to guarantee that borrowers do not default on the loans they incurred in period one, the following condition is assumed to hold

$$e_{1E} < e_{1U} + \frac{1+x_1^{*c}}{px_1^{*c}}e_{2U} . \tag{19}$$

In equilibrium, the interest rate in the loan market is greater when the agents face certain second-period income than when they face uncertainty about the endowment they will receive in period two. For lenders this means that in equilibrium they lend (save) more when faced with uncertain second-period incomes than when they know with certainty what their second-period incomes will be. In equilibrium, borrowers take out larger loans in an uncertain world than in a certain one.

Precautionary saving in the model with no unemployment insurance scheme in the case where $r_1 < x_1$ for those agents who are employed in the first period is given by the difference between (14) and (17)

$$PS_E^{NO\ UI} = (1-p)[e_{1E}-e_{1U}]\left(\frac{1}{1+x_1^*} - \frac{1}{1+x_1^{*c}}\right) \tag{20}$$

which is clearly greater than zero given that the certain interest rate is greater than the interest rate in the uncertain income case.

A calculation similar to that given in (20) does not make sense for those agents unemployed in period one who borrow against future income to augment first period consumption for how does one "dissave" as a precaution against future uncertainty? Borrowing in period one represents dissaving by agents unemployed in the first period of the model both in the certain and in the uncertain scenarios. While circumstances may cause agents to elect to draw upon savings that had been accumulated as a precaution against uncertainty, agents do not make a decision to dissave as a precaution against future uncertainty. Such a situation would be analogous to buying "uninsurance" as a safeguard against future catastrophe, a concept which is nonsensical.

Given that agents employed in the first period are the only ones engaging in precautionary saving behavior in a model with no unemployment insurance scheme and in which $r_1<x_1$, aggregate precautionary saving is given by

$$PS_1^{NO\ UI} = pN(1-p)[e_{1E}-e_{1U}]\left(\frac{1}{1+x_1^*}-\frac{1}{1+x_1^{*c}}\right) . \tag{21}$$

A comparison of this result with the results from the analysis of the two different unemployment insurance schemes considered, a forced-saving plan and a pay-as-you-go plan, will be presented in section five.

Case 2: $r_1=x_1$

In this case, the agent employed in the first period is indifferent between saving in the form of storage and saving in the form of lending to the bank since her return on saving is the same with either method. The unemployed agent, however, cannot engage in "negative storage," so she is forced to borrow from the bank if she desires to shift resources across periods.

The l_{1U} which maximizes the utility of the agent unemployed in the first period when $r_1=x_1$ and when the agent faces uncertain second-period income is given by

$$l_{1U} = \frac{1}{\gamma(1+r_1)}\left[\ln(\delta r_1)+\gamma e_{1U}+\ln(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})\right] \tag{22}$$

which is identical to the expression for l_{1U} given by (9) except for the fact that r_1 has replaced x_1. The unemployed in the first period have borrowing as their only avenue to smooth consumption across periods. To ensure that borrowers do not default on their loans in this case, the following is assumed

$$e_{2E} < e_{2U} - \frac{1}{\gamma}\ln\left[\frac{p-1}{p} + \frac{e^{-\gamma(e_{1U}+r_1^{-1}e_{2U})}}{p\delta r_1}\right] . \qquad (23)$$

This is a simplification of the "cannot borrow more than the minimum possible second-period endowment" condition used earlier in the borrowing and lending only case. There are many parameter values for which the term in brackets is a small fraction, meaning the second term on the right-hand side of the inequality is positive for many values of the parameters and therefore that the overall condition can be satisfied without violating the requirement that $e_{2E}>e_{2U}$.

In equilibrium, the loan market must clear which again implies that lending must equal borrowing in the aggregate, i.e. that $pNl_{1E}+(1-p)Nl_{1U}=0$. Substituting into this market clearing condition the expression for l_{1U} given in (22) and solving for l_{1E} gives the following expression for lending by an agent employed in period one

$$l_{1E} = \frac{-(1-p)}{p\gamma(1+r_1)}\left[\ln(\delta r_1)+\gamma e_{1U}+\ln(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})\right] \qquad (24)$$

which is greater than zero given that the expression in brackets is negative.

In the case of $r_1=x_1$, an employed agent facing second-period income uncertainty chooses a combination of storage and lending such that the first order condition (6a) holds with equality. Together, storage and lending must satisfy the condition (from (6a)) that

$$s_{1E}+l_{1E} = \frac{1}{\gamma(1+r_1)}\left[\ln(\delta r_1)+\gamma e_{1E}+\ln(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}})\right] . \qquad (25)$$

Given (24) and (25), storage by the employed agent in the first period is

$$s_{1E} = \frac{1}{p\gamma(1+r_1)}[\ln(\delta r_1\xi)+p\gamma e_{1E}+(1-p)\gamma e_{1U}] \qquad (26)$$

where

$$\xi = pe_{2E}+(1-p)e_{2U} .$$

Notice that total saving by the employed agent when faced with second period income uncertainty is given by (25) since saving is the combination of the amount stored by the agent and the amount the agent lends. This expression is identical to the expression for storage in the model of chapter one where the agent did not have the opportunity to lend. For the employed agent, opening the credit market simply alters the distribution of her portfolio of saving instruments.

With certain second-period income of the form given in the borrowing and lending only case earlier in this section, an agent unemployed in the first period maximizes utility by borrowing so that

$$l_{1U}^{c} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1)+\gamma e_{1U}-\gamma(pe_{2E}+(1-p)e_{2U})]\ . \tag{27}$$

This identical to the agent's choice when $r_1<x_1$ except for the replacement of the interest rate on borrowing and lending with the rate of return to storage due to the arbitrage condition $r_1=x_1$. It represents borrowing by the unemployed agent since the term in brackets is negative for reasonable parameter values. Substituting the expression for l_{1U} given in (27) into the loan market clearing condition and solving for l_{1E} yields

$$l_{1E}^{c} = \frac{-(1-p)}{p\gamma(1+r_1)}[\ln(\delta r_1)+\gamma e_{1U}-\gamma(pe_{2E}+(1-p)e_{2U})] \tag{28}$$

which is the equilibrium expression for lending by an employed agent in period one.

Since $r_1=x_1$, an employed agent is indifferent between lending and storage as a means of saving and chooses the combination of storage and lending such that

$$s_{1E}^{c}+l_{1E}^{c} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1)+\gamma e_{1E}-\gamma(pe_{2E}+(1-p)e_{2U})] \tag{29}$$

which means that the employed agent, when facing income certainty in period two, chooses storage in the first period such that

$$s_{1E}^{c} = \frac{1}{p\gamma(1+r_1)}[\ln(\delta r_1)+p\gamma(e_{1E}-e_{2E})+\gamma(1-p)(e_{1U}-e_{2U})]\ . \tag{30}$$

Again it is important to note that total saving by an employed agent with certain second-period income in this case is given by (29).

Precautionary saving in the $r_1=x_1$ case by an employed agent is the difference between saving under uncertainty given by (25) and saving under certainty as given by (29):

$$PS_E^{NO\ UI} = \frac{1}{\gamma(1+r_1)}[\ln\xi + \gamma(pe_{2E} + (1-p)e_{2U})] \cdot \qquad (31)$$

This is identical to the precautionary saving choice by an employed agent in the model without open credit markets. While an employed agent in the model in this chapter may have a different selection of saving instruments in her savings portfolio, she chooses a mixture of those savings instruments such that her level of precautionary saving is identical to that of the agent who has only storage as a means of saving as in the models presented in chapter one.

For the same reasons given earlier in this section, dissaving in the form of borrowing by the unemployed in period one cannot generate precautionary saving behavior. So although dissaving by agents unemployed in period one decreases aggregate saving in the model, it has no effect on aggregate precautionary saving in the model. Therefore, aggregate precautionary saving when $r_1=x_1$ in this model is given by

$$PS_{s,1}^{NO\ UI} = \frac{pN}{\gamma(1+r_1)}[\ln\xi + \gamma(pe_{2E} + (1-p)e_{2U})] \qquad (32)$$

A comparison of this result with those from the unemployment insurance models is contained in section five.

3. The Forced-Saving Unemployment Insurance OCM Model

This section introduces into the OCM model the forced-saving unemployment insurance scheme presented in chapter one in which employed agents pay into a fund and are required to have been employed in period one to qualify for unemployment insurance benefits in period two. Since this unemployment insurance scheme was thoroughly discussed in chapter one, this section will be limited to presenting it in the context of a model with a functioning credit market.

In the first period, the endowments of employed agents are taxed at rate $t_1 \epsilon [0,1]$. Given that there are pN employed agents in the economy in period one each receiving the high endowment of e_{1E}, the total tax revenue generated for the unemployment insurance fund is pNt_1e_{1E}. This tax revenue is placed in a trust fund held by a "government" whose sole function is to collect, hold, and disburse the UI tax revenue. It is assumed that the government has access only to the storage technology available to individual agents, meaning monies in the fund earn a gross rate of return r_1. Government trust funds, such as the unemployment insurance trust fund, are often prohibited from investing in high rate of return, riskier assets. The restriction in this model that the government is limited to earning only the rate of return to storage captures this effect. During period two, therefore, $pNr_1t_1e_{1E}$ is available for disbursement to the unemployed of the period.[7] Of the pN agents employed in the first period, 1-p will be unemployed in the second. Therefore, p(1-p)N agents will be eligible to receive UI benefits during the second period of their lives, implying a per capita disbursement of $r_1t_1e_{1E}(1-p)^{-1}$ to those who are eligible.

The budget constraints and the choice problem facing agents who are unemployed in period one are identical to those faced by these agents in the model with no unemployment insurance. Since they will have had no "work history," if they are again unemployed in the second period they will not be eligible for unemployment insurance benefits, so for them the forced-saving plan is nonexistent.

An agent employed in period one faces the budget constraints

$$
\begin{aligned}
&\text{Period 1:} \quad && e_{1E}(1-t_1) = c_{1E} + s_{1E} + l_{1E} \\
&\text{Period 2:} \quad && e_{2E} + r_1s_{1E} + x_1l_{1E} = c_{2E} \\
& && e_{2U} + r_1s_{1E} + x_1l_{1E} + r_1t_1e_{1E}(1-p)^{-1} = c_{2U} \\
& && c_{1E},\ c_{2E},\ c_{2U},\ s_{1E} \geq 0
\end{aligned}
\tag{33}
$$

where all variables are as defined above or in section 2. There are only

[7]The rather trivial government budget constraint is that the tax revenues collected in period one multiplied by the gross rate of return on trust fund monies must equal the unemployment insurance disbursement in period two.

two differences between the budget constraints presented in (33) and those presented in (2) in section 2: (1) agents are taxed at the rate t_1 in period one to build the unemployment insurance fund; and (2) if employed in period one but unemployed in period two, the agent receives the unemployment insurance benefit of $r_1 t_1 e_{1E}(1-p)^{-1}$ in addition to the low endowment and whatever savings she may have undertaken in period one.

An agent who is employed in the first period solves the following problem

$$\max_{s_{1E},\, l_{1E}} \frac{-1}{\gamma} e^{-\gamma(e_{1E}(1-t_1)-s_{1E}-l_{1E})} - \frac{\delta p}{\gamma} e^{-\gamma(e_{2E}+r_1 s_{1E}+x_1 l_{1E})} - \frac{\delta(1-p)}{\gamma} e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E}+r_1 t_1 e_{1E}(1-p)^{-1})} \tag{34}$$

in which the constraints from (33) have been substituted into (4). Because of the non-negativity constraint $s_{1E} \geq 0$, the first-order conditions for the above maximization problem are the Kuhn-Tucker conditions

$$-e^{-\gamma(e_{1E}(1-t_1)-s_{1E}-l_{1E})} + \delta p r_1 e^{-\gamma(e_{2E}+r_1 s_{1E}+x_1 l_{1E})} + \delta(1-p) r_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E}+r_1 t_1 e_{1E}(1-p)^{-1})} \leq 0, \quad =0 \text{ if } s_{1E} > 0 \tag{35a}$$

and

$$-e^{-\gamma(e_{1E}(1-t_1)-s_{1E}-l_{1E})} + \delta p x_1 e^{-\gamma(e_{2E}+r_1 s_{1E}+x_1 l_{1E})} + \delta(1-p) x_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E}+r_1 t_1 e_{1E}(1-p)^{-1})} = 0 \tag{35b}$$

where (35a) is the Kuhn-Tucker condition obtained from the partial differentiation of (34) with respect to s_{1E} and (35b) is the partial derivative of (34) with respect to l_{1E}.[8] As in the model with no unemployment insurance, (35a) and (35b) imply that $r_1 \leq x_1$ so that it is again necessary to consider two possible cases.

Case 1: $r_1 < x_1$

If the rate of return to storage is less than the borrowing and lending interest rate, the left-hand side of (35a) will be strictly less than zero, which means that $s_{1E}=0$ is necessary to satisfy the Kuhn-Tucker conditions for maximization. Since the employed agent does not engage in

---

[8] Appendix 2A contains a proof showing that the second-order conditions for maximization hold.

storage, (35b) becomes

$$-e^{-\gamma(e_{1E}(1-t_1)-l_{1E})}+\delta p x_1 e^{-\gamma(e_{2E}+x_1 l_{1E})}+\delta(1-p)x_1 e^{-\gamma(e_{2U}+x_1 l_{1E}+r_1 t_1 e_{1E}(1-p)^{-1})}=0 \tag{36}$$

which can be solved explicitly for the employed agent's choice of l_{1E} when second-period income is uncertain:

$$l_{1E}=\frac{1}{\gamma(1+x_1)}[\ln(\delta x_1)+\gamma e_{1E}(1-t_1)+\ln\Psi] \tag{37}$$

where

$$\Psi = pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma(e_{2U}+r_1 t_1 e_{1E}(1-p)^{-1})} \; .$$

As in the model with no unemployment insurance, loan market clearing requires that in the aggregate the amount lenders lend be equal to the amount the borrowers borrow, or that $pNl_{1E}+(1-p)Nl_{1U}=0$. Substituting (37) in for l_{1E} and (9) from section two in for l_{1U} into the loan market clearing condition and solving for x_1 yields an equilibrium interest rate of

$$x_1^{*}=\frac{1}{\delta}e^{-p(\ln\Psi+\gamma e_{1E}(1-t_1))-(1-p)(\ln\xi+\gamma e_{1U})} \tag{38}$$

where

$$\xi = pe_{2E}+(1-p)e_{2U}$$

as defined in section two and where the other variables are as defined above. Substituting x_1^{*} into (37) and (9) yields the equilibrium values for l_{1E} and l_{1U}, respectively, when period two income is uncertain:

$$l_{1E}^{*}=\frac{1-p}{\gamma(1+x_1^{*})}[\ln\Psi-\ln\xi-\gamma e_{1U}+\gamma e_{1E}(1-t_1)] \tag{39}$$

and

$$l_{1U}^{*}=\frac{p}{\gamma(1+x_1^{*})}[-\ln\Psi+\ln\xi+\gamma e_{1U}-\gamma e_{1E}(1-t_1)] \; . \tag{40}$$

Manipulation of the expressions for l_{1E}^{*} and l_{1U}^{*} reveals that a sufficient condition for the employed agents of period one to be lenders and the unemployed agents of period one to be borrowers is

$$t_1 \le \frac{(1-p)(e_{1E}-e_{1U})}{e_{1E}(1-p+r_1)} \; . \tag{41}$$

The condition on t_1 in (41) is assumed to hold and will be further explored later in this section when optimal tax rates are discussed. In order to abstract from problems which may arise if borrowers were permitted to default on the loans they take out, the following is presumed to be true:

$$e_{1E} \leq \frac{e_{1U}}{1-t_1} + \frac{(1+x_1^*)e_{2U}}{px_1^*(1-t_1)} - \frac{1}{\gamma(1-t_1)}\ln\left(\frac{\Psi}{\xi}\right) . \tag{42}$$

Since the terms multiplying both e_{1U} and e_{2U} are greater than one and since the final term on the right-hand side of the inequality is positive for any tax rate greater than zero, there are many possible parameter values for which this inequality holds without violating any assumptions about the relative sizes of the employed and the unemployed endowments.

Under certainty in this model, an unemployed agent behaves in exactly the same manner as she did in the model without unemployment insurance when choosing l_{1U}, given by (15). For an employed agent, the expected value of second-period income is $pe_{2E}+(1-p)(e_{2U}+(1-p)^{-1}r_1t_1e_{1E})$. Given this definition of certain period two income, the employed agent in period one chooses l_{1E} so that

$$l_{1E}^c = \frac{1}{\gamma(1+x_1)}[\ln(\delta x_1)+\gamma e_{1E}(1-t_1(1+r_1))-\gamma(pe_{2E}+(1-p)e_{2U})] . \tag{43}$$

Substituting the expressions for l_{1E} and l_{1U} from (43) and (15) into the loan market clearing condition and solving for x_1 yields the market clearing interest rate under certainty

$$x_1^{*c} = \frac{e^{-\gamma(p(e_{1E}(1-t_1-t_1r_1)-e_{2E})+(1-p)(e_{1U}-e_{2U}))}}{\delta} . \tag{44}$$

Using the market clearing interest rate from (44) in (43) and (15) yields the equilibrium values for l_{1E} and l_{1U}

$$l_{1E}^{*c} = \frac{1-p}{1+x_1^{*c}}[e_{1E}(1-t_1-t_1r_1)-e_{1U}] \tag{45}$$

and

$$l_{1U}^{*c} = \frac{p}{1+x_1^{*c}}[e_{1U}-e_{1E}(1-t_1-t_1r_1)] . \tag{46}$$

The same condition on t_1 sufficient for the employed in period one to be lenders when second-period income is uncertain, (41), is also sufficient to guarantee that the employed agents in period one will be lenders when second-period income is certain. The following condition will ensure that borrowers do not default on their loans

$$e_{1E}(1-t_1-t_1r_1) < e_{1U} + \frac{1+x_1^{*c}}{px_1^{*c}}e_{2U} \ . \tag{47}$$

Precautionary saving undertaken by an employed agent in the forced-saving model when $r_1<x_1$ is the difference between lending under uncertainty, (39), and lending under certainty, (45), given by

$$PS_E^F = \frac{1-p}{\gamma(1+x_1^*)}[\ln\Psi - \ln\xi - \gamma e_{1U} + \gamma e_{1E}(1-t_1)] - \frac{1-p}{1+x_1^{*c}}[e_{1E}(1-t_1-t_1r_1)-e_{1U}] \ . \tag{48}$$

Since, as discussed in section two, dissaving by unemployed agents in the form of borrowing cannot generate precautionary savings, aggregate precautionary saving when $r_1<x_1$ in the forced-saving model is

$$PS_I^F = \frac{pN(1-p)}{\gamma(1+x_1^*)}[\ln\Psi - \ln\xi - \gamma e_{1U} + \gamma e_{1E}(1-t_1)] - \frac{pN(1-p)}{1+x_1^{*c}}[e_{1E}(1-t_1-t_1r_1)-e_{1U}] \ . \tag{49}$$

Section five contains comparisons between precautionary saving as given in (49) and precautionary saving found in the other models.

Case 2: $r_1=x_1$

As in the model without unemployment insurance, agents employed in period one are indifferent between lending and storing as means of saving in the forced-saving model when $r_1=x_1$. Unemployed agents, since they cannot engage in negative storage, have only borrowing as a means of transferring wealth across periods. The unemployed agent in the forced-saving model, when facing second-period income uncertainty, solves exactly the same problem as she did in the model without unemployment insurance, meaning that her choice of l_{1U} is given by (22) of section two. As in the model without unemployment insurance, the condition given by (23) guarantees that borrowers in period one will not default on loan paybacks in period two.

Replacing l_{1U} in the loan market clearing condition by the right-hand side of equation (22) and solving for lending by the employed in period one yields

$$l_{1E} = \frac{-(1-p)}{p\gamma(1+r_1)}\left[\ln(\delta r_1)+\gamma e_{1U}+\ln\left(pe^{-\gamma e_{2E}}+(1-p)e^{-\gamma e_{2U}}\right)\right] \tag{50}$$

which is greater than zero given that the bracketed term is less than zero.

The agent employed in the period one chooses a combination of storing and lending such that the first order condition (35a) holds with equality when $r_1 = x_1$. From (35a), the amount the agent stores and the amount she lends must satisfy

$$s_{1E}+l_{1E} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1\Psi)+\gamma e_{1E}(1-t_1)] \,. \tag{51}$$

Subtracting (50) from (51) yields storage by the employed agent in the first period of the forced-saving model when the agent faces second-period income uncertainty:

$$s_{1E} = \frac{1}{p\gamma(1+r_1)}[p(\ln\Psi+\gamma e_{1E}(1-t_1))+\ln(\delta r_1)+(1-p)(\ln\xi+\gamma e_{1U})] \tag{52}$$

where all variables are as previously defined. As in the no insurance model, total saving by the employed agent in this model when $r_1 = x_1$ is given by (51) which represents the sum of storing and lending by the agent. Thus, when $r_1 = x_1$, total saving by the employed agent in the forced-saving model with a functioning credit market is identical to that of the employed agent in the model without a functioning credit market. The opening of credit markets simply allows an employed agent to distribute her saving between storing and lending instead of being constrained to storage only as in the model without credit markets.

An unemployed agent, when faced with certain second-period income of the form given earlier in this section in the borrowing and lending only case, will maximize utility by choosing l_{1U} such that (27) is true. Except for the replacement of x_1 with r_1 due to the arbitrage condition $r_1 = x_1$, the choice of l_{1U} by the agent is identical to her choice in the borrowing and lending only case. Substituting the expression for l_{1U} given by (27) into the loan market clearing condition and solving for l_{1E} gives

$$l_{1E}^{c} = \frac{-(1-p)}{p\gamma(1+r_1)}[\ln(\delta r_1) + \gamma e_{1U} - \gamma(pe_{2E} + (1-p)e_{2U})] , \tag{53}$$

which is the equilibrium expression for lending by an employed agent in period one when income in the second period is certain.

Total saving by the employed agent when $r_1 = x_1$ and when period two income is certain is the combination of storage and lending given by

$$s_{1E}^{c} + l_{1E}^{c} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1) + \gamma e_{1E}(1-t_1-t_1 r_1) - \gamma(pe_{2E} + (1-p)e_{2U})] \tag{54}$$

which means that storage by the employed agent is

$$s_{1E}^{c} = \frac{1}{p\gamma(1+r_1)}[\ln(\delta r_1) + \gamma p(e_{1E}(1-t_1-t_1 r_1) - e_{2E}) + \gamma(1-p)(e_{1U} - e_{2U})] \cdot \tag{55}$$

The difference between total saving under uncertainty, given by (51), and total saving under certainty, given by (54), is precautionary saving by an employed agent in the $r_1 = x_1$ case and is given by

$$PS_{E}^{F} = \frac{1}{\gamma(1+r_1)}[\ln\Psi + \gamma(pe_{2E} + (1-p)e_{2U}) + \gamma r_1 t_1 e_{1E}] \cdot \tag{56}$$

As in the model without unemployment insurance, this expression for precautionary saving by an employed agent is identical to the level of precautionary saving chosen by an agent in the model without a functioning credit market. Thus, although an agent may save with a mixture of storage and lending in this model, she chooses the same level of precautionary saving as she would choose in a storage-only model of chapter one since she faces the same risk in either model.

Aggregate precautionary saving in the $r_1 = x_1$ case of the forced-saving model is composed of the sum of the precautionary saving amounts by employed agents only since borrowing (dissaving) by the unemployed cannot generate precautionary saving behavior. Aggregate precautionary saving in this case is therefore given by

$$PS_{s,1}^{F} = \frac{pN}{\gamma(1+r_1)}[\ln\Psi + \gamma(pe_{2E} + (1-p)e_{2U}) + \gamma r_1 t_1 e_{1E}] \cdot \tag{57}$$

and will be examined more thoroughly in section five.

The Optimal Tax Rate in the Forced-Saving OCM Model

The optimal unemployment insurance tax rate t_1 may be found by maximizing the expected indirect utility of the employed agent with respect to t_1. The expected indirect utility function is formed by substituting into the expected utility function the optimal consumption values determined in the agent's problems from earlier in this section. Indirect utility is then a function of t_1 and parameters and by finding the t_1 which maximizes the employed agent's indirect utility, one can determine the optimal tax rate. Since those who are unemployed in period one are not eligible for unemployment insurance benefits in period two, the only impact they have on determining the optimal tax rate comes through the effect they have on the optimal consumption allocations of the initially employed. The optimal unemployment insurance tax rate when $r_1<x_1$ is different from that when $r_1=x_1$, so the two cases are treated separately below.

Case 1: $r_1<x_1$

The expected indirect utility function for an agent employed in period one is

$$V(t_1) = \frac{-1}{\gamma}e^{-\gamma c^*_{1E}} - \frac{\delta p}{\gamma}e^{-\gamma c^*_{2E}} - \frac{\delta(1-p)}{\gamma}e^{-\gamma c^*_{2U}} \tag{58}$$

where

$$c^*_{1E} = e_{1E}(1-t_1) - \frac{1-p}{\gamma(1+x^*_1)}[\ln\Psi-\ln\xi-\gamma e_{1U}+\gamma e_{1E}(1-t_1)]\,, \tag{59}$$

$$c^*_{2E} = e_{2E} + \frac{x^*_1(1-p)}{\gamma(1+x^*_1)}[\ln\Psi-\ln\xi-\gamma e_{1U}+\gamma e_{1E}(1-t_1)]\,, \tag{60}$$

and

$$c^*_{2U} = e_{2U} + (1-p)^{-1}r_1t_1e_{1E} + \frac{x^*_1(1-p)}{\gamma(1+x^*_1)}[\ln\Psi-\ln\xi-\gamma e_{1U}+\gamma e_{1E}(1-t_1)]\,, \tag{61}$$

with all of the other variables as defined earlier in either this section or in section two. The partial derivative of $V(t_1)$ with respect to t_1 is a very complicated expression which can be simplified to

$$e^{-\gamma c_{1E}^*}\left(\frac{\partial c_{1E}^*}{\partial t_1}\right)+\delta e^{-\gamma c_{2U}^*}\left(r_1 e_{1E}-\frac{e_{1E}(1-p)(1+r_1)x_1^*}{1+x_1^*}\right)$$
$$-\frac{\delta e^{-\gamma c_{2U}^*}e_{1E}(1-p)(1+r_1)pe^{-\beta}\ln\xi}{(1+x_1^*)^2\delta\xi} \tag{62}$$
$$-\frac{\delta e^{-\gamma c_{2U}^*}e_{1E}(1-p)(1+r_1)pe^{-\beta}}{(1+x_1^*)^2\delta\xi}\left[\frac{\gamma(r_1(e_{2E}-e_{1E}+e_{1U})+(1-p)(e_{2E}-e_{2U}))}{r_1}\right]=0$$

where

$$\beta = p\ln\Psi - p\ln\xi + p\gamma e_{1E}(1-t_1) + \gamma e_{1U}(1-p)$$

and where all other variables are as defined earlier. Equation (62) implicitly defines t_1 as there is no closed-form solution for t_1. In the forced-saving model without a functioning loan market, the optimal tax rate, given by

$$t_1^* = \frac{(e_{2E}-e_{2U})(1-p)}{r_1 e_{1E}}\ , \tag{63}$$

is such that $c_{2E}=c_{2U}$ for agents employed in period one. This same tax rate is not a root of equation (62) even though it does equate the second-period consumption of the employed and the unemployed in the forced-saving OCM model when $r_1<x_1$. This suggests that at the optimal tax rate, $c_{2E}\neq c_{2U}$ in the model when agents limit themselves to borrowing and lending only. This result stems from the fact that the equilibrium interest rate in the loan market, x_1^*, changes when the tax rate changes. If the equilibrium interest rate were invariant to changes in t_1, then the tax which equates second-period consumption across states would also maximize the expected indirect utility function.

Case 2: $r_1=x_1$

The indirect utility function for this case assumes the same basic form as in (58), but the optimizing values c_{1E}^*, c_{2E}^*, and c_{2U}^* are different. When $r_1=x_1$, the optimal consumption values become

$$c_{1E}^* = e_{1E}(1-t_1) - \frac{1}{\gamma(1+r_1)}[\ln\Psi+\ln(\delta r_1)+\gamma e_{1E}(1-t_1)]\ , \tag{64}$$

$$c_{2E}^* = e_{2E} + \frac{r_1}{\gamma(1+r_1)}[\ln\Psi+\ln(\delta r_1)+\gamma e_{1E}(1-t_1)]\ , \tag{65}$$

and

$$c^*_{2U} = e_{2U} + \frac{r_1}{\gamma(1+r_1)}[\ln\Psi + \ln(\delta r_1) + \gamma e_{1E}(1-t_1)] + r_1 t_1 e_{1E}(1-p)^{-1} \ . \tag{66}$$

Again taking the partial derivative of (58) with respect to t_1 yields (after some simplification)

$$\frac{e_{1E}}{1+r_1}\left(\frac{r_1 e^{-\gamma(e_{2U}+r_1 t_1 e_{1E}(1-p)^{-1})}}{\Psi}+1\right)\left[e^{-\gamma c^*_{1E}} - \delta p r_1 e^{-\gamma c^*_{2E}} - \delta(1-p) r_1 e^{-\gamma c^*_{2U}}\right] + \delta r_1 e_{1E} e^{-\gamma c^*_{2U}} - e_{1E} e^{-\gamma c^*_{1E}} = 0 \ . \tag{67}$$

It can be shown that the tax rate which solves (67) is that t_1 given in (63), the same optimal tax rate as in the forced-saving model without a functioning credit market and the same tax rate which equates second-period consumption across employment states.[9] This result is not that surprising given the fact that total saving and precautionary saving by an employed agent are identical in the forced-saving models with and without borrowing and lending. An agent demands the same level of unemployment insurance across models which means that the same optimal tax rate maximizes that agent's welfare.

4. The Pay-As-You-Go Unemployment Insurance OCM Model

In this section, the pay-as-you-go unemployment insurance plan first introduced in chapter one is reinvestigated in a model in which agents are allowed to lend or borrow. Unlike the forced-saving model of unemployment insurance, the pay-as-you-go model neither builds a trust fund with unemployment insurance tax revenue nor requires a prior work history to be eligible to receive benefits. Instead, employed agents are taxed in each period of the model and those funds are immediately disbursed to unemployed agents in the same period. Since the pay-as-you-go model was explained in detail in chapter one, this section simply extends the model found in the first chapter by adding a functioning loan market.

The endowments of agents employed in the first or second periods are taxed at the rates t_1 or t_2, respectively, where $t_1, t_2 \epsilon [0,1]$. Given that

---

[9] See Appendix 2C for proof of this result.

w

(

pe

in

speci

there are pN employed agents who are each receiving e_{1E} in period one, the total tax revenue collected for unemployment insurance purposes in period one is pNt_1e_{1E}. Similarly, the total tax revenue generated for unemployment insurance use in period two is pNt_2e_{2E}. The tax revenue is collected by a government whose only function is to gather and disburse the UI tax revenue in each period.[10] In each of the periods, (1-p)N agents will be unemployed and therefore will be eligible to receive UI benefits, meaning there is a per capita disbursement of $p(1-p)^{-1}t_1e_{1E}$ to agents unemployed in the first period and a per capita disbursement of $p(1-p)^{-1}t_2e_{2E}$ to unemployed agents in the second period.

An agent employed in period one maximizes expected utility subject to the following constraints

$$\begin{aligned} &\text{Period 1:} \quad e_{1E}(1-t_1) = c_{1E} + s_{1E} + l_{1E} \\ &\text{Period 2:} \quad e_{2E}(1-t_2) + r_1 s_{1E} + x_1 l_{1E} = c_{2E} \\ &\qquad\qquad\;\; e_{2U} + r_1 s_{1E} + x_1 l_{1E} + p(1-p)^{-1} t_2 e_{2E} = c_{2U} \\ &\qquad\qquad\;\; c_{1E},\ c_{2E},\ c_{2U},\ s_{1E} \geq 0 \end{aligned} \tag{68}$$

where all variables are as defined above or in section two. If an agent is unemployed in period one, she faces the following budget constraints

$$\begin{aligned} &\text{Period 1:} \quad e_{1U} + p(1-p)^{-1} t_1 e_{1E} = c_{1U} + s_{1U} + l_{1U} \\ &\text{Period 2:} \quad e_{2E}(1-t_2) + r_1 s_{1U} + x_1 l_{1U} = c_{2E} \\ &\qquad\qquad\;\; e_{2U} + r_1 s_{1U} + x_1 l_{1U} + p(1-p)^{-1} t_2 e_{2E} = c_{2U} \\ &\qquad\qquad\;\; c_{1U},\ c_{2E},\ c_{2U},\ s_{1U} \geq 0 \end{aligned} \tag{69}$$

when maximizing her utility. The budget constraints given in (68) and (69) are similar to those for the pay-as-you-go model in chapter.

An employed agent in period one who is uncertain about her second-period income in the pay-as-you-go model solves the following problem

$$\max_{s_{1E},\, l_{1E}} \frac{-1}{\gamma} e^{-\gamma(e_{1E}(1-t_1)-s_{1E}-l_{1E})} - \frac{\delta p}{\gamma} e^{-\gamma(e_{2E}(1-t_2)+r_1 s_{1E}+x_1 l_{1E})} - \frac{\delta(1-p)}{\gamma} e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E}+p(1-p)^{-1}t_2 e_{2E})}, \tag{70}$$

in which the constraints from (68) have been substituted into (4), subject

---

[10]Again, the government budget constraint is rather trivial. Tax revenues collected by the government in any specific period must equal unemployment insurance disbursements by the government in that period.

to the non-negativity constraint $s_{1E} \geq 0$. The first-order conditions for the above maximization problem take the form of the following Kuhn-Tucker conditions

$$-e^{-\gamma(e_{1E}(1-t_1)-s_{1E}-l_{1E})}+\delta p r_1 e^{-\gamma(e_{2E}(1-t_2)+r_1 s_{1E}+x_1 l_{1E})} \\ +\delta(1-p) r_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E}+p(1-p)^{-1} t_2 e_{2E})} \leq 0, \quad =0 \text{ if } s_{1E}>0 \tag{71a}$$

$$-e^{-\gamma(e_{1E}(1-t_1)-s_{1E}-l_{1E})}+\delta p x_1 e^{-\gamma(e_{2E}(1-t_2)+r_1 s_{1E}+x_1 l_{1E})} \\ +\delta(1-p) x_1 e^{-\gamma(e_{2U}+r_1 s_{1E}+x_1 l_{1E}+p(1-p)^{-1} t_2 e_{2E})}=0 \tag{71b}$$

where (71a) and (71b) are the partial derivatives of (70) with respect to s_{1E} and l_{1E}, respectively.[11]

An agent unemployed in period one facing uncertain period-two income solves a similar problem, maximizing (where the budget constraints in (69) have been substituted into (4))

$$\max_{s_{1U}, l_{1U}} \frac{-1}{\gamma} e^{-\gamma(e_{1U}+p(1-p)^{-1} t_1 e_{1E}-s_{1U}-l_{1U})}-\frac{\delta p}{\gamma} e^{-\gamma(e_{2E}(1-t_2)+r_1 s_{1U}+x_1 l_{1U})} \\ -\frac{\delta(1-p)}{\gamma} e^{-\gamma(e_{2U}+r_1 s_{1U}+x_1 l_{1U}+p(1-p)^{-1} t_2 e_{2E})}, \tag{72}$$

subject to the non-negativity constraint $s_{1U} \geq 0$. The Kuhn-Tucker conditions for the unemployed agent's problem are

$$-e^{-\gamma(e_{1U}+p(1-p)^{-1} t_1 e_{1E}-s_{1U}-l_{1U})}+\delta p r_1 e^{-\gamma(e_{2E}(1-t_2)+r_1 s_{1U}+x_1 l_{1U})} \\ +\delta(1-p) r_1 e^{-\gamma(e_{2U}+r_1 s_{1U}+x_1 l_{1U}+p(1-p)^{-1} t_2 e_{2E})} \leq 0, \quad =0 \text{ if } s_{1U}>0 \tag{73a}$$

$$-e^{-\gamma(e_{1U}+p(1-p)^{-1} t_1 e_{1E}-s_{1U}-l_{1U})}+\delta p x_1 e^{-\gamma(e_{2E}(1-t_2)+r_1 s_{1U}+x_1 l_{1U})} \\ +\delta(1-p) x_1 e^{-\gamma(e_{2U}+r_1 s_{1U}+x_1 l_{1U}+p(1-p)^{-1} t_2 e_{2E})}=0 \tag{73b}$$

where (73a) and (73b) are the partial derivatives of (72) with respect to s_{1U} and l_{1U}, respectively. As in the previous models in this chapter, (71a) and (71b) and (73a) and (73b) imply that $r_1 \leq x_1$, so that there are two possible cases to consider.

Case 1: $r_1 < x_1$

For the employed agent, when the interest rate for borrowing or lending is greater than the rate of return to storage, the left-hand side

---

[11]Proof that the second-order conditions hold is given in Appendix 2A.

of (71a) will be strictly less than zero which means that $s_{1E}=0$ is required to satisfy the Kuhn-Tucker conditions. Solving equation (71b) for l_{1E} when $s_{1E}=0$ yields

$$l_{1E} = \frac{1}{\gamma(1+x_1)}\left[\ln(\delta x_1) + \gamma e_{1E}(1-t_1) + \ln\Omega\right] \tag{74}$$

where

$$\Omega = pe^{-\gamma e_{2E}(1-t_2)} + (1-p)e^{-\gamma(e_{2U}+t_2 e_{2E} p(1-p)^{-1})}$$

and where the other variables are as defined previously.

Similarly for an agent unemployed in period one, solving (73b) for l_{1U} when $s_{1U}=0$ gives

$$l_{1U} = \frac{1}{\gamma(1+x_1)}\left[\ln(\delta x_1) + \gamma(e_{1U}+p(1-p)^{-1}t_1 e_{1E}) + \ln\Omega\right] \tag{75}$$

with all variables as defined earlier.

Equilibrium in this borrowing and lending only case occurs at an interest rate x_1^* which clears the loan market. Substituting the expressions for l_{1E} and l_{1U} from (74) and (75), respectively, into the loan market clearing condition and solving for x_1 gives the market clearing interest rate

$$x_1^* = \frac{e^{-\gamma(pe_{1E}+(1-p)e_{1U})}}{\delta\Omega}\ . \tag{76}$$

Replacing x_1 in (74) and (75) with x_1^* and simplifying yields equilibrium values for l_{1E} and l_{1U} when agents face uncertain future incomes in the borrowing and lending only case of

$$l_{1E}^* = \frac{1}{1+x_1^*}\left[e_{1E}(1-t_1-p) - (1-p)e_{1U}\right] \tag{77}$$

and

$$l_{1U}^* = \frac{p}{1+x_1^*}\left[-e_{1E}(1-t_1-p)(1-p)^{-1} + e_{1U}\right]\ . \tag{78}$$

Whether the first-period unemployed are borrowers or lenders in this case is determined by the first-period unemployment insurance tax rate t_1, ceteris paribus. If it is the case that

$$t_1 < \frac{(1-p)(e_{1E}-e_{1U})}{e_{1E}} , \tag{79}$$

then the unemployed in period one will be borrowers in the pay-as-you-go model with $r_1 < x_1$. If it is the case that the inequality in (79) is reversed, then the unemployed will be receiving such large unemployment insurance benefit amounts that they will become *lenders* in the first period.[12] Finally, if, instead of an inequality in (79), the right hand side equalled the left hand side, agents would neither borrow nor lend in equilibrium in this model. In order to eliminate the possibility that borrowers default on their loans, one of the following conditions is assumed to hold depending on whether the unemployed or the employed are borrowers

$$e_{1E}(1-t_1-p)(1-p)^{-1} < e_{1U} + \frac{1+x_1^*}{px_1^*}e_{2U} \quad \text{(unemployed)} \tag{80a}$$

$$e_{1E}(1-t_1-p) > e_{1U}(1-p) + \frac{1+x_1^*}{x_1^*}e_{2U} \quad \text{(employed)} . \tag{80b}$$

Certain second-period income for the pay-as-you-go model is defined as $pe_{2E}(1-t_2)+(1-p)(e_{2U}+p(1-p)^{-1}t_2e_{2E})$. Under certainty, an employed agent in the pay-as-you-go model with only borrowing and lending chooses l_{1E} such that

$$l_{1E}^c = \frac{1}{\gamma(1+x_1)}[\ln(\delta x_1)+\gamma e_{1E}(1-t_1)-\gamma(pe_{2E}+(1-p)e_{2U})] . \tag{81}$$

In a similar fashion, an agent unemployed in the first period in this model selects l_{1U} so that

$$l_{1U}^c = \frac{1}{\gamma(1+x_1)}[\ln(\delta x_1)+\gamma(e_{1U}+p(1-p)^{-1}t_1e_{1E})-\gamma(pe_{2E}+(1-p)e_{2U})] \tag{82}$$

when facing certain period-two income.

The equilibrium borrowing and lending only interest rate under certainty in the pay-as-you-go model is

---

[12]For the employed, (79) means they will be lenders in period one. Reversing the inequality in (79) causes the employed in period one to be *borrowers* because so much of their endowment is being taxed away.

$$x_1^{*c} = \frac{e^{-\gamma(p(e_{1E}-e_{2E})+(1-p)(e_{1U}-e_{2U}))}}{\delta} \tag{83}$$

where the expressions for l_{1E}^c and l_{1U}^c from (81) and (82), respectively, have been substituted into the loan market clearing condition, with the resulting equation solved for x_1^c. The equilibrium interest rate in this case is identical to that found in the $r_1<x_1$ case in the model without an unemployment insurance scheme. By replacing x_1^c in (81) and (82) with x_1^{*c}, one obtains the equilibrium values for borrowing and lending in the certain second-period income case

$$l_{1E}^{*c} = \frac{1}{1+x_1^{*c}}[e_{1E}(1-t_1-p) - (1-p)e_{1U}] \tag{84}$$

and

$$l_{1U}^{*c} = \frac{p}{1+x_1^{*c}}[-e_{1E}(1-t_1-p)(1-p)^{-1}+e_{1U}] \; . \tag{85}$$

As in the uncertainty case when $r_1<x_1$ in the pay-as-you-go model, (79) ensures that the unemployed in period one will be borrowers. Reversing the inequality in (79) causes unemployment insurance benefits to be so great that the unemployed in period one become lenders, while equality in (79) results in no borrowing nor lending taking place. An assumption similar to that given in (80), with x_1^* replaced by x_1^{*c}, guarantees that borrowers will not default on their loans.

In the pay-as-you-go model with $r_1<x_1$, precautionary saving, the difference between lending under uncertainty and lending under certainty, by the employed agent, given (79), is

$$PS_E^P = \left(\frac{1}{1+x_1^*} - \frac{1}{1+x_1^{*c}}\right)[e_{1E}(1-t_1-p) - (1-p)e_{1U}] \; . \tag{86}$$

Since $x_1^* \le x_1^{*c}$, the expression for precautionary saving given in (86) is non-negative. Aggregate precautionary saving in the pay-as-you-go model when the first-period tax rate is such that the employed are lenders is

$$PS_1^P = pN\left(\frac{1}{1+x_1^*} - \frac{1}{1+x_1^{*c}}\right)[e_{1E}(1-t_1-p) - (1-p)e_{1U}] \quad \text{(employed)} \tag{87}$$

since the dissaving in the form of borrowing by the unemployed in period one does not generate precautionary saving. If

$$t_1 > \frac{(1-p)(e_{1E}-e_{1U})}{e_{1E}}, \tag{88}$$

then an unemployed agent in the first period will be a lender and will generate precautionary saving of

$$PS_U^P = p\left(\frac{1}{1+x_1^*}-\frac{1}{1+x_1^{*c}}\right)\left[e_{1U}-e_{1E}(1-t_1-p)(1-p)^{-1}\right]. \tag{89}$$

Again, the expression for precautionary saving from (89) is non-negative given the condition on t_1 in (88) and aggregate precautionary saving is

$$PS_1^P = p(1-p)N\left(\frac{1}{1+x_1^*}-\frac{1}{1+x_1^{*c}}\right)\left[e_{1U}-e_{1E}(1-t_1-p)(1-p)^{-1}\right] \text{ (unemployed)}. \tag{90}$$

Precautionary saving as given in (87) and (90) is compared to the results from the other models in section five.

Case 2: $r_1=x_1$

When $r_1=x_1$, agents who would lend in the $r_1<x_1$ case of the pay-as-you-go model are indifferent between lending and storing as a means of saving while those agents who would typically borrow under $r_1<x_1$ are limited to borrowing since they cannot engage in negative storage. When facing uncertain second-period incomes, employed agents will lend and/or store if

$$t_1 < \frac{\ln(\delta r_1\Omega)+\gamma e_{1E}}{\gamma e_{1E}} \tag{91}$$

which is also a sufficient condition for unemployed agents to be borrowers in period one.[13] If the first-period tax on employed agents is great enough so that

$$t_1 > \frac{-(1-p)(\gamma e_{1U}+\ln(\delta r_1\Omega))}{\gamma p e_{1E}}, \tag{92}$$

then roles of borrower and lender would be reversed.[14]

---

[13]A necessary condition for the first-period unemployed to be borrowers is $t_1 < \frac{-(1-p)(\gamma e_{1U}+\ln(\delta r_1\Omega))}{\gamma p e_{1E}}$, which is satisfied if (91) holds.

[14](92) is sufficient to cause employed agents to desire to borrow, but they are prohibited from negative storage.

If (91) is true, then an unemployed agent, when faced with uncertain period-two income, chooses l_{1U} as given in (75) (with x_1 replaced by r_1). The assumption

$$\gamma p(1-p)^{-1}t_1e_{1E} > -\frac{\gamma(1+r_1)e_{2U}}{r_1p}-\gamma e_{1U}-\ln(\delta r_1)-\ln\Omega \tag{93}$$

ensures that she will not default on her loan. Substituting for l_{1U} from (75) into the loan market clearing condition and solving for lending by the employed in period one yields

$$l_{1E} = \frac{-(1-p)}{p\gamma(1+r_1)}[\ln(\delta r_1)+\gamma(e_{1U}+p(1-p)^{-1}t_1e_{1E})+\ln\Omega]\ . \tag{94}$$

It can be seen from (71a) that under uncertainty an employed agent, when (91) is true, chooses a combination of storing and lending such that

$$s_{1E}+l_{1E} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1\Omega)+\gamma e_{1E}(1-t_1)]\ . \tag{95}$$

(95) gives the total saving by an employed agent if (91) is true. Subtracting (94) from (95) gives storage by an employed agent when facing second-period income uncertainty in the pay-as-you-go model of

$$s_{1E} = \frac{1}{p\gamma(1+r_1)}[\ln(\delta r_1\Omega)+\gamma(pe_{1E}+(1-p)e_{1U})]\ . \tag{96}$$

In a similar manner to the analysis above, if (92) is true, then an employed agent faces such a high unemployment insurance tax in period one that she becomes a borrower, with the amount she borrows being identical to the amount in (74) (with x_1 replaced by r_1). An assumption similar to (93) guarantees that the employed borrower does not default on her loan. Using this expression for l_{1E} in the loan market clearing condition and solving for l_{1U} yields

$$l_{1U} = \frac{-p}{\gamma(1-p)(1+r_1)}[\ln(\delta r_1)+\gamma e_{1E}(1-t_1)+\ln\Omega] \tag{97}$$

which is the equilibrium level of *lending* by the unemployed in period one if (92) holds. Since lending and storage (total saving) by an unemployed agent in period one must be such that

$$s_{1U}+l_{1U} = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1)+\gamma(e_{1U}+p(1-p)^{-1}t_1e_{1E})+\ln\Omega]\ , \tag{98}$$

in equilibrium when (92) holds, an unemployed agent stores

$$s_{1U} = \frac{1}{\gamma(1-p)(1+r_1)}[\ln(\delta r_1\Omega)+\gamma(pe_{1E}+(1-p)e_{1U})] \; . \tag{99}$$

Second-period income certainty means that an agent will receive with probability one the expected value of her second-period endowments and unemployment insurance benefit as given earlier in this section in the borrowing and lending only case. As in the uncertain, $r_1=x_1$ case, an employed agent may be a lender or a borrower depending on the size of her first-period unemployment insurance tax payment. If t_1 is such that both

$$t_1 < \frac{\ln(\delta r_1)-\gamma(pe_{2E}+(1-p)e_{2U})+\gamma e_{1E}}{\gamma e_{1E}} \tag{100}$$

and

$$t_1 < \frac{-(1-p)[\ln(\delta r_1)-\gamma(pe_{2E}+(1-p)e_{2U})+\gamma e_{1U}]}{\gamma pe_{1E}} \; , \tag{101}$$

then an agent employed in period one is a lender while an unemployed agent in period one is a borrower. If the inequalities in (100) and (101) are reversed, the roles of borrower and lender are reversed.

If (100) and (101) hold, then an unemployed agent facing certain second-period income chooses l_{1U} such that (82) holds (with r_1 substituted in for x_1). Substituting the expression for l_{1U}^c from (82) into the loan market clearing condition and solving for l_{1E} yields

$$l_{1E}^c = \frac{-(1-p)}{p\gamma(1+r_1)}[\ln(\delta r_1)+\gamma(e_{1U}+p(1-p)^{-1}t_1e_{1E})-\gamma(pe_{2E}+(1-p)e_{2U})] \tag{102}$$

which is lending by an employed agent in period one when second-period income is certain. Total saving by an employed agent is a combination of storing and lending, when (100) and (101) hold, such that

$$s_{1E}^c+l_{1E}^c = \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1)+\gamma e_{1E}(1-t_1)-\gamma(pe_{2E}+(1-p)e_{2U})] \tag{103}$$

under certainty. Subtracting (102) from (103) yields storage under certainty by an employed agent in the pay-as-you-go model when (100) and (101) are true

$$s_{1E}^c = \frac{1}{p\gamma(1+r_1)}[\ln(\delta r_1)+\gamma(pe_{1E}+(1-p)e_{1U})-\gamma(pe_{2E}+(1-p)e_{2U})] \; . \tag{104}$$

t

l

y

wh

th

fa

st

whi

is

by a

betw

cert

E

Since

gener

above

PS

[4]Note

If the inequalities are reversed in (100) and (101) so that the roles of borrower and lender are reversed in the model, then an employed agent facing certain period-two income chooses to borrow an amount l_{1E} such that (81) holds (with r_1 in place of x_1). Substituting the expression for l^c_{1E} from (81) into the loan market clearing condition and solving for l_{1U} yields

$$l^c_{1U} = \frac{-p}{\gamma(1-p)(1+r_1)}[\ln(\delta r_1)+\gamma e_{1E}(1-t_1)-\gamma(pe_{2E}+(1-p)e_{2U})] \qquad (105)$$

which is the lending by the unemployed in period one given the reversal of the inequalities in (100) and (101). Total saving by the unemployed when facing certain period-two income in this situation is the mixture of storage and lending such that

$$s^c_{1U}+l^c_{1U} = \frac{\ln(\delta r_1)+\gamma(e_{1U}+p(1-p)^{-1}t_1e_{1E})-\gamma(pe_{2E}+(1-p)e_{2U})}{\gamma(1+r_1)}, \qquad (106)$$

which means that storage by the unemployed in period one in this instance is

$$s^c_{1U} = \frac{\ln(\delta r_1)+\gamma(pe_{1E}+(1-p)e_{1U})-\gamma(pe_{2E}+(1-p)e_{2U})}{\gamma(1-p)(1+r_1)}. \qquad (107)$$

In the $r_1=x_1$ case of the pay-as-you-go model, precautionary saving by an employed agent when (100) and (101) are true[15] is the difference between total saving under uncertainty, (95), and total saving under certainty, (103), and is given by

$$PS^P_E = \frac{1}{\gamma(1+r_1)}[\ln\Omega+\gamma(pe_{2E}+(1-p)e_{2U})]. \qquad (108)$$

Since dissaving by the unemployed in the form of borrowing does not generate precautionary saving, aggregate precautionary saving under the above conditions is

$$PS^P_{s,1} = \frac{pN}{\gamma(1+r_1)}[\ln\Omega+\gamma(pe_{2E}+(1-p)e_{2U})]. \qquad (109)$$

---

[15]Note that if t_1 is such that (100) is true, then (91) will also be true.

When the inequalities in (100) and (101) do not hold[16], so that the unemployed in period one become lenders, precautionary saving by an unemployed agent, the difference between (98) and (106), is identical to that of the employed agent when (100) and (101) are true and is

$$PS_U^P = \frac{1}{\gamma(1+r_1)}[\ln\Omega+\gamma(pe_{2E}+(1-p)e_{2U})] \cdot \tag{110}$$

Aggregate precautionary saving when (100) and (101) do not hold is

$$PS_{s,1}^P = \frac{(1-p)N}{\gamma(1+r_1)}[\ln\Omega+\gamma(pe_{2E}+(1-p)e_{2U})] \tag{111}$$

which is the sum of the precautionary saving by the unemployed agents only since the dissaving by the employed agents when the tax rate in period one is high does not generate precautionary saving.

The precautionary saving results in (109) and (111) are discussed and compared with those from the other models in section five.

Optimal Tax Rates in the Pay-As-You-Go OCM Model

The optimal unemployment insurance tax rates in the pay-as-you-go model with a functioning credit market are found by maximizing the weighted sum of the expected indirect utility functions of the employed and unemployed period-one agents.[17] The indirect utility functions in the pay-as-you-go model are functions of t_1, t_2, and parameters. By maximizing with respect to the tax rates, one can determine the combination of tax rates yielding the highest utility, i.e., the optimal rates. Since the optimal tax rates when $r_1<x_1$ are potentially different from the optimal rates when $r_1=x_1$, the cases are considered separately below.

Case 1: $r_1<x_1$

The weighted sum of the expected indirect utility functions when agents only lend or borrow in the pay-as-you-go model is

---

[16]If the inequality in (101) is reversed so that t_1 is greater than the expression on the right hand side, then condition (92) is satisfied.

[17]This method differs slightly from that used in finding the optimal tax rate in the forced-saving model since agents unemployed in the first period are eligible for unemployment insurance benefits in the model of this section and therefore must be directly accounted for in the utility maximization process.

$$V(t_1,t_2) = pN\left(\frac{-1}{\gamma}e^{-\gamma c_{1E}^{*E}} - \frac{\delta p}{\gamma}e^{-\gamma c_{2E}^{*E}} - \frac{\delta(1-p)}{\gamma}e^{-\gamma c_{2U}^{*E}}\right) + (1-p)N\left(\frac{-1}{\gamma}e^{-\gamma c_{1U}^{*U}} - \frac{\delta p}{\gamma}e^{-\gamma c_{2E}^{*U}} - \frac{\delta(1-p)}{\gamma}e^{-\gamma c_{2U}^{*U}}\right) \tag{112}$$

where

$$c_{1E}^{*E} = e_{1E}(1-t_1) - \frac{1}{1+x_1^*}[e_{1E}(1-t_1-p) - (1-p)e_{1U}] \tag{113}$$

$$c_{2E}^{*E} = e_{2E}(1-t_2) + \frac{x_1^*}{1+x_1^*}[e_{1E}(1-t_1-p) - (1-p)e_{1U}] \tag{114}$$

$$c_{2U}^{*E} = e_{2U} + p(1-p)^{-1}t_2e_{2E} + \frac{x_1^*}{1+x_1^*}[e_{1E}(1-t_1-p) - (1-p)e_{1U}] \tag{115}$$

$$c_{1U}^{*U} = e_{1U} + p(1-p)^{-1}t_1e_{1E} - \frac{p}{1+x_1^*}[-e_{1E}(1-t_1-p)(1-p)^{-1} + e_{1U}] \tag{116}$$

$$c_{2E}^{*U} = e_{2E}(1-t_2) + \frac{px_1^*}{1+x_1^*}[-e_{1E}(1-t_1-p)(1-p)^{-1} + e_{1U}] \tag{117}$$

and

$$c_{2U}^{*U} = e_{2U} + p(1-p)^{-1}t_2e_{2E} + \frac{px_1^*}{1+x_1^*}[-e_{1E}(1-t_1-p)(1-p)^{-1} + e_{1U}] \ . \tag{118}$$

The above are the optimal consumption values from the agents' problems solved earlier in this section. The superscript E (or U) denotes that the agent was initially employed (or unemployed). As is evident in (112), the components of $V(t_1,t_2)$ are weighted to represent their numbers in the economy. Thus, the indirect utility of an employed agent is weighted by pN as a way of summing over all employed agents while the indirect utility function for an unemployed agent is multiplied by (1-p)N to represent their numbers in this economy.

Taking the partial derivatives of (112) with respect to t_1 and t_2 yields the following first-order conditions

$$\frac{\partial V}{\partial t_1} = pN\left(e^{-\gamma c_{1E}^{*E}}\left(\frac{\partial c_{1E}^{*E}}{\partial t_1}\right) + \delta p e^{-\gamma c_{2E}^{*E}}\left(\frac{\partial c_{2E}^{*E}}{\partial t_1}\right) + \delta(1-p)e^{-\gamma c_{2U}^{*E}}\left(\frac{\partial c_{2U}^{*E}}{\partial t_1}\right)\right) + (1-p)N\left(e^{-\gamma c_{1U}^{*U}}\left(\frac{\partial c_{1U}^{*U}}{\partial t_1}\right) + \delta p e^{-\gamma c_{2E}^{*U}}\left(\frac{\partial c_{2E}^{*U}}{\partial t_1}\right) + \delta(1-p)e^{-\gamma c_{2U}^{*U}}\left(\frac{\partial c_{2U}^{*U}}{\partial t_1}\right)\right) \tag{119}$$

and

$$\frac{\partial V}{\partial t_2} = pN\left(e^{-\gamma c_{1E}^{*E}}\left(\frac{\partial c_{1E}^{*E}}{\partial t_2}\right) + \delta p e^{-\gamma c_{2E}^{*E}}\left(\frac{\partial c_{2E}^{*E}}{\partial t_2}\right) + \delta(1-p)e^{-\gamma c_{2U}^{*E}}\left(\frac{\partial c_{2U}^{*E}}{\partial t_2}\right)\right)$$
$$+ (1-p)N\left(e^{-\gamma c_{1U}^{*U}}\left(\frac{\partial c_{1U}^{*U}}{\partial t_2}\right) + \delta p e^{-\gamma c_{2E}^{*U}}\left(\frac{\partial c_{2E}^{*U}}{\partial t_2}\right) + \delta(1-p)e^{-\gamma c_{2U}^{*U}}\left(\frac{\partial c_{2U}^{*U}}{\partial t_2}\right)\right). \tag{120}$$

It can be shown that the following tax rates are roots of the above first-order conditions, meaning they are optimal tax rates since they maximize the welfare of the agents in the economy:[18]

$$t_1 = \frac{(1-p)(e_{1E}-e_{1U})}{e_{1E}} \tag{121}$$

and

$$t_2 = \frac{(1-p)(e_{2E}-e_{2U})}{e_{2E}} . \tag{122}$$

Note that the optimal tax rates given in (121) and (122) are identical to those found in the pay-as-you-go model without a functioning credit market. Also, when taxes are set at their optimal rates, agents neither borrow nor lend in the $r_1<x_1$ case. The unemployment insurance tax achieves an optimal allocation and eliminates the desire on the part of agents to shift resources from one period to the next through lending or borrowing.

Case 2: $r_1=x_1$

The weighted sum of the expected indirect utility functions when agents are indifferent between storing and lending as means of saving is identical to the expression given by (112). However, the optimal consumption allocations are different than in the case of $r_1<x_1$. In equilibrium they become

$$c_{1E}^{*E} = e_{1E}(1-t_1) - \frac{1}{\gamma(1+r_1)}[\ln(\delta r_1) + \ln\Omega + \gamma e_{1E}(1-t_1)] \tag{123}$$

$$c_{2E}^{*E} = e_{2E}(1-t_2) + \frac{r_1}{\gamma(1+r_1)}[\ln(\delta r_1) + \ln\Omega + \gamma e_{1E}(1-t_1)] \tag{124}$$

$$c_{2U}^{*E} = e_{2U} + \frac{r_1}{\gamma(1+r_1)}[\ln(\delta r_1) + \ln\Omega + \gamma e_{1E}(1-t_1)] + p(1-p)^{-1}t_2 e_{2E} \tag{125}$$

---

[18]This is shown in Appendix 2C.

and

wher

(or

iden

(119

alloc

earl

diffe

case

optim

cases

credi

5. C

preca

and i

stora

time.

preca

saving

chapte

econom

"This

$$c_{1U}^{*U} = e_{1U} - \frac{\ln(\delta r_1) + \ln\Omega + \gamma e_{1U} + \gamma p(1-p)^{-1} t_1 e_{1E}}{\gamma(1+r_1)} + p(1-p)^{-1} t_1 e_{1E} \tag{126}$$

$$c_{2E}^{*U} = e_{2E}(1-t_2) + \frac{r_1\left(\ln(\delta r_1) + \ln\Omega + \gamma e_{1U} + \gamma p(1-p)^{-1} t_1 e_{1E}\right)}{\gamma(1+r_1)} \tag{127}$$

and

$$c_{2U}^{*U} = e_{2U} + \frac{r_1\left(\ln(\delta r_1) + \ln\Omega + \gamma e_{1U} + \gamma p(1-p)^{-1} t_1 e_{1E}\right)}{\gamma(1+r_1)} + p(1-p)^{-1} t_2 e_{2E} \tag{128}$$

where again the superscript E (or U) indicates that the agent was employed (or unemployed) in period one.

The partial derivatives of (112) with respect to t_1 and t_2 are identical in form to those given by (119) and (120). However, within (119) and (120), the partial derivatives of the optimal consumption allocations with respect to the tax rates are different than in the earlier case. Even though the optimal consumption allocations respond differently to changes in the tax rates in this model, it is still the case that the optimal tax rates are those in (121) and (122).[19] The optimal tax rates in the pay-as-you-go model do not vary across the two cases ($r_1 < x_1$ and $r_1 = x_1$) and are invariant to whether or not a functioning credit market is in operation in the economy.

5. Comparing the Various Models

This section compares and contrasts the assorted models of precautionary saving and unemployment insurance presented in this chapter and in chapter one. Agents in the models of chapter one had access to a storage technology as the only means of transferring resources across time. The models in that chapter examined the interaction between precautionary saving and two unemployment insurance schemes: a forced-savings model and a pay-as-you-go model. In this chapter, the models from chapter one are extended by adding a functioning credit market to the economy, giving agents two ways of moving wealth between periods.

---

[19]This is shown in Appendix 2C.

One has much difficulty in comparing the various models since in equilibrium each has a different rate of interest. In particular, comparing the results when $r_1 = x_1$ with those when $r_1 < x_1$ is not easy since in the former case the equilibrium interest rate is the rate of return to storage while in the latter it is the interest rate in the loan market which is some unspecified amount greater than r_1. Even within the $r_1 < x_1$ cases for which the interest rate is some amount greater than r_1, comparisons are difficult since the equilibrium interest rate varies from model to model.

The following proposition provides one of the main results of chapter two:

Proposition 1: *Unemployment insurance in a forced-saving model with borrowing and lending is provided to covered workers at the cost of higher interest rates for those workers not covered by the plan.*

Proof: If $t_1 = 0$ in the forced-saving model, the equilibrium interest rates under both certainty and uncertainty, (44) and (38), respectively, equal their counterparts in the model with no unemployment insurance plan, (16) and (10). Given that the interest rates in the forced-saving plan are monotonically increasing in t_1, introducing a forced-saving unemployment insurance plan increases the equilibrium interest rate in the economy, making borrowing more expensive.

Q.E.D.

Protection for workers covered by the forced-saving plan, the lenders, comes at the expense of those workers who are not covered, the borrowers, even though they do not directly pay for the cost of the program, since they have to pay a higher interest rate on the money they borrow.

Another finding which comes out of this chapter concerns the pay-as-you-go unemployment insurance plan and is given in the next proposition.

Proposition 2: *There exist many tax rates t_2 for which precautionary saving in the $r_1 < x_1$ case of the pay-as-you-go model is less than precautionary saving in the similar case of the model without unemployment insurance.*

Proof: As the derivative of PS_1^P with respect to t_2 in Appendix 2B indicates, PS_1^P reaches a minimum point where $t_2 = t_2^*$. At $t_2 = 0$, it is the case that precautionary saving in the pay-as-you-go model is equal to that in the model without an insurance plan. It must be the case, therefore, that, at least for the values of t_2 such that $t_2<t_2^*$, precautionary saving in the borrowing and lending only case of the pay-as-you-go model is less than in the borrowing and lending case of the model with no UI plan.

Q.E.D.

This result is similar to that given by Proposition 2 of chapter one for the pay-as-you-go model without borrowing and lending. Simply introducing this type of unemployment insurance plan will reduce private precautionary saving in the economy.

The first four rows of Table 2.1 on the following page show the comparative statics results for the models in which $r_1=x_1$.[20] In these models, agents are able to engage in both storage and lending, as indicated by the subscript s,l on PS. The comparative statics of rows one through four are identical to those given in chapter one in which loan markets were closed because the expressions for precautionary saving in the aggregate are identical to those of chapter one in each of the cases. When the loan market is functioning and $r_1=x_1$, agents choose the same level of precautionary saving as they do when the loan market is closed in each of the models. The only aspect of the agents' saving behavior that changes is that they may alter their saving portfolio by dividing saving between storage and lending as opposed to having storage as the only means of saving as in the models of the first chapter. The logic behind the comparative statics results of chapter one and the five propositions given in that chapter apply as well to the results given in the first four rows of Table 2.1.

The results given in rows five through eight of Table 2.1 show the signs of the comparative statics on aggregate precautionary saving for the various models when $r_1<x_1$. For the borrowing and lending only cases, signified by the subscript l on PS, determining the reaction of aggregate precautionary saving to a change in a parameter value is more difficult

---

[20]The partial derivatives for the comparative statics of the last four rows of the table are given in Appendix 2B. The partial derivatives for the first four rows are identical to those given in chapter one.

P
PS
PS
PS
PS
PS
PS
PS

becau

marke

precau

plan

changi

when r

someth

Table 2.1
Comparative Static Results for Precautionary Saving[1]

	r_1	p	e_{1E}	e_{1U}	e_{2E}	e_{2U}	t_1	t_2	t_1e_{1E}
$PS_{s,1}^{NO\ UI}$	-	?	N/A	N/A	+	-	N/A	N/A	N/A
$PS_{s,1}^{F}$	-[2]	?[2] +[3]	N/A	NA/	+[2] -[3]	-[2] +[3]	N/A	N/A	-[2] +[3]
$PS_{s,1}^{P}$ (employed)	-	?[4] +[5]	N/A	N/A	+[4,7] -[6]	-[4] +[5]	N/A	-[4] +[5]	N/A
$PS_{s,1}^{P}$ (unemployed)	-	-[4] ?[5]	N/A	N/A	+[4,7] -[6]	-[4] +[5]	N/A	-[4] +[5]	N/A
$PS_{1}^{NO\ UI}$	N/A	?	+	?	+	-	N/A	N/A	N/A
PS_{1}^{F}	?	?	?	?	?	?	?	N/A	N/A
PS_{1}^{P} (employed)	N/A	?	+[4] ?[5]	?[4] -[5]	+[4] -[5]	-[4] +[5]	-	-[4] +[5]	N/A
PS_{1}^{P} (unemployed)	N/A	?	?[4,8] +[4,9] -[5,8] ?[5,9]	+[4] ?[5]	+[4] -[5]	-[4] +[5]	+	-[4] +[5]	N/A

[1]Blocks with N/A inside indicate that either the expression for precautionary saving does not contain that variable or that the variable is examined jointly with another variable (i.e., t_1 and e_{1E} were examined as one variable, t_1e_{1E}, in the instances where they always appeared together). Any assumptions used to sign a partial derivative are noted and explained in the other footnotes below. All signs are determined under the assumption that parameter values are such that the applicable precautionary saving is non-negative. A question mark indicates a partial derivative whose sign is indeterminate.
[2]If t_1 is less than the optimal tax rate, t_1^*.
[3]If t_1 is greater than the optimal tax rate, t_1^*.
[4]If t_2 is less than the optimal tax rate, t_2^*.
[5]If t_2 is greater than the optimal tax rate, t_2^*.
[6]If t_2 is greater than t_2^* but less than 1-p.
[7]If t_2 is greater than 1-p.
[8]If t_1 is less than 1-p.
[9]If t_1 is greater than 1-p.

because such a change may affect the equilibrium interest rate in the loan market which in turn causes secondary effects.

Changing the rate of return to storage does not affect aggregate precautionary saving in either the model without an unemployment insurance plan or the model with a pay-as-you-go UI plan, while the effect of changing r_1 in the forced-saving plan is indeterminate. PS_1^F is affected when r_1 changes because of the trust fund aspect of the forced-saving plan, something which is absent in the other two models. Since the equilibrium interest rate in both the model without an unemployment insurance scheme and the pay-as-you-go model is unchanged by changes in the rate of return to storage, aggregate precautionary saving will be unchanged in these two models. In the forced-saving model, however, an increase in r_1 increases both the certain and the uncertain equilibrium loan market interest rates. However, without strong assumptions about parameter values, it is not possible to determine whether the effect on x_1^* or on x_1^{**} is greater, which means that the overall effect of a change in r_1 on PS_1^F is indeterminate.

Rows five through eight of Table 2.1 indicate that for all of the models in which $r_1 < x_1$, altering the probability of second-period employment has indeterminate effects on aggregate precautionary saving. In fact, changes in p have indeterminate effects on the equilibrium interest rates in each of the models unless one makes strong assumptions about parameter values. In all three models, increasing p decreases the income uncertainty faced by an employed agent and therefore decreases her desire to lend (decreases the supply of funds to the loan market) because of a reduced precautionary saving motive. However, the number of employed agents increases when p increases which, ceteris paribus, increases the supply of funds to the loan market. Thus the overall effect on the supply of funds to the loan market is indeterminate. For those unemployed in period one, increasing p increases their desire to borrow (increases the demand for funds in the loan market) to smooth their consumption. When p increases, though, there are fewer unemployed agents borrowing which by itself would reduce the demand for funds in the loan market. Again, the overall effect on the demand for funds in the loan market cannot be determined which also means that the effect of changing p on loan market interest rates cannot be resolved.

Increasing either the first-period high endowment or the first-period low endowment influences aggregate precautionary saving in all of the models when $r_1 < x_1$ by altering the equilibrium interest rate in the loan market, although the impact of that influence cannot always be determined. The mechanism of this change is similar in all three models. An increase

in
lend
loan
on p
thei
will
prin
dema
the
rate
by (
plan,
domin
incre

preca
PS
react
a cha
increa
in th
unempl
precau
to sa
increa
on para

T
e_{IE} or
taxes i
and whe
aggregat

in e_{1E} will increase lending by the employed agents in period one since lending is a normal good. This increase in the supply of funds to the loan market decreases the equilibrium interest rate, which has two effects on precautionary saving: (1) agents receiving a lower rate of return on their saving (lending) will save less and consume more; and (2) agents will need to save more to achieve some desired "coverage" amount of principal plus interest. Similarly, an increase in e_{1U} decreases the demand for borrowing by unemployed agents in period one. This decrease in the demand for funds in the loan market decreases the equilibrium interest rate in the loan market with the effects on precautionary saving described by (1) and (2) above. For the model without an unemployment insurance plan, an increase in e_{1E} increases precautionary saving as effect (2) dominates; however, the effect on aggregate precautionary saving of an increase in e_{1U} cannot be determined.

Changing either e_{1E} or e_{1U} has indeterminate effects on aggregate precautionary saving in the forced-saving model when $r_1 < x_1$. Both PS_1^F and $PS_1^{NO\ UI}$ react to a change in e_{1U} is the same fashion, hence the indeterminate reaction by aggregate precautionary saving in the forced-saving model to a change in e_{1U}. Increasing e_{1E} in the forced-saving model tends to increase precautionary saving by the employed for the reasons given above in the no UI model. However, an increase in e_{1E} also increases the unemployment insurance benefit in period two, which decreases the need for precautionary saving by the employed in period one. Thus it is impossible to say whether precautionary saving increases or decreases with an increase in e_{1E} in the forced-saving model without additional restrictions on parameters.

The reaction of aggregate precautionary saving to a change in either e_{1E} or e_{1U} depends on the relationship between imposed taxes and optimal taxes in the pay-as-you-go model. When employed agents are the lenders and when the second-period tax rate is less than the optimal tax rate, aggregate precautionary saving reacts to changes in e_{1E} and e_{1U} in the same manner and for the same reasons as in the model without unemployment insurance. If $t_2>t_2^*$, the equilibrium interest rate reacts less strongly to changes in e_{1E} and e_{1U} than when $t_2<t_2^*$. An increase in e_{1E} when $t_2>t_2^*$ has an indeterminate effect on aggregate precautionary saving while an increase in e_{1U} when $t_2>t_2^*$ actually causes precautionary saving to fall as the effect described in (1) above dominates. If unemployed agents are the lenders under the pay-as-you-go scheme, the reaction of precautionary saving to changes in e_{1E} and e_{1U} is, for the most part, the reverse of what it was when the employed were lenders, given the tax rates.

With the exception of the forced-saving plan, aggregate precautionary saving reacts to changes in the second-period high endowment and the second-period low endowment in the same fashion in the $r_1<x_1$ models as it did in the $r_1=x_1$ models. Precautionary saving is positively related to e_{2E} for the model with no UI system and for the pay-as-you-go model when $t_2<t_2^*$. An increase in e_{2E} leads to an increase in the equilibrium interest rate in both the no UI model and the pay-as-you-go model, with the opposite effects on precautionary saving of (1) and (2) above. In addition, for both models, increasing e_{2E} widens the gap between income when employed in period two and income when unemployed in period two. This increased second-period income variance leads an agent to increase precautionary saving, with the overall effect being an increase in precautionary saving in both models. In the pay-as-you-go model, t_2 larger than the optimal rate causes an increase in e_{2E} to decrease the variance of second period income, thereby reducing the agent's desire for precautionary saving, the net effect being a decrease in precautionary saving.

An increase in e_{2U} will decrease the level of precautionary saving by an agent in the model with no UI plan and in the pay-as-you-go model when $t_2<t_2^*$. An increase in e_{2U} will increase the equilibrium interest rate, yielding effects on precautionary saving opposite those in (1) and (2) above. Furthermore, the greater e_{2U}, the lower the income uncertainty

fac

ins

bei

you

sec

cau

the

sav

inde

for

endc

savi

inte

of (

inde

A si

the

incre

the u

the

indet

In t

throu

incom

the e

they

unempl

changi

tax rat

faced by agents in the second period and the lower their demand for self-insurance in the form of precautionary saving, with the overall effect being a reduction in precautionary saving in both models. In the pay-as-you-go model with $t_2 > t_2^*$, precautionary saving is positively related to the second-period low endowment because an increase in e_{2U} in that situation causes an *increase* in income disparity which drives the agents to increase their precautionary saving, giving an overall increase in precautionary saving when combined with the interest rate effects.

For the forced-saving plan, changing either e_{2E} or e_{2U} has an indeterminate effect on aggregate precautionary saving. Increasing e_{2E}, for example, leads to an increase in the variance of second-period endowments which by itself would lead to an increase in precautionary saving. However, increasing e_{2E} also increases the equilibrium loan market interest rate which again has the opposite effect on precautionary saving of (1) and (2) above. The combined outcome of these effects is an indeterminate reaction to changes in e_{2E} by aggregate precautionary saving. A similar argument may be made for the reaction of precautionary saving in the forced-saving plan to changes in e_{2U}.

An increase in the first-period unemployment insurance tax rate increases aggregate precautionary saving in the pay-as-you-go model when the unemployed are the lenders (savers), decreases precautionary saving in the pay-as-you-go model when the employed are the lenders, and has indeterminate effects on precautionary saving in the forced-saving model. In the pay-as-you-go model, changing t_1 affects precautionary saving through a simple income effect. Increasing t_1 decreases the after-tax income of the employed in period one, meaning, if they are the savers in the economy, that they have less ability to save. For the unemployed when they are the savers in the economy, an increase in t_1 increases their unemployment insurance benefits and permits them to increase their saving.

For the forced-saving plan, the effect on precautionary saving of changing t_1 is unclear. Increasing the first-period unemployment insurance tax rate decreases the ability of the employed in the first period to lend (save). In addition, increasing t_1 increases the unemployment insurance benefit in the second period which decreases the income disparity faced by the agent, decreasing her desire to engage in precautionary saving. Finally, increasing t_1 increases the equilibrium loan market interest rate which affects saving the reverse of effects (1) and (2) above. The net result is that without making specific assumptions about parameter values, one cannot determine what happens to precautionary saving when t_1 changes.

The second-period tax on endowments is found only in the pay-as-you-go model. Precautionary saving, when $r_1<x_1$, reacts in the same way to changes in t_2 as it does when $r_1=x_1$. Whether precautionary saving is positively or negatively related to changes in t_2 depends on whether t_2 is greater than or less than the optimal tax rate in the economy. At a high enough tax rate (i.e., at a tax rate greater than the optimal tax rate), so much income is being transferred from the employed to the unemployed in the second-period that an agent facing the saving/consumption decision in the first period would save to insure herself against the possibility of *being employed* in the second period. Further increases in the tax rate beyond the optimal rate would induce further precautionary saving on the part of an agent. For tax rates smaller than the optimal tax rate, increasing the tax rate towards the optimal rate would decrease the income uncertainty faced by an agent during the second period and would therefore lead to a decrease in precautionary saving.

6. Conclusion

This chapter extended the work of chapter one by adding a functioning credit market to each of the models presented: a model without unemployment insurance, a forced-saving model of unemployment insurance, and a pay-as-you-go model of unemployment insurance. The relatively simple framework used allowed for the actual derivation of an expression for precautionary saving in each of the three models and for an examination of the reaction of precautionary saving to parameter changes.

I find that adding borrowing and lending to the models alters neither the level of precautionary saving chosen by agents who are saving nor the reaction of precautionary saving to changes in parameters when it is the case that the rate of return to storage in the economy equals the interest rate in the loan market. Agents may adjust their saving portfolio to include both storing and lending, but their total saving does not change.

I also find that introducing a forced-saving unemployment insurance plan into a model in which the agents borrow or lend only because the interest rate in the loan market dominates the rate of return to storage adversely affects the welfare of those agents not covered by the unemployment insurance plan even though they do not have to directly pay for such a plan. Increasing the unemployment insurance tax rate in the forced-saving model increases the interest rate in the loan market, making it more expensive for the borrowers in the economy, who also happen to be those not covered by the unemployment insurance plan, to borrow. Public borrowing in the form of an unemployment insurance plan crowds out private borrowing by the unemployed agents.

One final idea from this chapter is that those who are dissaving cannot generate positive levels of precautionary saving. In other words, one cannot engage in precautionary dissaving. This has implications for empirical work in that if one is examining saving in the hopes of uncovering evidence of precautionary saving, the theoretical work of this chapter indicates that those who are dissaving should not be considered.

APPENDIX 2A

The
are

wher

All
for

I

where
etc.
the
since
simpl

(

which

Secon

The s
are

s_i^2

s_{i}

APPENDIX 2A

Second-Order Conditions: OCM Model with No UI Plan

The second partials (and cross partial) of (5) with respect to s_{IE} and l_{IE} are

$$s_{1E}^2: \quad -\gamma e^{-\theta} - \delta p\gamma r_1^2 e^{-\omega} - \delta(1-p)\gamma r_1^2 e^{-\rho} \tag{2A.1}$$

$$s_{1E}l_{1E}: \quad -\gamma e^{-\theta} - \delta p\gamma r_1 x_1 e^{-\omega} - \delta(1-p)\gamma r_1 x_1 e^{-\rho} \tag{2A.2}$$

$$l_{1E}^2: \quad -\gamma e^{-\theta} - \delta p\gamma x_1^2 e^{-\omega} - \delta(1-p)\gamma x_1^2 e^{-\rho} \tag{2A.3}$$

where

$$\begin{aligned} \theta &= \gamma(e_{1E} - s_{1E} - l_{1E}) \\ \omega &= \gamma(e_{2E} + r_1 s_{1E} + x_1 l_{1E}) \\ \rho &= \gamma(e_{2U} + r_1 s_{1E} + x_1 l_{1E}) \end{aligned} \tag{2A.4}$$

All three expressions in 2A.1-2A.3 above are negative. The Hessian matrix for this system is

$$K = \begin{bmatrix} s_{1E}^2 & s_{1E}l_{1E} \\ s_{1E}l_{1E} & l_{1E}^2 \end{bmatrix} \tag{2A.5}$$

where s_{IE}^2 stands for the expression for the second partial given in 2A.1, etc. If the determinant of the matrix in 2A.5 is greater than zero, then the second-order conditions for utility maximization will be satisfied since K_{11} is negative. The determinant of the above matrix is (after some simplification)

$$(\delta p\gamma^2 e^{-\theta} e^{-\omega} + \delta(1-p)\gamma^2 e^{-\theta} e^{-\rho})(x_1 - r_1)^2 \tag{2A.6}$$

which is clearly non-negative.

Second-Order Conditions: OCM Model with Forced-Saving UI Plan

The second partials (and cross partial) of (34) with respect to s_{IE} and l_{IE} are

$$s_{1E}^2: \quad -\gamma e^{-\epsilon} - \gamma\delta p r_1^2 e^{-\epsilon} - \gamma\delta(1-p) r_1^2 e^{-\eta} \tag{2A.7}$$

$$s_{1E}l_{1E}: \quad -\gamma e^{-\epsilon} - \gamma\delta p r_1 x_1 e^{-\epsilon} - \gamma\delta(1-p) r_1 x_1 e^{-\eta} \tag{2A.8}$$

1

where

All
expre
Hessi
above
2A.9

(

whic
maxi

Secon

The
are

wher

All
expr
Hess
abov
2A.1

whic
maxi

$$l_{1E}^2: \quad -\gamma e^{-\alpha} - \gamma\delta p x_1^2 e^{-\epsilon} - \gamma\delta(1-p)x_1^2 e^{-\eta} \tag{2A.9}$$

where

$$\begin{aligned} \alpha &= \gamma(e_{1E}(1-t_1) - s_{1E} - l_{1E}) \\ \epsilon &= \gamma(e_{2E} + r_1 s_{1E} + x_1 l_{1E}) \\ \eta &= \gamma(e_{2U} + r_1 s_{1E} + x_1 l_{1E} + r_1 t_1 e_{1E}(1-p)^{-1}) \end{aligned} \tag{2A.10}$$

All three expressions in 2A.7-2A.9 are negative. Note that the expressions take the same form as those in 2A.1-2A.3 above, so that the Hessian matrix of second partials takes on the same form as that in 2A.5 above. The determinant of the Hessian formed by the expressions in 2A.7-2A.9 is

$$(\delta p\gamma^2 e^{-\alpha}e^{-\epsilon} + \delta(1-p)\gamma^2 e^{-\alpha}e^{-\eta})(x_1 - r_1)^2 \tag{2A.11}$$

which is non-negative, meaning the second-order conditions for utility maximization in the forced-saving model are satisfied.

Second-Order Conditions: OCM Model with Pay-As-You-Go UI Plan

The second partials (and cross partial) of (70) with respect to s_{1E} and l_{1E} are

$$s_{1E}^2: \quad -\gamma e^{-\zeta} - \gamma\delta p r_1^2 e^{-\lambda} - \gamma\delta(1-p)r_1^2 e^{-\nu} \tag{2A.12}$$

$$s_{1E}l_{1E}: \quad -\gamma e^{-\zeta} - \gamma\delta p r_1 x_1 e^{-\lambda} - \gamma\delta(1-p)r_1 x_1 e^{-\nu} \tag{2A.13}$$

$$l_{1E}^2: \quad -\gamma e^{-\zeta} - \gamma\delta p x_1^2 e^{-\lambda} - \gamma\delta(1-p)x_1^2 e^{-\nu} \tag{2A.14}$$

where

$$\begin{aligned} \zeta &= \gamma(e_{1E}(1-t_1) - s_{1E} - l_{1E}) \\ \epsilon &= \gamma(e_{2E}(1-t_2) + r_1 s_{1E} + x_1 l_{1E}) \\ \eta &= \gamma(e_{2U} + r_1 s_{1E} + x_1 l_{1E} + t_2 e_{2E} p(1-p)^{-1}) \end{aligned} \tag{2A.15}$$

All three expressions in 2A.12-2A.14 are negative. Note that the expressions take the same form as those in 2A.1-2A.3 above, so that the Hessian matrix of second partials takes on the same form as that in 2A.5 above. The determinant of the Hessian formed by the expressions in 2A.12-2A.14 is

$$(\delta p\gamma^2 e^{-\zeta}e^{-\lambda} + \delta(1-p)\gamma^2 e^{-\zeta}e^{-\nu})(x_1 - r_1)^2 \tag{2A.16}$$

which is non-negative, meaning the second-order conditions for utility maximization in the pay-as-you-go model are satisfied.

APPENDIX 2B

APPENDIX 2B

Derivatives for the OCM Model with No UI Plan

Aggregate precautionary saving in the extended model without an unemployment insurance plan when $r_1 < x_1$ is

$$PS_1^{NO\,UI} = pN(1-p)[e_{1E}-e_{1U}]\left(\frac{1}{1+x_1^*}-\frac{1}{1+x_1^{*c}}\right). \tag{2B.1}$$

(2B.2) through (2B.6) give the partial derivatives of $PS_1^{NO\,UI}$ with respect to p, e_{1E}, e_{1U}, e_{2E}, and e_{2U} (with variables as defined in section two):

$$\begin{aligned}\frac{\partial PS_1^{NO\,UI}}{\partial p} &= (1-2p)N[e_{1E}-e_{1U}]\Lambda \\ &+p(1-p)N[e_{1E}-e_{1U}]\frac{e^{-\upsilon}(e^{-\gamma e_{2E}}-e^{-\gamma e_{2U}}+\xi\gamma(e_{1E}-e_{1U}))}{\delta(1+x_1^*)^2\xi^2} \\ &+p(1-p)N[e_{1E}-e_{1U}]\frac{e^{-\upsilon+\mu}(-\gamma(e_{1E}-e_{2E})+\gamma(e_{1U}-e_{2U}))}{\delta(1+x_1^{*c})^2}\end{aligned} \tag{2B.2}$$

where

$$\Lambda = \frac{1}{1+x_1^*}-\frac{1}{1+x_1^{*c}}$$
$$\upsilon = \gamma(pe_{1E}+(1-p)e_{1U})$$
$$\mu = \gamma(pe_{2E}+(1-p)e_{2U})$$

$$\frac{\partial PS_1^{NO\,UI}}{\partial e_{1E}} = p(1-p)N\left(\Lambda+[e_{1E}-e_{1U}]\left(\frac{\gamma pe^{-\upsilon}}{\delta\xi(1+x_1^*)^2}-\frac{\gamma pe^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right)\right) \tag{2B.3}$$

$$\frac{\partial PS_1^{NO\,UI}}{\partial e_{1U}} = p(1-p)N\left(-\Lambda+[e_{1E}-e_{1U}]\left(\frac{\gamma(1-p)e^{-\upsilon}}{\delta\xi(1+x_1^*)^2}-\frac{\gamma(1-p)e^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right)\right) \tag{2B.4}$$

$$\frac{\partial PS_1^{NO\,UI}}{\partial e_{2E}} = p(1-p)N[e_{1E}-e_{1U}]\left(\frac{-\gamma pe^{-\upsilon-\gamma e_{2E}}}{\delta\xi^2(1+x_1^*)^2}+\frac{\gamma pe^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right) \tag{2B.5}$$

$$\frac{\partial PS_1^{NO\,UI}}{\partial e_{2U}} = p(1-p)N[e_{1E}-e_{1U}]\left(\frac{-\gamma(1-p)e^{-\upsilon-\gamma e_{2U}}}{\delta\xi^2(1+x_1^*)^2}+\frac{\gamma(1-p)e^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right) \tag{2B.6}$$

Derivatives for the OCM Forced-Saving Model

Aggregate precautionary saving in the OCM forced-saving unemployment insurance model when $r_1 < x_1$ is

$$PS_1^F = \frac{pN(1-p)}{\gamma(1+x_1^*)}[\ln\Psi - \ln\xi - \gamma e_{1U} + \gamma e_{1E}(1-t_1)] - \frac{pN(1-p)}{1+x_1^{*c}}[e_{1E}(1-t_1-t_1 r_1) - e_{1U}] \ . \qquad (2B.7)$$

2B.8 through 2B.13 give the partial derivatives of PS_1^F with respect to r_1, p, e_{1E}, e_{1U}, e_{2E}, e_{2U}, and t_1 (where variables are as defined in section three):

$$\frac{\partial PS_1^F}{\partial r_1} = \frac{-p(1-p)Nt_1 e_{1E} e^{-\omega}}{\Psi(1+x_1^*)^2}\left(\frac{p[A]}{\delta e^{\theta}} + 1 + x_1^*\right) + \frac{p(1-p)Nt_1 e_{1E}(\gamma p[B]e^{-\eta} + \delta(1+x_1^{*c}))}{\delta(1+x_1^{*c})^2} \qquad (2B.8)$$

where

$$A = \ln\Psi - \ln\xi - \gamma e_{1U} + \gamma e_{1E}(1-t_1)$$

$$B = e_{1E}(1-t_1-t_1 r_1) - e_{1U}$$

$$\theta = p\ln\Psi + p\gamma e_{1E}(1-t_1) + (1-p)(\ln\xi + \gamma e_{1U})$$

$$\eta = \gamma p(e_{1E}(1-t_1-t_1 r_1) - e_{2E}) + \gamma(1-p)(e_{1U} - e_{2U})$$

$$\omega = \gamma(e_{2U} + r_1 t_1 e_{1E}(1-p)^{-1})$$

$$\frac{\partial PS_1^F}{\partial e_{1E}} = \frac{-p(1-p)N}{(1+x_1^*)^2}\left[\frac{r_1 t_1}{e^{\omega}\Psi} - 1 + t_1\right]\left(\frac{[A]p}{\delta e^{\theta}} + 1 + x_1^*\right) - \frac{p(1-p)N(1-t_1-t_1 r_1)}{(1+x_1^{*c})^2}\left(\frac{[B]\gamma p}{\delta e^{\eta}} + 1 + x_1^{*c}\right) \qquad (2B.9)$$

$$\frac{\partial PS_1^F}{\partial e_{1U}} = \frac{p(1-p)N}{(1+x_1^*)^2}\left(\frac{[A](1-p)}{\delta e^{\theta}} - (1+x_1^*)\right) - \frac{p(1-p)N}{(1+x_1^{*c})^2}\left(\frac{[B]\gamma(1-p)}{\delta e^{\eta}} - (1+x_1^{*c})\right) \qquad (2B.10)$$

$$\frac{\partial PS_1^F}{\partial e_{2E}} = \frac{-p^2(1-p)N}{e^{\gamma e_{2E}}(1+x_1^*)^2}\left(\frac{[A]}{\delta e^{\theta}}\left(\frac{p}{\Psi} + \frac{1-p}{\xi}\right) + (1+x_1^*)\left(\frac{1}{\Psi} - \frac{1}{\xi}\right)\right) + \frac{p^2(1-p)N[B]\gamma}{\delta e^{\eta}(1+x_1^{*c})^2} \qquad (2B.11)$$

$$\frac{\partial PS_1^F}{\partial e_{2U}} = \frac{-p(1-p)^2 N}{(1+x_1^*)^2}\left(\frac{[A]}{\delta e^{\theta}}\left(\frac{pe^{-\omega}}{\Psi} + \frac{1-p}{\xi e^{\gamma e_{2U}}}\right) + (1+x_1^*)\left(\frac{e^{-\omega}}{\Psi} - \frac{e^{-\gamma e_{2U}}}{\xi}\right)\right) + \frac{p(1-p)^2 N[B]\gamma}{\delta e^{\eta}(1+x_1^{*c})^2} \qquad (2B.12)$$

$$\frac{\partial PS_1^P}{\partial t_1} = \frac{-p(1-p)Ne_{1E}}{(1+x_1^*)^2}\left[\frac{r_1}{e^{\omega}\Psi}+1\right]\left(\frac{[A]p}{\delta e^{\theta}}+1+x_1^*\right) + \frac{p(1-p)Ne_{1E}(1+r_1)}{(1+x_1^{*c})^2}\left(\frac{[B]\gamma p}{\delta e^{\eta}}+1+x_1^{*c}\right) \tag{2B.13}$$

Derivatives for the OCM Pay-As-You-Go Model

Aggregate precautionary saving in the OCM pay-as-you-go unemployment insurance model when $r_1<x_1$ and the employed agents are the lenders (savers) in the economy is

$$PS_1^P = pN\left(\frac{1}{1+x_1^*}-\frac{1}{1+x_1^{*c}}\right)[e_{1E}(1-t_1-p)-(1-p)e_{1U}] \tag{2B.14}$$

2B.15 through 2B.21 give the partial derivatives of PS_1^P (employed) with respect to p, e_{1E}, e_{1U}, e_{2E}, e_{2U}, t_1, and t_2 (where variables are as defined in section three):

$$\frac{\partial PS_1^P}{\partial p} = [N\Gamma+pN(e_{1U}-e_{1E})]\Lambda + \frac{pN\Gamma\gamma e^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}(e_{2E}-e_{1E}+e_{1U}-e_{2U}) + \frac{pN\Gamma e^{-\upsilon}}{\delta\Omega^2(1+x_1^*)^2}\left(e^{-\gamma e_{2E}(1-t_2)}-\Upsilon e^{-\tau}+\Omega\gamma(e_{1E}-e_{1U})\right) \tag{2B.15}$$

where

$$\Lambda = \frac{1}{1+x_1^*}-\frac{1}{1+x_1^{*c}}$$

$$\Gamma = e_{1E}(1-t_1-p)-(1-p)e_{1U}$$

$$\upsilon = \gamma(pe_{1E}+(1-p)e_{1U})$$

$$\mu = \gamma(pe_{2E}+(1-p)e_{2U})$$

$$\tau = \gamma(e_{2U}+p(1-p)^{-1}t_2e_{2E})$$

$$\Upsilon = 1+\gamma t_2e_{2E}+\gamma p(1-p)^{-1}t_2e_{2E}$$

$$\frac{\partial PS_1^P}{\partial e_{1E}} = pN(1-t_1-p)\Lambda + pN\Gamma\left(\frac{\gamma pe^{-\upsilon}}{\delta\Omega(1+x_1^*)^2}-\frac{\gamma pe^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right) \tag{2B.16}$$

$$\frac{\partial PS_1^P}{\partial e_{1U}} = -pN(1-p)\Lambda + pN\Gamma\left(\frac{\gamma(1-p)e^{-\upsilon}}{\delta\Omega(1+x_1^*)^2}-\frac{\gamma(1-p)e^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right) \tag{2B.17}$$

$$\frac{\partial PS_1^P}{\partial e_{2E}} = pN\Gamma\left(\frac{-\gamma pe^{-\upsilon}\left((1-t_2)e^{-\gamma e_{2E}(1-t_2)}+t_2e^{-\tau}\right)}{\delta\Omega^2(1+x_1^*)^2}+\frac{\gamma pe^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right) \tag{2B.18}$$

$$\frac{\partial PS_1^P}{\partial e_{2U}} = pN\Gamma\left(\frac{-\gamma(1-p)e^{-\upsilon-\tau}}{\delta\Omega^2(1+x_1^*)^2} + \frac{\gamma(1-p)e^{-\upsilon+\mu}}{\delta(1+x_1^{*C})^2}\right) \tag{2B.19}$$

$$\frac{\partial PS_1^P}{\partial t_1} = -pNe_{1E}\Lambda \tag{2B.20}$$

$$\frac{\partial PS_1^P}{\partial t_2} = pN\Gamma\left(\frac{\gamma pe_{2E}e^{-\upsilon}\left(e^{-\gamma e_{2E}(1-t_2)} - e^{-\tau}\right)}{\delta\Omega^2(1+x_1^*)^2}\right) \tag{2B.21}$$

Aggregate precautionary saving in the OCM pay-as-you-go unemployment insurance model when $r_1<x_1$ and the unemployed agents are the lenders (savers) in the economy is

$$PS_1^P = pN\left(\frac{1}{1+x_1^*} - \frac{1}{1+x_1^{*C}}\right)\left[e_{1U}(1-p) - (1-t_1-p)e_{1E}\right] \tag{2B.22}$$

2B.23 through 2B.29 give the partial derivatives of PS_1^P (unemployed) with respect to p, e_{1E}, e_{1U}, e_{2E}, e_{2U}, t_1, and t_2 (where variables are as defined in section three):

$$\frac{\partial PS_1^P}{\partial p} = \left[NX + pN(e_{1E}-e_{1U})\right]\Lambda + \frac{pNX\gamma e^{-\upsilon+\mu}}{\delta(1+x_1^{*C})^2}(e_{2E}-e_{1E}+e_{1U}-e_{2U}) + \frac{pNXe^{-\upsilon}}{\delta\Omega^2(1+x_1^*)^2}\left(e^{-\gamma e_{2E}(1-t_2)} - \Upsilon e^{-\tau} + \Omega\gamma(e_{1E}-e_{1U})\right) \tag{2B.23}$$

where

$$\Lambda = \frac{1}{1+x_1^*} - \frac{1}{1+x_1^{*C}}$$

$$X = e_{1U}(1-p) - (1-t_1-p)e_{1E}$$

$$\upsilon = \gamma(pe_{1E} + (1-p)e_{1U})$$

$$\mu = \gamma(pe_{2E} + (1-p)e_{2U})$$

$$\tau = \gamma(e_{2U} + p(1-p)^{-1}t_2e_{2E})$$

$$\Upsilon = 1 + \gamma t_2e_{2E} + \gamma p(1-p)^{-1}t_2e_{2E}$$

$$\frac{\partial PS_1^P}{\partial e_{1E}} = -pN(1-t_1-p)\Lambda + pNX\left(\frac{\gamma pe^{-\upsilon}}{\delta\Omega(1+x_1^*)^2} - \frac{\gamma pe^{-\upsilon+\mu}}{\delta(1+x_1^{*C})^2}\right) \tag{2B.24}$$

$$\frac{\partial PS_1^P}{\partial e_{1U}} = pN(1-p)\Lambda + pNX\left(\frac{\gamma(1-p)e^{-\upsilon}}{\delta\Omega(1+x_1^*)^2} - \frac{\gamma(1-p)e^{-\upsilon+\mu}}{\delta(1+x_1^{*C})^2}\right) \tag{2B.25}$$

$$\frac{\partial PS_1^P}{\partial e_{2E}} = pN\mathbf{X}\left(\frac{-\gamma p e^{-\upsilon}\left((1-t_2)e^{-\gamma e_{2E}(1-t_2)}+t_2 e^{-\tau}\right)}{\delta\Omega^2(1+x_1^*)^2}+\frac{\gamma p e^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right) \tag{2B.26}$$

$$\frac{\partial PS_1^P}{\partial e_{2U}} = pN\mathbf{X}\left(\frac{-\gamma(1-p)e^{-\upsilon-\tau}}{\delta\Omega^2(1+x_1^*)^2}+\frac{\gamma(1-p)e^{-\upsilon+\mu}}{\delta(1+x_1^{*c})^2}\right) \tag{2B.27}$$

$$\frac{\partial PS_1^P}{\partial t_1} = pNe_{1E}\Lambda \tag{2B.28}$$

$$\frac{\partial PS_1^P}{\partial t_2} = pN\mathbf{X}\left(\frac{\gamma p e_{2E} e^{-\upsilon}\left(e^{-\gamma e_{2E}(1-t_2)}-e^{-\tau}\right)}{\delta\Omega^2(1+x_1^*)^2}\right) \tag{2B.29}$$

APPENDIX 2C

APPENDIX 2C

The Optimal Tax in the Forced-Saving OCM Model with $r_1 = x_1$

Equation 2C.1 is the partial derivative of the indirect utility function for the $r_1 = x_1$ case of the forced-saving model.

$$\frac{e_{1E}}{1+r_1}\left(\frac{r_1 e^{-\gamma(e_{2U}+r_1 t_1 e_{1E}(1-p)^{-1})}}{\Psi}+1\right)\left[e^{-\gamma c_{1E}^{*}}-\delta p r_1 e^{-\gamma c_{2E}^{*}}-\delta(1-p) r_1 e^{-\gamma c_{2U}^{*}}\right] + \delta r_1 e_{1E} e^{-\gamma c_{2U}^{*}} - e_{1E} e^{-\gamma c_{1E}^{*}} = 0 \; . \qquad (2C.1)$$

At a tax rate of

$$t_1 = \frac{(e_{2E}-e_{2U})(1-p)}{r_1 e_{1E}} \; , \qquad (2C.2)$$

it is the case that

$$\begin{aligned} \Psi &= e^{-\gamma e_{2E}} \\ e^{-\gamma(e_{2U}+r_1 t_1 e_{1E}(1-p)^{-1})} &= e^{-\gamma e_{2E}} \\ c_{2E}^{*} &= \frac{r_1 \ln(\delta r_1) + \gamma(r_1 e_{1E} + p e_{2E} + (1-p) e_{2U})}{\gamma(1+r_1)} = c_{2U}^{*} \; . \end{aligned} \qquad (2C.3)$$

Substituting from (2C.3) into (2C.1) and simplifying yields

$$e^{-\gamma c_{1E}^{*}} - \delta p r_1 e^{-\gamma c_{2E}^{*}} - \delta(1-p) r_1 e^{-\gamma c_{2U}^{*}} + \delta r_1 e^{-\gamma c_{2U}^{*}} - e^{-\gamma c_{1E}^{*}} = 0 \; . \qquad (2C.4)$$

Now since (2C.3) shows that the consumption by the employed and the unemployed is identical at the tax rate given in (2C.2), the left hand side of (2C.4) is zero. Thus the tax rate given in (2C.2) solves the first-order condition (2C.1) and is the tax rate that maximizes the utility of the employed agents in the forced-saving OCM model.

Optimal Taxes in the Pay-As-You-Go OCM Model with $r_1 < x_1$

Equations (2C.5) and (2C.6) are the partial derivatives of the indirect utility function in the pay-as-you-go OCM model with $r_1 < x_1$.

$$\begin{aligned} \frac{\partial V}{\partial t_1} = {} & pN\left(e^{-\gamma c_{1E}^{*E}}\left(\frac{\partial c_{1E}^{*E}}{\partial t_1}\right) + \delta p e^{-\gamma c_{2E}^{*E}}\left(\frac{\partial c_{2E}^{*E}}{\partial t_1}\right) + \delta(1-p) e^{-\gamma c_{2U}^{*E}}\left(\frac{\partial c_{2U}^{*E}}{\partial t_1}\right)\right) \\ & + (1-p)N\left(e^{-\gamma c_{1U}^{*U}}\left(\frac{\partial c_{1U}^{*U}}{\partial t_1}\right) + \delta p e^{-\gamma c_{2E}^{*U}}\left(\frac{\partial c_{2E}^{*U}}{\partial t_1}\right) + \delta(1-p) e^{-\gamma c_{2U}^{*U}}\left(\frac{\partial c_{2U}^{*U}}{\partial t_1}\right)\right) \end{aligned} \qquad (2C.5)$$

and

$$\frac{\partial V}{\partial t_2} = pN\left(e^{-\gamma c_{1E}^{*E}}\left(\frac{\partial c_{1E}^{*E}}{\partial t_2}\right) + \delta p e^{-\gamma c_{2E}^{*E}}\left(\frac{\partial c_{2E}^{*E}}{\partial t_2}\right) + \delta(1-p)e^{-\gamma c_{2U}^{*E}}\left(\frac{\partial c_{2U}^{*E}}{\partial t_2}\right)\right)$$
$$+ (1-p)N\left(e^{-\gamma c_{1U}^{*U}}\left(\frac{\partial c_{1U}^{*U}}{\partial t_2}\right) + \delta p e^{-\gamma c_{2E}^{*U}}\left(\frac{\partial c_{2E}^{*U}}{\partial t_2}\right) + \delta(1-p)e^{-\gamma c_{2U}^{*U}}\left(\frac{\partial c_{2U}^{*U}}{\partial t_2}\right)\right). \quad (2C.6)$$

The partial derivatives of the various optimal consumption expressions with respect to t_1 and t_2 are

$$\frac{\partial c_{1E}^{*E}}{\partial t_1} = \frac{\partial c_{2E}^{*E}}{\partial t_1} = \frac{\partial c_{2U}^{*E}}{\partial t_1} = \frac{-x_1^* e_{1E}}{1+x_1^*}$$
$$\frac{\partial c_{1U}^{*U}}{\partial t_1} = \frac{\partial c_{2E}^{*U}}{\partial t_1} = \frac{\partial c_{2U}^{*U}}{\partial t_1} = \frac{x_1^* p e_{1E}(1-p)^{-1}}{1+x_1^*} \quad (2C.7)$$

and

$$\frac{\partial c_{1E}^{*E}}{\partial t_2} = \frac{U}{(1+x_1^*)^2}$$
$$\frac{\partial c_{2E}^{*E}}{\partial t_2} = -e_{2E} + \frac{U}{1+x_1^*} - \frac{Ux_1^*}{(1+x_1^*)^2}$$
$$\frac{\partial c_{2U}^{*E}}{\partial t_2} = p(1-p)^{-1}e_{2E} + \frac{U}{1+x_1^*} - \frac{Ux_1^*}{(1+x_1^*)^2}$$
$$\frac{\partial c_{1U}^{*U}}{\partial t_2} = \frac{p\mathring{A}}{(1+x_1^*)^2} \quad (2C.8)$$
$$\frac{\partial c_{2E}^{*U}}{\partial t_2} = -e_{2E} + \frac{p\mathring{A}}{1+x_1^*} - \frac{px_1^*\mathring{A}}{(1+x_1^*)^2}$$
$$\frac{\partial c_{2U}^{*U}}{\partial t_2} = p(1-p)^{-1}e_{2E} + \frac{p\mathring{A}}{1+x_1^*} - \frac{px_1^*\mathring{A}}{(1+x_1^*)^2}$$

where

$$U = (e_{1E}(1-t_1-p) - (1-p)e_{1U})\left[\frac{-p\gamma e_{2E}e^{\theta}\eta}{\delta\Omega^2}\right] = -(1-p)\mathring{A}$$
$$\theta = -\gamma(pe_{1E} + (1-p)e_{1U})$$
$$\eta = e^{-\gamma e_{2E}(1-t_2)} - e^{-\gamma(e_{2U}+p(1-p)^{-1}t_2e_{2E})} \quad .$$

If the tax rates in the pay-as-you-go OCM model are

$$t_1 = \frac{(1-p)(e_{1E}-e_{1U})}{e_{1E}} \quad (2C.9)$$

and

$$t_2 = \frac{(1-p)(e_{2E}-e_{2U})}{e_{2E}} , \tag{2C.10}$$

then the following are true

$$\begin{aligned} &\mho = \Lambda = 0 \qquad (\text{since } \eta = 0) \\ &c_{1E}^{*E} = pe_{1E}+(1-p)e_{1U} = c_{1U}^{*U} \\ &c_{2E}^{*E} = c_{2U}^{*E} = pe_{2E}+(1-p)e_{2U} = c_{2E}^{*U} = c_{2U}^{*U} . \end{aligned} \tag{2C.11}$$

Using the first expression in (2C.11), the partial derivatives of the indirect utility function become

$$\frac{\partial V}{\partial t_1} = e^{-\gamma c_{1E}^{*E}}+\delta pe^{-\gamma c_{2E}^{*E}}+\delta(1-p)e^{-\gamma c_{2U}^{*E}}-e^{-\gamma c_{1U}^{*U}}+\delta pe^{-\gamma c_{2E}^{*U}}+\delta(1-p)e^{-\gamma c_{2U}^{*U}}=0 \tag{2C.12}$$

and

$$\frac{\partial V}{\partial t_2} = p\left(-\delta pe_{2E}e^{-\gamma c_{2E}^{*E}}+\delta pe_{2E}e^{-\gamma c_{2U}^{*E}}\right)+(1-p)\left(-\delta pe_{2E}e^{-\gamma c_{2E}^{*U}}+\delta pe_{2E}e^{-\gamma c_{2U}^{*U}}\right)=0 . \tag{2C.13}$$

Using the final two expressions in (2C.11), it is easy to see that the middle segments of the expressions in (2C.12) and (2C.13) are equal to zero. Thus, the tax rates given in (2C.9) and (2C.10) solve the first-order conditions given in (2C.5) and (2C.6) and therefore are the tax rates which maximize the utility of the agents in the pay-as-you-go OCM model when $r_1<x_1$.

Optimal Taxes in the Pay-As-You-Go OCM Model with $r_1=x_1$

Equations (2C.14) and (2C.15) are the partial derivatives of the indirect utility function in the pay-as-you-go OCM model with $r_1=x_1$.

$$\begin{aligned} \frac{\partial V}{\partial t_1} = {} & pN\left(e^{-\gamma c_{1E}^{*E}}\left(\frac{\partial c_{1E}^{*E}}{\partial t_1}\right)+\delta pe^{-\gamma c_{2E}^{*E}}\left(\frac{\partial c_{2E}^{*E}}{\partial t_1}\right)+\delta(1-p)e^{-\gamma c_{2U}^{*E}}\left(\frac{\partial c_{2U}^{*E}}{\partial t_1}\right)\right) \\ & +(1-p)N\left(e^{-\gamma c_{1U}^{*U}}\left(\frac{\partial c_{1U}^{*U}}{\partial t_1}\right)+\delta pe^{-\gamma c_{2E}^{*U}}\left(\frac{\partial c_{2E}^{*U}}{\partial t_1}\right)+\delta(1-p)e^{-\gamma c_{2U}^{*U}}\left(\frac{\partial c_{2U}^{*U}}{\partial t_1}\right)\right) \end{aligned} \tag{2C.14}$$

and

$$\begin{aligned} \frac{\partial V}{\partial t_2} = {} & pN\left(e^{-\gamma c_{1E}^{*E}}\left(\frac{\partial c_{1E}^{*E}}{\partial t_2}\right)+\delta pe^{-\gamma c_{2E}^{*E}}\left(\frac{\partial c_{2E}^{*E}}{\partial t_2}\right)+\delta(1-p)e^{-\gamma c_{2U}^{*E}}\left(\frac{\partial c_{2U}^{*E}}{\partial t_2}\right)\right) \\ & +(1-p)N\left(e^{-\gamma c_{1U}^{*U}}\left(\frac{\partial c_{1U}^{*U}}{\partial t_2}\right)+\delta pe^{-\gamma c_{2E}^{*U}}\left(\frac{\partial c_{2E}^{*U}}{\partial t_2}\right)+\delta(1-p)e^{-\gamma c_{2U}^{*U}}\left(\frac{\partial c_{2U}^{*U}}{\partial t_2}\right)\right) . \end{aligned} \tag{2C.15}$$

The partial derivatives of the various optimal consumption expressions with respect to t_1 and t_2 are

$$\frac{\partial c_{1E}^{*E}}{\partial t_1} = \frac{\partial c_{2E}^{*E}}{\partial t_1} = \frac{\partial c_{2U}^{*E}}{\partial t_1} = \frac{-r_1 e_{1E}}{1+r_1}$$
$$\frac{\partial c_{1U}^{*U}}{\partial t_1} = \frac{\partial c_{2E}^{*U}}{\partial t_1} = \frac{\partial c_{2U}^{*U}}{\partial t_1} = \frac{r_1 p e_{1E}(1-p)^{-1}}{1+r_1} \tag{2C.16}$$

and

$$\frac{\partial c_{1E}^{*E}}{\partial t_2} = \frac{-pe_{2E}}{(1+r_1)}\left[\frac{\eta}{\Omega}\right] = \frac{\partial c_{1U}^{*U}}{\partial t_2}$$
$$\frac{\partial c_{2E}^{*E}}{\partial t_2} = -e_{2E} + \frac{r_1 p e_{2E}}{1+r_1}\left[\frac{\eta}{\Omega}\right] = \frac{\partial c_{2E}^{*U}}{\partial t_2} \tag{2C.17}$$
$$\frac{\partial c_{2U}^{*E}}{\partial t_2} = p(1-p)^{-1}e_{2E} + \frac{r_1 p e_{2E}}{1+r_1}\left[\frac{\eta}{\Omega}\right] = \frac{\partial c_{2U}^{*U}}{\partial t_2}$$

where η is as defined above in the $r_1<x_1$ case and Ω is as defined in section four. If the tax rates in the pay-as-you-go OCM model are as given in (2C.9) and (2C.10), then the following are true

$$\eta = 0$$
$$c_{1E}^{*E} = \frac{r_1(pe_{1E}+(1-p)e_{1U})}{1+r_1} - \frac{\ln(\delta r_1) - \gamma(pe_{2E}+(1-p)e_{2U})}{\gamma(1+r_1)} = c_{1U}^{*U} \tag{2C.18}$$
$$c_{2E}^{*E} = c_{2U}^{*E} = \frac{pe_{2E}+(1-p)e_{2U}}{1+r_1} + \frac{\ln(\delta r_1) + \gamma(pe_{1E}+(1-p)e_{1U})}{\gamma(1+r_1)} = c_{2E}^{*U} = c_{2U}^{*U}\ .$$

Using the first expression in (2C.18), the partial derivatives of the indirect utility function become

$$\frac{\partial V}{\partial t_1} = e^{-\gamma c_{1E}^{*E}} + \delta p e^{-\gamma c_{2E}^{*E}} + \delta(1-p)e^{-\gamma c_{2U}^{*E}} - e^{-\gamma c_{1U}^{*U}} + \delta p e^{-\gamma c_{2E}^{*U}} + \delta(1-p)e^{-\gamma c_{2U}^{*U}} = 0 \tag{2C.19}$$

and

$$\frac{\partial V}{\partial t_2} = -\delta p e_{2E} e^{-\gamma c_{2E}^{*E}} + \delta p e_{2E} e^{-\gamma c_{2U}^{*E}} - \delta p e_{2E} e^{-\gamma c_{2E}^{*U}} + \delta p e_{2E} e^{-\gamma c_{2U}^{*U}} = 0\ . \tag{2C.20}$$

It is easy to see that, using the last two expressions in (2C.18), the middle segments of the expressions in (2C.19) and (2C.20) are equal to zero. Therefore, the tax rates given in (2C.9) and (2C.10) solve the first-order conditions given in (2C.14) and (2C.15) and are the tax rates which maximize the utility of the agents in the pay-as-you-go OCM model when $r_1=x_1$.

REFERENCES

Abel, A. and O. Blanchard, 1983, "An Intertemporal Model of Saving and Investment," *Econometrica*, 51:675-92.

Arrow, K., 1974, *Essays in the Theory of Risk-Bearing*, Amsterdam: North-Holland.

Baily, M., 1978, "Some Aspects of Optimal Unemployment Insurance," *Journal of Public Economics*, 10:379-402.

Barsky, R., Mankiw, N. and S. Zeldes, 1986, "Ricardian Consumers with Keynesian Propensities," *American Economic Review*, 76:676-91.

Beenstock, M. and V. Brasse, 1986, *Insurance for Unemployment*, London: Allen & Unwin Ltd.

Caballero, R., 1990, "Consumption Puzzles and Precautionary Savings," *Journal of Monetary Economics*, 25:113-36.

Caballero, R., 1991, "Earnings Uncertainty and Aggregate Wealth Accumulation," *American Economic Review*, 81:859-71.

Carroll, C. and A. Samwick, 1992, "How Important Is Precautionary Saving?" mimeo (December), Federal Reserve Board.

Carroll, C. and A. Samwick, 1992, "The Nature and Magnitude of Precautionary Wealth," *Economic Activity Section Working Paper Series No. 124*, Board of Governors of the Federal Reserve System.

Chapin, G., 1971, "Unemployment Insurance, Job Search and the Demand for Leisure, *Western Economic Journal*, 9:102-06.

Dardanoni, V., 1988, "Optimal Choices Under Uncertainty: The Case of Two-Argument Utility Functions," *The Economic Journal*, 98:429-50.

Dynan, K., 1991, "How Prudent are Consumers?" mimeo (October), Harvard University.

Ehrenberg, R. and R. Oaxaca, 1976, "Unemployment Insurance: Duration of Unemployment and Subsequent Wage Gain," *American Economic Review*, 66:754-66.

Farmer, R., 1990, "RINCE Preferences," *Quarterly Journal of Economics*, 105:43-60.

Feldstein, M., 1974, "Unemployment Compensation: Adverse Incentives and Distributional Anomalies," *National Tax Journal*, 27:231-44.

Feldstein, M., 1975, "The Importance of Temporary Layoffs: An Empirical Analysis," *Brookings Papers on Economic Activity*, 3:725-45.

Flemming, J., 1978, "Some Aspects of Optimal Unemployment Insurance: Search, Leisure, Savings and Capital Market Imperfections," *Journal of Public Economics*, 10:403-25.

Hall, R. and F. Mishkin, 1982, "The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Households," *Econometrica*, 50:461-81.

Hansen, W. and J. Byers, eds., 1990, *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press.

Hayashi, F., 1985, "The Effect of Liquidity Constraints on Consumption: A Cross-Sectional Analysis," *Quarterly Journal of Economics*, 100:183-206.

Hubbard, R. and K. Judd, 1987, "Social Security and Individual Welfare: Precautionary Saving, Borrowing Constraints, and the Payroll Tax," *American Economic Review*, 77:630-46.

Johnsen, T. and J. Donaldson, 1985, "The Structure of Intertemporal Preferences Under Uncertainty and Time-Consistent Plans," *Econometrica*, 53:1451-58.

Kimball, M., 1990, "Precautionary Saving in the Small and in the Large," *Econometrica*, 58:53-73.

Kreps, D. and E. Porteus, 1979, "Temporal von Neumann-Morgenstern and Induced Preferences," *Journal of Economic Theory*, 20:81-109.

Leland, H., 1968, "Saving and Uncertainty: The Precautionary Demand for Saving," *Quarterly Journal of Economics*, 82:153-63.

Levhari, D. and T. Srinivasan, "Optimal Savings Under Uncertainty," *Review of Economic Studies*, 36:153-63.

Machina, M., 1984, "Temporal Risk and the Nature of Induced Preferences," *Journal of Economic Theory*, 33:199-231.

MaCurdy, T., 1982, "The Use of Time Series Processes to Model the Error Structure of Earnings in a Longitudinal Data Analysis," *Journal of Econometrics*, 18:83-114.

McLaughlin, E., Millar, J. and K. Cooke, 1989, *Work and Welfare Benefits*, Brookfield, VT: Gower Publishing Co.

Merton, R., 1969, "Lifetime Portfolio Selection Under Uncertainty: The Continuous-Time Case," *The Review of Economics and Statistics*, 51:247-57.

Pratt, J., 1964, "Risk Aversion in the Small and in the Large," *Econometrica*, 32:122-36.

Reubens, B., 1990, "Unemployment Insurance in Western Europe: Responses to High Unemployment, 1973-1983," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 173-206.

Rubin, M., 1990, "Federal-State Relations in Unemployment Insurance," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 207-43.

Sandmo, A., 1970, "The Effect of Uncertainty on Savings Decisions," *Review of Economic Studies*, 37:353-60.

Selden, L., 1978, "A New Representation of Preferences of 'Certain x Uncertain' Consumption Pairs: The 'Ordinal Certainty Equivalent' Hypothesis," *Econometrica*, 46:1045-60.

Selden, L., 1979, "An OCE Analysis of the Effect of Uncertainty on Saving Under Risk Independence," *Review of Economic Studies*, 45:73-82.

Sheshinski, E.and Y. Weiss, 1981, "Uncertainty and Optimal Social Security Systems," *Quarterly Journal of Economics*, 96:189-206.

Skinner, J., 1988, "Risky Income, Life Cycle Consumption, and Precautionary Savings," *Journal of Monetary Economics*, 22:237-255.

Summers, L. and C. Carroll, 1987, "Why is U.S. National Saving So Low?" *Brookings Papers on Economic Activity*, 2:607-35.

Topel, R., 1990, "Financing Unemployment Insurance: History, Incentives, and Reform," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 108-35.

Vroman, W., 1990, *Unemployment Insurance Trust Fund Adequacy in the 1990s*, Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

Weil, P., 1990, "Nonexpected Utility in Macroeconomics," *Quarterly Journal of Economics*, 105:29-42.

Zeldes, S., 1989, "Consumption and Liquidity Constraints: An Empirical Investigation," *Journal of Political Economy*, 97:305-46.

Zeldes, S., 1989, "Optimal Consumption with Stochastic Income: Deviations from Certainty Equivalence," *Quarterly Journal of Economics*, 104:275-98.

CHAPTER III: PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE: EMPIRICAL TESTS

CHAPTER III

PRECAUTIONARY SAVING AND UNEMPLOYMENT INSURANCE: EMPIRICAL TESTS

1. Introduction

The presence of precautionary saving behavior, exhibited by consumers facing some form of uncertainty in their lives, has potentially important macroeconomic implications. Bequests passed on to offspring may simply represent an overestimation of the savings needed to protect a consumer against future income uncertainty. Barsky, Mankiw, and Zeldes (1986) argue that precautionary saving behavior can lead to a violation of Ricardian equivalence. The recent decline in the U.S. saving rate could be the result of shrinking levels of precautionary saving as consumers replace "own insurance" with health insurance and life insurance, as implied by Summers and Carroll (1987). Skinner (1988) finds that precautionary savings could account for more than 50 percent of aggregate life cycle savings, while Caballero (1991) shows that "precautionary savings due to earnings uncertainty alone can easily generate aggregate wealth levels above 60 percent of the observed *net* U.S. total stock of wealth."[1]

Despite the potential importance of precautionary saving, very few studies have attempted to empirically confirm the existence of such saving behavior. Most of the empirical research on life-cycle saving under income uncertainty has worked under the assumption of certainty-equivalence, which by its very nature precludes the existence of precautionary saving. Furthermore, the quadratic utility used to derive the certainty equivalence solutions exhibits increasing absolute risk aversion, which is considered by most to be an unsuitable description of the behavior of risk averse agents.

[1]See Caballero (1991), pg. 859.

One paper which does test for the existence of precautionary saving is Skinner (1988). It contains a brief empirical section in which he attempts to show, using cross-section data, that average savings would be higher for individuals in occupations subject to greater earnings risk. In fact, he finds that those whose occupations are traditionally thought to have riskier incomes, the self-employed and sales workers, actually held lower average savings levels than did those thought to have stable incomes. He notes that there may be a self-selection problem in his method in that the least risk-averse consumers, those who would probably save little for precautionary reasons, may also be those who choose the "riskiest" occupations.

Skinner's work is extended by Dardanoni (1991) who uses data from the 1984 UK Family Expenditure Survey to estimate precautionary saving. His estimating equation is based on an expected-utility maximizing model with an exponential functional form, which is similar to the model I use as a theoretical basis for the estimating equations in this chapter. Dardanoni divides his households into groups according to the occupation of the head of the household so that each group is homogeneous. He then uses this grouped data to regress a measure of consumption on a within-group variance of labor income measure (a proxy for future income variability) and a within-group average disposable income measure (a proxy for permanent income) in order to determine how consumption responds to changes in income variability. In this framework, the estimated coefficient on the labor-income variance term is related to the risk premium-precautionary component of consumption. Dardanoni finds that this risk premium is about 4 percent of total consumption and that precautionary savings comprises more than 60 percent of total savings for those in his sample, thus providing evidence for the existence of precautionary savings.

Kuehlwein (1991) argues that occupation is not a good index of consumer uncertainty due to the potential self-selection problem noted by Skinner. He opts instead to measure the uncertainty faced by a consumer with the estimated expectational errors from a consumption Euler equation for a consumer exhibiting constant relative risk aversion. He uses these estimated errors to test for the relationship between consumption growth (and indirectly precautionary saving) and uncertainty. Using food expenditure data from the Panel Study of Income Dynamics, Kuehlwein finds that "for all plausible values of relative risk aversion, consumption growth is negatively, and significantly, correlated with consumer uncertainty."[2] He also performs the same testing procedure on a subset of households from which those with liquidity constraints have been eliminated but finds no evidence of precautionary saving behavior (although the negative relationship between uncertainty and consumption growth is not statistically significant for the subset).

A slightly different approach to finding evidence of precautionary saving is employed by Dynan (1991). She uses expected consumption variability as a measure of the risk facing a consumer and shows theoretically that there exists a positive relationship between the variability of consumption and the growth rate of consumption, implying that individuals facing greater risk save more.[3] Dynan uses data from the 1985 Consumer Expenditure Interview Survey to test the validity of the hypotheses of her theoretical model and finds some evidence for the existence of a precautionary saving effect, although the magnitude of the effect is small and the estimated coefficients are not statistically different from zero.[4]

The attempt to find evidence of the existence of precautionary saving behavior in this chapter is different from those papers discussed above in two respects. The previous attempts at uncovering precautionary

---

[2]See Kuehlwein (1991), pg. 474.

[3]The Euler equation from her model shows that the greater the risk faced by the consumer, the greater the consumer's desired growth rate of consumption. Since the consumer faces a lifetime budget constraint, a faster desired consumption growth rate implies lower consumption now and greater consumption later, meaning higher saving now.

[4]She also argues that studies using only food expenditure data, such as that done by Kuehlwein, are flawed in that the correlation between average growth in food consumption and average growth in consumption of nondurables and services across households is less than .5.

saving all utilize some proxy of consumption expenditures to indirectly observe saving behavior. Skinner uses a measure of consumption that includes non-durables and some percentage of durables, Kuehlwein uses only the food expenditure portion of consumption expenditures, and Dynan uses total non-durables and services as to proxy consumption expenditures. This method is only as valid as the link between the proxy used and consumer saving choices. In this chapter, by utilizing data from the National Longitudinal Surveys (NLS) with its wealth of financial asset information, I am able to investigate saving behavior directly using data obtained over a fifteen-year period. Using actual savings data eliminates any question about the validity of a consumption proxy.

The second way in which my work differs from previous empirical work on precautionary saving is that I attempt to show the link between saving behavior and unemployment insurance as it affects precautionary saving. As Skinner states, "If a primary motive for saving were to guard against future income uncertainty, then programs designed to reduce uncertainty, such as unemployment insurance and welfare programs, could have the unintended effect of reducing national savings."[5] This empirical study attempts to test for the existence of a relationship between precautionary saving and the level of unemployment insurance benefit provision.[6] Using the NLS data, I investigate the existence and magnitude of the unemployment insurance effect on precautionary saving.

A third contribution of this chapter is the development and use of an index of unemployment insurance benefit generosity. This index is a cardinal measure of the generosity of unemployment insurance provision levels across states and allows me to test whether differing levels of unemployment insurance provision affect consumer saving decisions.

The rest of the chapter is arranged as follows. Section two describes the data used and the variables generated from the NLS data set.

---

[5]See Skinner (1988), pg. 250.

[6]In chapter one, I present the theoretical model from which this relationship is derived.

Section three describes the creation of the unemployment insurance index. Section four describes the estimating equations and how they relate to the theoretical model in chapter one. Section five presents results from various regression equations. The results from section five, and problems found in the estimation procedures, are discussed in section six. Conclusions are drawn in section seven.

2. Data

To examine the impact of unemployment benefit generosity on precautionary saving, I make use of data from the National Longitudinal Surveys (NLS) of Mature Men aged forty-five to fifty-four in 1966. The initial panel of 5020 respondents were interviewed at intervals over the period 1966 to 1981 and were selected to be representative of the U.S. male population in the designated age range.[7] The NLS panel represents an excellent source of data for investigations of consumer saving behavior due to the abundance of financial asset information available. I use selected financial, income, and demographic data reported in the 1966, 1969, 1971, 1976, and 1981 surveys. The financial and income variables used are in terms of 1976 dollars, deflated by the gross national product deflator for personal consumption expenditures.

I use five different income measures in the following analysis. $FAMLABINC_t$, t=66,69,71,76,81, represents the family unit's real labor income in each of the years of the study. Real labor income is used rather than some measure of family's total income since the latter may contain income from financial holdings.

A second income variable, PERMINC, is a measure of the permanent income of the respondent's family.[8] PERMINC is the average of the family

[7]The one exception to the representative sample idea comes in the form of over-sampling of black males in order to garner a larger number of black respondents. Non-whites form 30% of the sample, a significantly higher percentage than the 16%-20% of the male population who were non-white over the period of the sample.

[8]Credit for the creation of this variable goes to N. A. Jianakoplos, P. L. Menchik, and F.O. Irvine who have used it in several papers. Many of the variables used here come from the data sets they have created for their work.

unit's after-tax income discounted to age sixty-two and is given by the following formula:

$$PERMINC = \frac{1}{n}\sum Y_t(1-TRATE_t)(1.02)^{62-AGE_t},$$

where t represents the year of the survey, n is the number of observations of earnings in the average, Y is the reported income of the family in the given year, TRATE is an estimate of the combined federal and state average income tax rate applicable, and AGE is the respondent's age in the year of the survey. PERMINC was calculated only if the panel contained at least two years of valid observations on earnings.[9]

VARINC, the third income variable, represents the variance of income around its mean value. The theoretical model makes it clear that income fluctuations play an important part in determining the desired level of precautionary saving. Ideally, this variable would only measure unexpected variations in income as *expected* increases or decreases in income should have little effect on precautionary saving behavior.[10] Unfortunately, ex post it is generally very difficult to tell whether income variations were expected or unexpected. It is hoped that VARINC to some degree picks up unexpected variations in income, and would therefore serve as a proxy for the income risk faced by the members in the panel. A priori, one expects that the larger the variance of income around some mean level (i.e., the larger VARINC given PERMINC), the greater the desired precautionary saving by consumers.

Early regression results indicated the possibility of a nonlinear relationship between wealth and income so an income-squared term is included in both the cross-section regressions and the fixed-effects panel regressions. $LABINCSQR_t$ represents the square of $FAMLABINC_t$ while $PERMINCSQR_t$ is $PERMINC_t$ squared.

---

[9]See Jianakoplos, Menchik, and Irvine (1989).

[10]Expected variations in income will cause changes in saving(s) but will not affect precautionary saving(s). Precautionary saving(s) is that part of saving(s) which serves as a hedge against unanticipated income fluctuations only.

c
a
p
in

con
The
and
meas
DSAV
In t
respo

relate
report
and is

Several wealth measures were used in an attempt to capture precautionary saving effects. The NLS panel contains data on various financial assets: deposits in financial institutions, the value of U.S. savings bond holdings, and wealth held in the form of bonds, stocks, and mutual funds. In addition to these more liquid assets, data are also available on net residential housing assets, net business assets, net real estate investment, and net farm assets, which I consider to be illiquid assets. It can be argued that given the "self-insurance" aspect of precautionary saving, such savings are likely to be held in liquid assets. To determine if this is indeed the case, two liquid measures and one illiquid measure of asset holdings are used as the dependent variables in regressions . $SAV1_t$ represents deposits in financial institutions and is the most liquid of the savings measures. $SAV2_t$ is a broader measure of liquid asset holdings and is computed by summing the values of the respondent's deposits in financial institutions and U.S. savings bond, stock, bond, and mutual fund holdings. $SAV3_t$ is the least liquid measure of asset holdings as it consists of the sum of net residential housing assets, net farm assets, net business assets, net investment real estate, personal loans made to others, unsecured personal debt, and the assets included in $SAV2_t$.

In addition to the savings measures described above, I am able to construct *saving* measures due to the multi-year nature of the data set. The saving measures corresponding to $SAV1_t$, $SAV2_t$, and $SAV3_t$, $DSAV1_t$, $DSAV2_t$, and $DSAV3_t$, respectively, are constructed by differencing the yearly measures of the liquid asset holdings of a respondent. For example, DSAV166 is computed by taking the difference between SAV166 and SAV169. In this way, four pairs of saving measures can be constructed for those respondents with the necessary data for the years in question.

Two additional variables are shown by the theoretical model to be related to a consumer's precautionary saving behavior. $REAL\ INT_t$ is the reported market rate of return on asset holdings adjusted for inflation and is used in the panel regressions only. During a given year, the reported market rate of return on asset holdings does not exhibit enough variation across individuals to provide meaningful results in the cross-section analysis. However, over the entire fifteen year period, reported rates of return varied from five percent to thirteen and one-half percent and the fixed-effects panel regressions make use of this information to help explain saving behavior. The theoretical model indicates that precautionary saving should be negatively related to the rate of return to saving.

$JURAT_t$ is the job-specific unemployment rate faced by each individual in the panel who reported his occupation at the time of the interview. The reported occupation, given at the three-digit Standard Industrial Classification (SIC) code level, was matched with an unemployment rate for that SIC code for the relevant year. The assumption behind the use of $JURAT_t$ is that if 3.5% of all autoworkers experienced some spell of unemployment in 1966, for example, then any individual autoworker faced a 3.5% probability of being unemployed at some point in 1966. Obviously, the probability of future unemployment is individual specific. However, data on individual-specific, expected unemployment probabilities are not available so it is hoped that $JURAT_t$ serves as a proxy and that it is therefore related to the income risk faced by respondents due to potential unemployment. Precautionary saving is expected to be positively related to $JURAT_t$.

A dummy variable, $SPOUSEINC_t$, indicates whether or not the respondent's spouse had labor income. It seems likely that in a two-income family, precautionary saving would be lower than if that same household relied on a single income because the potential income fluctuation in a two-income household from the respondent losing his job is lower than that in a single-earner family. If the regressions indicate that a saving measure is negatively related to $SPOUSEINC_t$, then they may be detecting precautionary saving.

Several demographic variables are used to capture other facets of consumer saving behavior. DRACE is a dummy variable which assumes the value zero for white respondents and one for non-white members of the panel. UNION is a dummy variable which is one for respondents who were members of a labor union and zero otherwise. AGE_t is the age of the respondent during the year in question. $TENCJ_t$ represents the tenure on the current job, and may be thought of as a proxy for "job security" in that generally individuals with long job tenure are less likely to lose their jobs than are those with less seniority. Precautionary saving should be negatively related to $TENCJ_t$ if more job security translates into less variable income. NC_t represents the number of children in the household. Respondents with many dependents may be unable to save due to the ongoing need to feed, clothe, and house a large family. Finally, MD_t is a dummy variable which assumes a value of one if the respondent is married and zero otherwise. A large drop in savings from one year to the next accompanied by a change in MD_t from one to zero may be indicative of a costly divorce settlement, for example, and not necessarily a change in precautionary saving behavior.

3. Index of Unemployment Insurance Generosity

Comparing UI generosity across states is difficult due to the state-specific nature of the unemployment insurance system in this country. Given that states, for the most part, control the duration of benefit provision, the eligibility requirements, the size of the weekly benefit, and many other aspects of unemployment provision, a broad measure of the generosity of UI coverage encompassing several of these factors is required. The index used has five desirable features: (1) it captures the sum of the net benefits per year; (2) it is independent of state population so that large and small states can be compared; (3) it is independent of wage levels so that differing wage levels between states do not affect the relative index numbers; (4) it controls for differing unemployment rates across states; and (5) it controls for differing ratios of covered to uncovered employment across states.

The index number for each state is calculated according to the following:

$$\text{index} = \left(\frac{A}{B}\right)*\Gamma*\left(\frac{\Delta}{E}\right)*10000,$$

where

A = total benefit payments
B = total covered wages and salaries
$\Gamma = \dfrac{\text{mean covered unemployment rate}}{\text{state covered unemployment rate}}$
Δ = number of covered employees
E = total state employees

The term A, the total of all benefit checks issued during a year, varies directly with any liberalization or tightening of benefit provisions. B represents the earnings of those people working in covered employment and controls for differences in size and wages among states. States with the same benefit ratio, A/B, given that they face the same unemployment rates, provide their covered employees with the same value of insurance coverage regardless of differences in state size, wage levels, and legal provisions.

In order to compensate for differing unemployment rates across states, the above index measure is adjusted by scaling it to an average covered unemployment rate for the years under study. The scaling factor is the mean covered unemployment rate for the five years under study, 3.32%, divided by the actual covered unemployment rate in a specific state during a given year.

Finally, the measure is modified by multiplying the first two components described above by the ratio of the covered employment in a state during a given year to the total employment in that state that year. The inclusion of the term Δ/E makes the index a true measure of generosity for all workers in the sense that in order for a state to have a "high" index number, that state must provide both relatively large benefit payments per dollar of covered wages and salaries and it must provide those unemployment insurance benefits to a relatively large portion of its work force.

The index is a cardinal measure of the generosity of unemployment benefits for each state and for the District of Columbia. The actual numbers used to formulate the index for each of the states for the years 1966, 1969, 1971, 1976, and 1981 are contained in Appendix 3C. Data for calculating the indices are taken from the U.S. Statistical Abstract and from the Handbook of Labor Statistics.

4. Empirical Specification

The theoretical model of consumer saving behavior in the U.S. with an unemployment insurance scheme in place shows precautionary saving to be a function of income, of the probability of being employed in the next period, of the rate of return to saving, of the level of unemployment benefits, and of the degree of absolute risk aversion exhibited by the consumer.[11] Because previous attempts to empirically establish the existence of precautionary saving have varied as to their success, I proceed with my analysis in two distinct directions.

Cross-section Analysis

The first method I use to test for the existence and strength of the above relationships is a cross-section analysis utilizing the following basic estimating equation

$$SAV_t = \beta_1 + \beta_2 PERMINC + \beta_3 PERMINCSQR + \beta_4 VARINC + \beta_5 UINDX_t + \beta_6 JURAT_t + \gamma' \mathbf{X}_t + e_t \quad (1)$$

where t represents the year of the cross section and where PERMINC, PERMINCSQR, VARINC, and $JURAT_t$ are as defined in section two. SAV_t is one of six possible wealth measures, $SAV1_t$, $SAV2_t$, $SAV3_t$, $DSAV1_t$, $DSAV2_t$, or $DSAV3_t$. For each of the savings measures $SAV1_t$, $SAV2_t$, and $SAV3_t$, five different cross sections corresponding to the years 1966, 1969, 1971, 1976, and 1981 are analyzed. Four cross sections are available for analysis for the saving measures $DSAV1_t$, $DSAV2_t$, and $DSAV3_t$ because they

---

[11] I present these results in chapter one.

represent variations in liquid asset holdings from one year of the study to the next.

$UINDX_t$ is the index of unemployment insurance benefit generosity as calculated from the formula given in section three. This index varies both from state to state, since different states provide different levels of benefits to their unemployed workers, and from year to year for each state, since over time, due to legal modifications and/or changing economic conditions, benefit generosity within a state fluctuates. In the cross-section analysis, consumers in states with more generous unemployment insurance provision levels (a higher $UINDX_t$ number) should save less than similar individuals in states with less generous unemployment insurance programs because of the effects of unemployment insurance on precautionary saving.

$\gamma'X$ is a vector sum of additional exogenous variables intended to control for characteristics other than those presented above which may affect the level of saving undertaken by someone in the panel. These additional variables include DRACE, UNION, AGE_t, $TENCJ_t$, NC_t, $SPOUSEINC_t$ and MD_t, all of which were defined in section two.

A two-stage regression process is used to analyze the versions of equation (1) which use the savings measures as dependent variables.[12] An investigation of the data shows that a significant number of individuals in the panel reported holding zero liquid assets. The percentage of those who reported having no deposits in financial institutions ($SAV1_t$=0) ranged from a low of 39% in 1976 to a high of 46% in 1969. For the broader measure of liquid asset holdings ($SAV2_t$), the percentage reporting zero holdings ranged from 37.5 percent of the respondents in 1971 to 40 percent in 1969. Significantly smaller percentages of respondents reported zero or negative net real wealth holdings, ranging from 19% in 1966 to 14% in

[12] This is the "hurdle" method proposed by Cragg (1971). He originally proposed this method as a means of modelling the demand for durable goods by consumers but argued that it is applicable to any situation in which "there is an event which at each observation may or may not occur. If it does occur, associated with it will be a continuous, positive random variable. If it does not occur, this variable has zero value." Cragg (1971, p. 829)

1981. The first stage of the regression process involves using a logit model to distinguish between the savers and the nonsavers in the panel.[13] The logit model indicates which traits increase the probability of an individual holding some positive level of saving.

The second stage in the analysis of (1) involves running either OLS or weighted least squares on those observations for which the savings measures are positive. Because of the large range of reported values for PERMINC, it is possible that the error terms from OLS in this second stage might be heteroscedastic. A Breush-Pagan test is conducted for each of the regressions and if the null of homoscedasticity is rejected, weighted least squares is used to ensure that correct standard errors are reported.[14]

To analyze (1) when the saving measures $DSAV1_t$, $DSAV2_t$, and $DSAV3_t$ are used as dependent variables, a similar procedure to that outlined above is used. The saving measures assume positive, zero, or negative values as individuals save, maintain a constant level of liquid asset holdings, or dissave, respectively, over the period in question. A logit model is again used in the first stage, this time to distinguish the zero savers from those who have saved or dissaved over a period. As before, the second stage involves running OLS or weighted least squares, depending on the outcome of a Breush-Pagan test, on those observations for which the saving measure non-zero. The results for the cross-section analyses conducted are reported in section five.

Panel Data Analysis

The second method I employ makes use of the panel aspects of the data by extending in both the individual and the time dimensions. The model estimated, similar to equation (1), is given by the following

---

[13]Nothing in the data indicates the true nature of the distribution of the error terms. Using a probit model in place of the logit model does not change the results in any qualitative or quantitative way.

[14]The weighted least squares procedure is performed in the following way. The natural logarithms of the squares of the residuals from an OLS regression are regressed on the OLS variable set. The exponentiated fitted values from this regression are then used as weights on the variables. OLS is then run on these weighted observations.

$$SAV_{it} = \alpha_i + X_{it}\beta + u_{it} \quad (2)$$

where i indexes the individuals, t indexes the time periods, α_i represents those effects fixed for an individual over time, X_k represents those k variables which vary over individuals as well as over time, and u_k is an error term. I chose to estimate a "fixed-effects" panel model because there is no reason to assume that the α_i's will be uncorrelated with X_k. I also assume that the parameters are fixed across individuals and time and that the errors are i.i.d. For ease of computation, I first differenced equation (2) rather doing a fixed-effects estimation, both of which eliminate the fixed-effect component of the error term. After first differencing, the specific form that equation (2) takes for estimating is

$$\begin{aligned} SAV_{it}-SAV_{it-1} = \beta_1 &+ \beta_2(FAMLABINC_{it}-FAMLABINC_{it-1}) \\ &+ \beta_3(LABINCSQR_{it}-LABINCSQR_{it-1}) \\ &+ \beta_4(UINDX_{it}-UINDX_{it-1}) \\ &+ \beta_5(REAL\ INT_{it}-REAL\ INT_{it-1}) \\ &+ \beta_6(JURAT_{it}-JURAT_{it-1}) \\ &+ (Z_{kit}-Z_{kit-1})\beta_k + u_{it}-u_{it-1} \end{aligned} \quad (3)$$

where Z_k represents additional exogenous variables included in the various regressions, and the other variables are as explained above. Note that variables which are constant over time, such as PERMINC and VARINC, are not included in a fixed-effects panel regression because it is not possible to estimate the coefficients of time-invariant regressors. Thus, real labor income, FAMLABINC, is used to capture the effects of income on the saving decision.

Besides the possible efficiency gain which comes from estimating the model with more information, using the entire panel should allow me to examine the saving behavior of individuals over time. Specifically, as the index of unemployment insurance generosity changes within states over time, we should observe an inverse relationship between those unemployment insurance generosity changes and the level of precautionary saving desired by individuals. We should observe analogous effects for the other variables as they change over time.

5. Regression Results

The results from the regressions described in the previous section are presented below. The tables dealing with the cross-section analysis of accumulated savings, contained in Appendix 3A, are paired, with the first table (designated a) in the pair containing the results from the logit regressions and with the second table (designated b) containing the corresponding OLS or weighted least squares results. Each pair of tables presents the results for the five years used in the study. Also contained in Appendix 3A are the OLS or weighted least squares regression results for the saving equations.[15] The results from the fixed-effects panel regressions, which are presented in Appendix 3B, are examined after the discussion of the cross-section results.

Cross-section Results for the Savings Equations

The empirical results for the regressions using the entire sample with accumulated savings as the dependent variable are presented in Tables 3A.1a through 3A.3b in Appendix 3A. The Breush-Pagan (B-P) statistics reported in Table 3A.1b (as well as in the other tables) are those for the unweighted OLS regression in question, while the coefficients and t-statistics presented in Table 3A.1b (and the others) are either those for the OLS regressions if the B-P test shows little evidence of heteroscedasticity or those for the weighted least squares regressions if the B-P test indicates that heteroscedasticity may be a problem.

Given the logit results presented in Tables 3A.1a, 3A.2a, and 3A.3a, it seems fair to conclude that the higher a respondent's permanent income, the greater the probability of the respondent having deposits in financial institutions, as all of the coefficients on PERMINC for the liquid savings measures are positive and statistically significant while three of the five regressions on the illiquid savings measure show significant and positive coefficients on PERMINC. It also seems evident that the

[15]The logit results for the saving regressions are available from the author upon request. They are very similar to the logit regressions for the savings equations in sign and statistical significance.

relationship between asset holdings and income is nonlinear since the coefficients on PERMINCSQR are in nearly all cases statistically significant. For the liquid savings measures, it is generally the case that the higher the index of unemployment insurance generosity, UINDX, the higher the probability of having accumulated savings. An increase in the generosity of unemployment insurance may decrease the probability that the respondent held wealth in illiquid assets, as shown by Table 3A.3a, although in only two of the five regressions is the coefficient statistically different from zero. Tables 3A.1a, 3A.2a, and 3A.3a also indicate that: (1) having an income-earning spouse (SPOUSEINC=1), if anything, increases the probability of having accumulated savings; (2) the greater the income variability, VARINC, the lower the probability of the respondent having accumulated savings; (3) the higher the job-specific unemployment rate, in general, the lower the probability of having accumulated savings; (4) the greater the age of the respondent, the higher the probability of having accumulated savings; (5) the greater the number of children (NC), the lower the probability of having accumulated savings; (6) the longer the respondent had worked at the same job (TENCJ), the higher the probability of having accumulated savings; (7) black respondents (DRACE=1) had a much lower probability of having accumulated savings than did white respondents; and (8) union members (UNION=1) exhibited a much lower probability of having accumulated savings than did respondents who were not members of a labor union. The coefficients on UINDX, VARINC, and JURAT seem to run counter to what would be expected if consumers were saving for precautionary reasons. However, it must be kept in mind that these regressions only distinguish between those respondents who have accumulated savings and those who do not. Agents who have experienced periods of unemployment in the past or who have highly variable incomes may have had to "pay the bills" using their accumulated savings during an unemployment spell or a low income stretch, thus decreasing their level of accumulated savings.

Tables 3A.1b, 3A.2b, and 3A.3b present the results from the weighted least squares regressions for the three savings measures under examination conditional on accumulated savings being positive. The regressions in these tables show demonstrate the nonlinearity of the relationship between accumulated savings and permanent income in this data, especially the regressions for $SAV2_t$ and $SAV3_t$.

The results with respect to UINDX in Tables 3A.1b, 3A.2b, and 3A.3b would seem to indicate that the higher the index of unemployment insurance generosity, the greater the accumulated savings for those with positive levels of accumulated savings.[16] For the three tables, only those coefficients which are positive are statistically significant. Given that on average a $1 increase in weekly benefits translates into an increase in UINDX of about 2.5 points[17], every additional $1 of weekly unemployment insurance benefit meant nearly $90 dollars of additional passbook savings by respondents in 1966 who had accumulated savings and nearly $658 dollars of additional net wealth. One possible explanation for this result is that the savings measure used might not be a good proxy for precautionary savings. If agents set aside a specific dollar amount for precautionary reasons, say the equivalent of three months income, and maintain that as a minimum level of savings, then any fluctuations in accumulated savings above that dollar amount may not accurately reflect changes in precautionary saving behavior. If a positive relationship between unemployment insurance benefit generosity and savings does exist, the results from the chapter one would imply that the unemployment insurance tax rate in the U.S. may be greater than the optimal tax rate.

---

[16]Regressions using the separate components of the unemployment insurance generosity index were run to determine if any individual component was more important than the others with regards to the results on the UINDX variable. The results from these regressions showed no consistent pattern on the coefficients of the three components of the index in terms of sign or statistical significance. For some years, the benefit ratio was important in determining the level of savings by the respondents in the surveys while for other years the covered unemployment rate seemed to be more important in determining the level of savings. Since there is no individual component of the generosity index which consistently determined the level of savings, the index itself seems to be the better overall determinant in the level of savings. The individual component regression results are available from the author.

[17]This varies from state to state depending on the level of the average weekly benefit in that state. The figure used is an average for all the states.

The coefficients on JURAT are small in value and are generally not statistically significant for the regressions which use the liquid savings measure as the dependent variables, meaning that for this sample of individuals, changes in the job-specific unemployment rate affect liquid savings very little. Table 3A.3b shows, however, that net wealth is negatively related to the job-specific unemployment rate (at least for all years other than 1981). There are two possible reasons for the lack of a statistical relationship between JURAT and the two liquid savings measures. It is conceivable that for these individuals, most of whom have been working at the same job for long periods of time, the unemployment rate represented by JURAT does not accurately represent the unemployment possibilities they face. If that is the case, then changes in JURAT would not affect SAV1 or SAV2 in any systematic way. A second possible reason might be that because of their long job times, the subjective probabilities of these individuals being unemployed may be so low that they save little as a precaution against future unemployment. The negative, statistically significant relationship between JURAT and net wealth could indicate that respondents who face relatively high unemployment rates may have experienced frequent periods of unemployment, prohibiting them from building up assets in the form of homes, autos, etc. Finally, the negative coefficients on JURAT in all three tables, although in many of the cases not statistically significant, could be the result of self-selection on the part of respondents in that those more willing to accept the risk of a job in a field with higher unemployment rates would also be those less likely to save for precautionary reasons.[18]

The coefficients on SPOUSEINC, a dummy variable indicating whether the spouse of the respondent had any wage or salary income, may indicate the existence of precautionary saving behavior. Without a precautionary saving motive, one would expect that having a working spouse would translate into higher levels of family savings if saving is a normal good.

---

[18]Skinner (1988) also recognized that this may be a problem when categorizing the income risk faced by individuals according to the job they possess.

For the regressions depicted in Tables 3A.1b, 3A.2b, and 3A.3b, the only coefficients on SPOUSEINC which are statistically significant are negative in sign, with the exception of the 1981 regression using SAV3 as the dependent variable. For the respondents in this data set, having an income-earning spouse corresponds to lower levels of accumulated savings, conditional upon accumulated savings being positive, perhaps because of a decreased demand for precautionary saving.

The coefficients on VARINC seem to indicate that variance of income explains little if any of the variation in the level of accumulated savings for those who have accumulated savings since the coefficient is statistically significant in only three of the fifteen regressions in the three tables. When statistically significant, the coefficients on VARINC are negatively signed which may indicate that these respondents simply are not able to accumulate wealth as effectively when their income exhibits large fluctuations.

The coefficients on AGE in nearly all of the regressions in the three tables show that the level of accumulated savings is positively related to the age of the respondent. The older the participant in the survey, other things equal, the higher the level of accumulated savings.

The length of time on the current job, TENCJ, was included as a regressor to capture the possibility that long job tenure represented greater job security and therefore less risk of income drops due to unemployment, meaning that if a precautionary saving motive were operative one might expect there to be an inverse relationship between savings and job tenure. Tables 3A.1b, 3A.2b, and 3A.3b reveal, however, that the coefficients on TENCJ are most often positive, and in none of the regressions are they negative and statistically significant, meaning that the longer the time on the current job, the more the respondent had in accumulated savings. It is likely that the coefficients on TENCJ again reflect a self-selection process in action. Individuals with long job histories may also be individuals with a greater predisposition towards saving, causing TENCJ to fail to detect precautionary saving behavior.

The greater the number of children in the home, the lower the level of savings, especially liquid savings, as can be seen by examining the coefficients on NC in the regressions in Tables 3A.1b, 3A.2b, and 3A.3b. The expense involved in feeding, clothing, and caring for children evidently reduces the ability of consumers to accumulate liquid savings. The relationship is much less strong between net wealth and NC. Those with children living with them may be more likely to also be homeowners and may be accumulating wealth in the form of home equity, which may offset the effects of having children on other assets.

The coefficients on the dummy variable for race, DRACE, are negatively signed and highly statistically significant for the regressions presented in all three tables. For this sample, non-white males had average accumulated liquid savings up to $4800 less, depending on the saving measure used, and on average up to *$60,000* less in net wealth, than did white males, everything else constant. The NLS did intentionally oversample blacks with nearly thirty percent of the respondents in the sample being black. Average PERMINC for the black respondents was nearly $6000 lower than that for the white respondents, so it is very likely the case that the black respondents simply were unable to save as much as their white counterparts.

The coefficients on UNION in Tables 3A.1b, 3A.2b, and 3A.3b are, for the most part, negatively signed, large in magnitude, and statistically significant, indicating that union members accumulate significantly less savings, both liquid and illiquid, than do those not in labor unions. One possible explanation for this effect could be that unions provide more income security both in the form of greater job security and in higher unemployment insurance benefit provision should layoffs occur, thus decreasing the need for precautionary saving by union members since income variability is reduced. Separate regressions were run for union members and for those not in unions with the results reported later in this section.

For the most part, being married reduced the accumulated liquid savings for the respondents in the survey, conditional on savings being positive, as shown by the coefficients on MD in Tables 3A.1b and 3A.2b in Appendix 3A. On the other hand, Table 3A.3b indicates that being married generally led to greater levels of illiquid asset holdings. For the liquid savings measures, it may be that MD is capturing the same type of effect as the regressor NC, namely that it is more expensive for two people to live than one, and that those in the survey who were married were unable to save as much as their unmarried counterparts. It could be that the married dummy is capturing the effects of having a spouse with income which are not captured by the variable SPOUSEINC. If the spouses of the respondents had significant sources of income other than wage and salary income, then perhaps MD captures a precautionary saving effect similar to that indicated by SPOUSEINC. An outside income source (other than labor income) would make family income less volatile, reducing the need for precautionary saving. The positive relationship between net wealth and being married may indicate that net wealth is not a good proxy for precautionary savings. MD may simply be picking up the fact that married couples tend to accumulate assets in the form of homes, cars, and other such illiquid wealth in place of more liquid assets.

Cross-section Results for the Saving Equations

Tables 3A.4 through 3A.9b in Appendix 3A give the results for the regressions using a measure of saving as the dependent variable. Tables 3A.4 through 3A.6 present the regression results for DSAV1, DSAV2, and DSAV3, respectively, when the dependent variables are comprised of both savers and dissavers. As the low values for the F-statistics and the R-squares indicate, these variables do a poor job of explaining why both savers save as much as they do and dissavers dissave as much as they do, given that they either save or dissave.

Because it might be the case that the same model does not adequately explain the behavior of both savers and dissavers, a variation of the hurdle method was used which distinguishes between the three groups, dissavers, zero savers, and savers. In the first stage of the process, a multinomial logit model is used to differentiate between those who dissave, those who save, and those who choose zero saving over a period. The second stage of the process involves running separate OLS (or weighted least squares) regressions on those with positive saving and those with negative saving.

Tables 3A.7a through 3A.9b present the saving regression results.[19] The "a" portion of the table gives the regression results conditional on saving being positive over the period in question while the "b" portion of the table presents the results conditional on saving being negative over the period. A test to determine the equivalence of the "a" and "b" regressions (whether or not the samples come from the same population) overwhelmingly rejects the hypothesis that the coefficients in the "a" and "b" regressions are equal.[20] For this sample, it seems that saving and dissaving should be modelled in different ways.

Tables 3A.7a, 3A.8a, and 3A.9a in Appendix 3A show the weighted least squares regression results conditional on saving in a period being positive. As with the regressions dealing with accumulated savings, the regressions on saving in Tables 3A.7a, 3A.8a, and 3A.9a generally indicate that there is a nonlinear relationship between saving and the family unit's permanent income.

The coefficients on UINDX in Tables 3A.7a, 3A.8a, and 3A.9a again generally seem to indicate that a more generous unemployment insurance plan results in increased saving by those who save. Where the coefficients on UINDX are statistically significant, they show a positive relationship between the unemployment generosity and saving. As stated earlier, given the theoretical work in chapter one, this may be an

---

[19]The multinomial logit regression results are similar to the logit regression results given in tables 3A.1a, 3A.2a, and 3A.3a in terms of signs and statistical significance of the coefficients. These results are available upon request.

[20]A Chow test was used to determine whether or not the two samples came from the same population in each of the regression pairs. The F-statistics from the Chow tests were all greater than 50 meaning, with the critical value being less than 2 in all cases, that the null hypotheses of equivalence of coefficients between the various pairs of regressions is easily rejected.

indication that the unemployment insurance tax rate (and therefore the UI benefits) is too high.

The coefficients on VARINC are positive for the most part in Tables 3A.7a, 3A.8a, and 3A.9a which might indicate precautionary saving on the part of the respondents. However, in all cases but one the coefficients are not statistically different from zero. As is the case with the regressions dealing with accumulated savings, the variance of income seems to play little role in determining the amount of saving undertaken during a period.

The coefficients on JURAT provide little evidence for or against the existence of precautionary saving in the regressions detailed in tables. In the twelve regressions in these three tables, in only four regressions is the coefficient on JURAT statistically significant, three times negatively so. A job-specific unemployment rate for workers in specific job categories may not be a good proxy for the perceived unemployment probabilities faced by these respondents. Overall, little can be said about the effects of the unemployment rate on the level of precautionary saving using these data in a cross-section analysis.

The results for the effect of having an income-earning spouse on saving behavior may provide evidence of precautionary saving behavior. Tables 3A.7a and 3A.8a show that for the periods 1966-69 and 1969-71 for the narrow saving measure and for all four periods for the broader liquid saving measure, families with two incomes saved less than families with only one income (conditional on saving being positive). One possible explanation is that given in the discussion of the accumulated savings regressions: two-income households have a lower probability, in general, of drastic income decreases and hence have a lower demand for precautionary saving. The coefficients on SPOUSEINC for the last two regressions in Table 3A.7a may indicate that as older respondents retire, only those with working spouses are able to add to very liquid savings. The regressions in Table 3A.9a show that a working spouse seems to have very little impact on saving in the form of illiquid asset accumulation.

The results for the other variables in the saving regressions in Tables 3A.7a, 3A.8a, and 3A.9a are very similar to those for accumulated savings given in Tables 3A.1b, 3A.2b, and 3A.3b and the discussions there about the reasons behind the results apply here as well. The coefficients on AGE in the regressions in Tables 3A.7a, 3A.8a, and 3A.9a for the most part show that the older the respondent, the more he saved in a period. Similarly, the longer the respondent has been on the job (the larger TENCJ), the greater the saving undertaken by the respondent on average. The greater the number of children at home (the greater NC), the lower the saving undertaken by the average respondent. Non-white respondents generally saved a great deal less than did white respondents in any given period. For the saving regressions, a married respondent seemed to save less than a non-married respondent in the form of liquid assets. The coefficients on MD in Table 3A.9a would seem to indicate that being married had very little effect on saving in the form of illiquid assets for the respondents in the survey. In general, union members saved less than non-union members in the form of illiquid assets and in SAV2-type assets.

Cross-section Regressions by Union Membership

Whether or not a respondent is a member of a labor union may play a role in the precautionary saving decision process. Frequently, labor unions provide unemployment insurance benefits beyond those provided by a state, may ensure that their members are provided health care, and may provide for greater job security for their members. If union members are the beneficiaries of such programs, they may exhibit different saving behavior than their non-union counterparts. A comparison of the two groups indicates that union members have substantially higher labor income on average, although their family permanent income is only about $300 per year greater than that of the average non-union member. Also interesting is the fact that for the five years of this data set, union members consistently reported very liquid asset holdings (deposits in banks and savings & loans) only sixty percent, on average, of those of the typical non-union member. In order to examine this aspect of precautionary saving behavior more closely, separate regressions were run for those who were members of a union and for those who were not union members. Selected results for the regressions on these two groups are reported in Tables 3A.10 through 3A.12 of Appendix 3A.[21]

The regressions of the saving(s) measure on the independent variables conditional on saving(s) being positive, show that job tenure may be viewed differently by the two groups in this sample when the decision about how much to save is made. For non-union members, the coefficients on TENCJ were positive and generally statistically significant, indicating that longer job tenure for non-union workers meant, on average, higher levels of saving(s). For union members, the coefficients on TENCJ were never statistically significant.

There also may be some difference between union members and non-union members with respect to the generosity of unemployment insurance. More often than not, for union members the coefficients on UINDX are positive, statistically significant, and larger in magnitude than the corresponding coefficients on UINDX for non-union members. Given the results from the theoretical work, this empirical result may be evidence that labor unions replace a larger-than-optimal portion of a laid-off worker's income.

The fact that union members generally had lower asset holdings than did non-union members may indicate that union members perceived themselves to be at lower risk of loss of income due to unemployment because of their union membership and thus chose to save less. If this is the case, then increased union membership may lead to decreased precautionary saving.

Fixed-Effects Panel Regression Results

The tables in Appendix 3B present the results from various regressions using the fixed-effects panel data model. Table 3B.1 in

---

[21]Regression results for the other years are available from the author upon request. The logit regressions by union membership for all of the years in the study are also available.

Appendix 3B shows the regression results for all six measures of saving(s), SAV1, SAV2, SAV3, DSAV1, DSAV2, and DSAV3, and provides some evidence as to the existence of precautionary saving behavior. The coefficients on the variable SPOUSEINC are negative (although not statistically significant) for the liquid saving(s) measures, meaning that respondents with income-earning spouses generally had lower levels of accumulated savings and that they saved less over any given period. As explained in the cross-section analysis parts above, this could come about because of a reduced demand for precautionary saving due to lower family income uncertainty. For the illiquid measure of saving(s), the coefficients on SPOUSEINC are positive but are not statistically significant. This may be another indication that net wealth is not a good proxy for precautionary savings.

Also indicative of the possible existence of precautionary saving behavior are the coefficients on the regressor TENCJ in Table 3B.1. Negative (although again not statistically significant) in three of the four regressions on the liquid saving(s) measures, the coefficients on TENCJ show that a longer time on the current job results in a lower level of accumulated savings. One reason for this might be that a longer time on the job translates into greater job security, lower income uncertainty, and a therefore a reduced need for precautionary saving on the part of the respondents in the surveys.

Similarly, for the more liquid saving(s) measures SAV1 and DSAV1, the positive and statistically significant coefficients on JURAT in Table 3B.1 of Appendix 3B reflect the fact that the greater the probability of being unemployed, as measured by the unemployment rate, the higher the level of accumulated savings and the higher the amount of saving each period. This makes sense in a world in which the individuals are saving for precautionary reasons against some potential income loss. In three of the other four regressions, the coefficients on JURAT are positive, though not statistically significant, giving further evidence of behavior one would expect if the respondents were saving for precautionary reasons.

The coefficients on UINDX in Table 3B.1 are all positive but not significantly different from zero. The fact that the coefficients are positive could be an indication that the unemployment insurance tax rate is greater than the optimal tax rate. However, given the fact that the coefficients are not statistically significant, the generosity of unemployment insurance provision would seem to have little effect on the saving(s) behavior of those in the sample. Again, it is not clear whether this accurately reflects the lack of any substantial link between precautionary saving behavior and the provision of unemployment insurance or whether, since I have not distinguished between the covered and non-covered respondents, my data are insufficient to detect the link. As stated earlier in the discussion of the cross-section results, it may also be the case that this group of individuals, with their generally long job tenures, may face such low personal probabilities of unemployment that changes in the generosity of UI benefits have little effect on their saving(s) behavior.

Time dummies D1, D2, and D3 were used in regressions for each of the savings measures to determine if any effects outside the model which changed over time had an impact on saving(s) behavior, and given the results in Table 3B.1, it is clear that the respondents had larger accumulated savings balances as they aged. It also seems clear that the respondents saved less in any one period as they aged, given the coefficients on DD2 and DD3 in the regressions using the saving variables of the last three columns. In conjunction with the large magnitude of the coefficients on REAL INT, the reported rate of return to asset holdings adjusted for inflation, the coefficients on D1, D2, and D3 for the accumulated savings regressions could also be detecting the effects of the liberalization of the banking laws in the 1970's. The saving environment changed greatly over the years 1966 to 1981, with the late 1970's and early 1980's being a period of high interest rates and diversification in banking services, enabling those who desired secure investments to obtain high rates of return on bank instruments such as certificates of deposit.

As in the cross-section analysis, the coefficients on FAMLABINC and LABINCSQR provide evidence that the relationship between a family's labor income and its saving(s) is nonlinear for those in this data set.

The coefficients on the variables NC and MD are not statistically significant for the saving(s) regressions of Table 3B.1, although the positive coefficient on the number of children for the regressions is somewhat curious. The cross-section results indicate that saving is negatively related to the number of children in the household. This is a strong, consistent result of the cross-section analysis. It is not clear why saving(s) should increase with the number of children unless some sort of "saving for the children's future" is occurring.

Fixed-effects Panel Regressions by Union Membership

Tables 3B.3 and 3B.4 of Appendix 3B show the results of splitting the sample into respondents who are in a labor union and respondents who are not members of a labor union, respectively. The regressions for those not in labor unions for the most part show a nonlinear relationship between income and saving(s). This is not the case for those respondents who were members of labor unions as clearly seen in Table 3B.4 of Appendix 3B.

Also interesting are the coefficients on UINDX for the respective groups. For the non-union respondents, changes in the generosity of unemployment benefits seem to have little affect on saving(s). However, for those respondents who were union members, the regressions in Table 3B.4 indicate that the more generous the unemployment insurance benefits, the higher the level of saving(s). This might be evidence that for union members, unemployment insurance benefits are greater than some optimal benefit level. In this case, the theoretical model of chapter one indicates that a positive relationship between precautionary saving and unemployment insurance benefits is to be expected.

One final difference between the panel regressions run on union members versus those run on non-union members involves the coefficients on JURAT. The coefficients on JURAT for the liquid saving(s) measures SAV1 and DSAV1 for non-union respondents are positive and statistically significant, while none of the coefficients on JURAT for those respondents who were union members are statistically significant. This might indicate that the possibility of future unemployment causes the non-union members to engage in precautionary saving against some probability of future income loss, while union members can rely more heavily on their union to provide for them during bouts of unemployment.

In summary, the results of the fixed-effects panel regressions show a limited relationship between the generosity of unemployment insurance provision and precautionary saving. There is some evidence that for union members, precautionary saving and unemployment insurance generosity may be positively related. These regressions do, however, seem to indicate the presence of precautionary saving behavior on the part of the respondents in the survey. Section six discusses reasons for the difficulties encountered in determining the relationship between precautionary saving and unemployment insurance generosity.

6. Estimation Problems and Precautionary Saving Behavior

As the previous section detailed, there appeared to be limited evidence from the regressions run for the existence of a link between precautionary saving and the generosity of unemployment insurance benefits. Furthermore, signs of precautionary saving behavior were detected, but in many cases these signs were based on coefficients which were not statistically significant or whose signs fluctuated from regression to regression. Below I detail some of the possible reasons for these problems.

Inadequate Measures of Precautionary Saving

The proxies used in this chapter may not accurately represent precautionary saving. To accurately perform this type of analysis, what is needed is a survey asking the respondents exactly how much of their "saving" dollar is set aside for precautionary reasons, how much for their retirement, how much for the new car they wish to buy, etc. Unfortunately such data, to my knowledge, do not exist. The researcher is left to try to control for as many variables affecting saving behavior as possible in the hopes of being able to distinguish between the reasons for saving, a task which proves to be very difficult. All of the empirical studies to date have struggled with the question of how to represent precautionary savings. Most have opted to try to detect consumption fluctuations brought about by changes in some variable representing the risk faced by consumers. These previous empirical studies have met with little success, indicating either that precautionary saving behavior does not exist or that their measure of precautionary savings was flawed. I make use of reported liquid asset holdings data in the belief that any precautionary savings would be held in liquid form so that it would be readily accessible. It is possible that since precautionary savings may actually be some fraction of actual asset holdings, my measures may be detecting saving forces at work other than the precautionary saving forces I had hoped to detect.

Precautionary Savings Satiation Point

If consumers set aside some fixed amount in a "rainy-day fund" and the amount in this fund stays relatively constant, then fluctuations in income, interest rate, unemployment insurance provision, etc. will not have any detectable effects on precautionary savings. Any changes in savings brought about by changes in these variables would not reflect changes in precautionary savings, and thus coefficients may not be statistically different from zero.

Liquidity Constraints

Another possible reason for the failure to find strong evidence of precautionary saving behavior and to find a link between unemployment insurance benefits and precautionary savings may be that some of the respondents in the surveys were liquidity constrained. If they needed every dollar of income simply to meet day-to-day living expenses, those surveyed would have been unable to save for any reason, let alone for precautionary reasons. In order to test for the possibility of liquidity constrained behavior, I eliminated all households with permanent income of less than $5000 and less than $10000 (in 1976 dollars) and reran the main regressions presented in section five. The results for regressions in which households with permanent incomes of less than $5000 have been eliminated are presented in Tables 3A.13a through 3A.18b in Appendix 3A for the cross-section regressions and Table 3B.2 in Appendix 3B for the panel regressions.[22] Even though this resulted in the elimination of up to half the observations in some of the regressions, the results are nearly identical in terms of signs, magnitudes, and the statistical significance of the coefficients to the results of section five. The fact that eliminating respondents who may be liquidity constrained had little effect on the detection of precautionary savings behavior corroborates the same finding by Dynan (1991).

Data Problems

In addition to the above problem in defining precautionary savings, there are problems particular to the NLS data set I use. Ideally, I would have savings data (as well as the other data) for at least every year over a five or ten year period. The fact that I have "snapshots" of savings behavior at two- to five-year intervals, while better than having simply one year of cross-sectional data, allows for large, and quite possibly important, intraperiod fluctuations in savings which I am unable to detect.

Perhaps the main problem with the data set is that these respondents may have very low perceived probabilities of being unemployed in the future because of their ages and job tenures, meaning changes in the generosity of unemployment insurance benefits would have very little practical impact on them. If they feel with near certainty that they are

[22]The results for regressions in which households with permanent incomes of less than $10,000 have been eliminated are available upon request.

not going to be unemployed in the prior to retirement due to layoff, for example, they may not alter their saving behavior in any way in response to a small change in UI benefit levels.

Precautionary Saving Levels May Be Very Low

Given all of the social safety nets in today's society, it may be the case that people simply do not save a great deal for precautionary reasons. Auto insurance, health insurance, life insurance, unemployment insurance, food stamps, welfare, and other "assistance" programs may have eroded the perceived need for precautionary saving to the point where the levels of precautionary saving are indistinguishable from zero empirically. So even though people may have an inclination to save for an uncertain future, the need to do so is not there because of the programs mentioned above.

7. Conclusions

This chapter empirically tests the link between precautionary saving and the generosity of unemployment insurance provision. In order to do this, I develop an index of unemployment insurance benefit generosity for each state. Using this index and data from the National Longitudinal Surveys of Mature Men for the years 1966, 1969, 1971, 1976, and 1981, I test for the above link using two distinct methods: (1) I perform separate cross-section analyses for each of the years listed above, using six different liquid asset measures and various sets of regressors in a two-stage process; (2) I use a fixed-effects panel regression model to analyze the six liquid asset measures in both the individual and the time dimensions.

I find some evidence of a link between precautionary savings and unemployment insurance benefit generosity. In the cases in which the coefficients are statistically significant, more often than not they indicate the existence of a positive relationship between unemployment insurance and precautionary saving. This positive relationship between precautionary saving and unemployment insurance seems especially evident in the case of union members, which may be an indication that UI benefit provision levels by labor unions are greater than optimal. In part, the difficulty in finding definitive evidence of the link in the whole sample may be due to the fact that the respondents in this sample are generally at a point in their careers at which their perceived probability of being unemployed in the near future is very low. If this is the case, changing unemployment insurance benefit generosity will have very little, if any, effect on them since they do not anticipate ever needing to use it.

My regressions do show some evidence of the existence of precautionary saving, unlike the results of Skinner (1988), Kuehlwein (1991), or Dynan (1991). I find that the levels of liquid asset holdings are generally lower for respondents in the survey who have an income-earning spouse. The risk of complete income loss faced by two-income households is lower than that faced by a single-income household and the empirical results indicate that this reduced risk leads to lower levels of saving, presumably because of lower levels of precautionary saving.

Also, the levels of liquid asset holdings are in some cases found to be inversely related to tenure on the current job. If long job time can be equated with job security and hence with a decrease in income uncertainty, then the negative relationship between length of job tenure and saving levels may be an indication of precautionary saving behavior.

Finally, I find a positive relationship between the job-specific unemployment rate faced by the respondents and the level of savings for some of the regressions. Higher saving in the face of higher unemployment rates is behavior typical of a consumer engaging in precautionary saving behavior.

The fact that this work finds no evidence that increasing unemployment benefit provision reduces the level of savings is especially important given the evidence uncovered of precautionary saving behavior on the part of the respondents in this sample. If the respondents were not saving for precautionary reasons, one would not expect changes in unemployment insurance benefits to affect savings since the precautionary component of savings would be absent. However, given the empirical evidence that these respondents *are* engaging in precautionary saving behavior, the lack of empirical evidence of an inverse relationship between savings and unemployment insurance is more robust.

Given the potential significance of saving in terms of capital accumulation and economic growth, it is important to determine if (and the extent to which) programs such as unemployment insurance, health insurance, worker's compensation, and the host of social welfare programs have decreased consumer saving by decreasing the demand for precautionary saving. This chapter represents the first attempt to determine empirically the extent to which unemployment insurance programs affect precautionary saving behavior.

APPENDIX 3A

APPENDIX 3A

TABLE 3A.1a
LOGIT RESULTS USING $SAV1_t$[1]

	1966	1969	1971	1976	1981
PERMINC	.00020 (12.056)	.00019 (10.475)	.00017 (9.46)	.00012 (5.159)	.00015 (4.973)
PERMINCSQR	-2.7e-09 (-7.813)	-2.68e-09 (-7.312)	-2.48e-09 (-6.846)	-1.4e-09 (-2.461)	-2.11e-09 (-3.579)
UINDX	.0053 (1.400)	.0091 (2.242)	-.0030 (-.888)	.0069 (1.387)	.0132 (2.419)
VARINC	-7.36e-10 (-.932)	-1.85e-09 (-1.954)	-9.01e-10 (-1.084)	-2.29e-09 (-2.354)	-6.81e-09 (-2.817)
AGE	.0266 (2.315)	.0273 (2.188)	.0311 (2.511)	.0100 (.597)	.0227 (.937)
SPOUSEINC	-.0051 (-.054)	.1190 (1.154)	-.0786 (-.771)	.1792 (1.362)	.6862 (3.360)
NC	-.1089 (-4.182)	-.1159 (-3.653)	-.1493 (-4.657)	-.0480 (-.949)	-.0511 (-.494)
TENCJ	.0116 (2.756)	.0138 (3.274)	.0065 (1.653)	.0074 (1.650)	.0106 (1.738)
DRACE	-1.052 (-10.462)	-1.072 (-9.64)	-1.066 (-9.912)	-1.163 (-8.778)	-1.295 (-6.372)
UNION	-.1248 (-1.339)	-.2469 (-2.459)	-.0142 (-.142)	-.1275 (-.996)	-.2045 (-1.082)
MD	-.2622 (-1.671)	-.2561 (-1.515)	-.2114 (-1.327)	-.0085 (-.048)	-.6702 (-2.638)
JURAT	-.0444 (-1.825)	-.0922 (-2.734)	-.0280 (-1.421)	.0115 (.562)	-.0208 (-.786)
CONS	-2.524 (-3.668)	-2.751 (-3.491)	-1.870 (-2.366)	-1.582 (-1.387)	-2.795 (-1.611)
OBS	2962	2482	2552	1613	766
LOG LIKELIHOOD	-1623.95	-1385.51	-1435.93	-897.92	-422.38
chi2	650.45	515.27	418.63	263.51	158.82

[1]t-statistics are given in parentheses beneath the coefficient values.

P
P
U
V

TABLE 3A.1b
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE SAV1$_t$[1]

	1966	1969	1971	1976	1981
PERMINC	.0027 (.037)	.0711 (.895)	.0701 (.605)	-.5349 (-3.060)	.4386 (.994)
PERMINCSQR	3.65e-06 (1.407)	3.78e-06 (1.250)	5.62e-06 (1.312)	.000025 (3.475)	8.08e-06 (.510)
UINDX	35.97 (4.190)	11.62 (1.264)	13.83 (1.327)	-17.11 (-1.032)	-43.36 (-1.474)
VARINC	8.22e-07 (.243)	-3.92e-06 (-.814)	2.64e-06 (.253)	-.000011 (-2.608)	-.000019 (-1.976)
AGE	181.40 (6.561)	216.81 (6.401)	204.80 (4.471)	-162.07 (-2.211)	343.24 (1.773)
SPOUSEINC	-633.13 (-3.448)	-528.35 (-2.372)	-986.90 (-2.965)	826.82 (1.641)	-2658.26 (-2.491)
NC	-80.27 (-2.772)	-99.51 (-1.766)	-448.68 (-3.600)	-704.50 (-4.725)	-914.03 (-3.844)
TENCJ	.0250 (.003)	28.24 (2.655)	10.04 (.753)	84.82 (4.073)	.4578 (.011)
DRACE	-2051.27 (-9.949)	-2152.10 (-9.178)	-2138.44 (-6.713)	-3351.31 (-7.405)	-4098.36 (-4.674)
UNION	-546.92 (-2.848)	-788.93 (-3.349)	-833.01 (-2.398)	1298.2 (2.370)	-2041.63 (-1.878)
MD	-767.14 (-.791)	-3117.90 (-1.814)	-1652.92 (-2.201)	48.15 (.076)	4142.01 (3.642)
JURAT	-10.09 (-.242)	-14.65 (-.225)	-76.07 (-1.270)	-100.42 (-1.558)	78.03 (.533)
CONS	-6561.51 (-3.671)	-5918.77 (-2.441)	-5432.49 (-2.008)	18389.97 (3.979)	-18048.69 (-1.311)
OBS	1871	1549	1670	1071	488
F-STAT	54.77	51.46	52.62	36.61	12.79
R-square	.2770	.3034	.2922	.3103	.2592
B-P	80.45[2]	82.87[2]	54.78[2]	32.02[3]	44.65[2]

[1] t-statistics are given in parentheses beneath the coefficient values.
[2] Significant at the .001 level, so weighted least squares results reported.
[3] Significant at the .005 level, so weighted least squares results reported.

TABLE 3A.2a
LOGIT RESULTS USING $SAV2_t$[1]

	1966	1969	1971	1976	1981
PERMINC	.00021 (10.320)	.00024 (12.028)	.00020 (10.113)	.00015 (5.751)	.00017 (5.478)
PERMINCSQR	-2.35e-09 (-4.775)	-3.31e-09 (-8.321)	-2.58e-09 (-6.219)	-1.67e-09 (-2.532)	-2.40e-09 (-3.947)
UINDX	.0051 (1.258)	.0074 (1.687)	-.0008 (-.221)	.0074 (1.438)	.0146 (2.543)
VARINC	-7.49e-10 (-.789)	-2.73e-09 (-2.731)	-1.35e-09 (-1.468)	-2.86e-09 (-2.769)	-6.09e-09 (-2.599)
AGE	.0259 (2.127)	.0266 (1.985)	.0379 (2.861)	.0041 (.235)	.0136 (.542)
SPOUSEINC	.0011 (.011)	.0337 (.303)	-.1446 (-1.322)	.1941 (1.405)	.7979 (3.675)
NC	-.1404 (-5.189)	-.1170 (-3.518)	-.1059 (-3.231)	-.0541 (-1.042)	.0378 (.361)
TENCJ	.0204 (4.524)	.0160 (3.538)	.0106 (2.521)	.0124 (2.629)	.0132 (2.050)
DRACE	-1.051 (-10.202)	-1.082 (-9.507)	-1.082 (-9.793)	-1.131 (-8.324)	-1.336 (-6.488)
UNION	-.1088 (-1.090)	-.1995 (-1.829)	-.0782 (-.729)	-.1754 (-1.304)	-.3377 (-1.716)
MD	-.2110 (-1.308)	-.2496 (-1.426)	-.2196 (-1.329)	-.1852 (-1.023)	-.7579 (-2.870)
JURAT	-.0524 (-2.030)	-.1257 (-3.488)	-.0375 (-1.777)	.0120 (.554)	-.0201 (-.727)
CONS	-2.400 (-3.302)	-2.609 (-3.100)	-2.450 (-2.904)	-1.276 (-1.073)	-2.317 (-1.284)
OBS	2962	2482	2552	1613	766
LOG LIKELIHOOD	-1479.02	-1236.47	-1295.99	-836.76	-394.28
chi2	732.83	604.40	493.71	293.91	174.61

[1] t-statistics are given in parentheses beneath the coefficient values.

TABLE 3A.2b
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE SAV2[1]

	1966	1969	1971	1976	1981
PERMINC	-.1130 (-.629)	-.3965 (-1.656)	.2175 (.905)	-1.013 (-4.052)	1.451 (2.273)
PERMINCSQR	.00001 (1.882)	.00002 (2.825)	.00001 (1.188)	.00005 (4.407)	-.00002 (-.667)
UINDX	43.98 (2.470)	92.69 (4.549)	19.91 (1.195)	-3.61 (-.166)	6.33 (.127)
VARINC	-.00003 (-1.700)	-.00001 (-.611)	8.88e-06 (.595)	7.51e-06 (.248)	-.00006 (-.574)
AGE	304.03 (4.981)	518.88 (6.856)	386.58 (5.602)	-74.38 (-.750)	698.86 (2.040)
SPOUSEINC	-1247.11 (-2.894)	-1429.90 (-2.814)	-2192.88 (-4.498)	478.17 (.757)	-273.32 (-.168)
NC	-140.07 (-1.143)	-292.78 (-2.053)	-438.14 (-3.160)	-881.78 (-4.293)	-622.75 (-1.432)
TENCJ	-13.08 (-.568)	26.52 (1.106)	66.67 (3.226)	69.66 (3.046)	.4180 (.007)
DRACE	-3153.36 (-6.837)	-2811.72 (-5.418)	-2690.77 (-5.172)	-4378.92 (-7.606)	-3957.57 (-2.238)
UNION	-1380.08 (-3.020)	-888.92 (-1.651)	-2343.55 (-4.551)	922.85 (1.274)	-5409.64 (-3.056)
MD	-5052.13 (-5.018)	-2747.19 (-1.613)	-3512.32 (-3.376)	344.07 (.416)	3118.64 (1.541)
JURAT	-162.82 (-1.509)	-113.29 (-.662)	-10.03 (-.105)	-188.34 (-2.168)	444.19 (1.832)
CONS	-5796.03 (-1.663)	-22414.09 (-4.952)	-14745.62 (-3.418)	16609.77 (2.666)	-51634 (-2.194)
OBS	2029	1710	1805	1131	519
F-STAT	46.64	38.91	65.55	36.09	12.46
R-square	.2312	.2296	.3223	.2956	.2425
B-P	33.07[2]	229.48[2]	332.48[2]	88.22[2]	24.86[3]

[1] t-statistics are given in parentheses beneath the coefficient values.
[2] Significant at the .001 level, so weighted least squares results reported.
[3] Significant at the .025 level, so weighted least squares results reported.

TABLE 3A.3a
LOGIT RESULTS USING SAV3[1]

	1966	1969	1971	1976	1981
PERMINC	.00016 (5.436)	.00020 (5.524)	.00018 (3.618)	.00009 (1.089)	.00014 (1.210)
PERMINCSQR	-1.78e-09 (-2.170)	-2.28e-09 (-2.215)	-1.26e-09 (-.727)	420e-09 (1.125)	3.30e-09 (.664)
UINDX	-.0113 (-1.939)	-.0140 (-2.176)	-.0077 (-1.312)	.0060 (.731)	-.0035 (-.378)
VARINC	-1.01e-09 (-.769)	-1.98e-09 (-1.149)	5.37e-10 (.221)	-2.64e-09 (-1.404)	-1.11e-08 (-3.231)
AGE	.0174 (1.039)	.0424 (2.186)	.0438 (2.123)	.0634 (2.174)	.0690 (1.672)
SPOUSEINC	.0227 (.158)	-.1488 (-.900)	-.2521 (-1.426)	.1578 (.627)	.0669 (.179)
NC	-.0514 (-1.577)	-.0622 (-1.461)	-.0520 (-1.248)	-.0556 (-.807)	.2002 (1.124)
TENCJ	.0366 (5.491)	.0305 (4.405)	.0321 (4.524)	.0259 (3.086)	.0297 (2.513)
DRACE	-1.286 (-9.376)	-1.113 (-7.153)	-1.144 (-6.989)	-1.192 (-5.647)	-1.020 (-3.375)
UNION	-.4030 (-2.810)	-.7378 (-4.482)	-.3410 (-1.947)	-.7199 (-3.052)	-.9204 (-2.701)
MD	.5743 (3.116)	.8128 (4.020)	.6697 (3.227)	1.019 (4.378)	.6949 (2.070)
JURAT	-.1352 (-4.086)	-.1621 (-3.410)	-.0604 (-1.930)	-.0586 (-1.675)	.0097 (.219)
CONS	.5531 (.563)	-.8734 (-.731)	-1.332 (-1.022)	-3.439 (-1.736)	-4.232 (-1.389)
OBS	2962	2482	2552	1613	766
LOG LIKELIHOOD	-864.79	-678.49	-627.39	-363.94	-175.11
chi2	442.32	358.85	309.28	270.28	122.73

[1]t-statistics are given in parentheses beneath the coefficient values.

PE
PE
U
V
A
S

TABLE 3A.3b
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE SAV3[1]

	1966	1969	1971	1976	1981
PERMINC	.3895 (.660)	-2.519 (-3.042)	.4565 (.747)	-2.408 (-4.105)	-4.614 (-2.821)
PERMINCSQR	7.79e-06 (.345)	.00011 (3.860)	.00003 (1.363)	.00015 (6.714)	.00023 (3.678)
UINDX	263.14 (4.110)	589.74 (3.860)	155.38 (3.661)	-62.24 (-1.277)	-129.98 (-.804)
VARINC	.00003 (1.210)	-.00014 (-2.554)	.000030 (1.757)	-.00006 (-.993)	-.00036 (-1.505)
AGE	589.42 (2.878)	947.58 (3.785)	207.07 (1.117)	-417.38 (-2.064)	2544.03 (4.192)
SPOUSEINC	-1450.09 (-.867)	-5071.38 (-2.834)	-4551.89 (-3.012)	-8090.59 (-5.639)	11736.03 (2.152)
NC	213.04 (.617)	-374.00 (-.744)	-601.31 (-1.416)	-294.45 (-1.147)	-1007.96 (-.718)
TENCJ	194.42 (2.432)	-51.85 (-.585)	.2650 (.004)	120.19 (1.818)	-47.11 (-.208)
DRACE	-9094.41 (-5.783)	-12787.1 (-7.105)	-12166.57 (-8.696)	-17927.26 (-10.614)	-27199.18 (-4.304)
UNION	-4177.99 (-2.254)	-5727.57 (-2.361)	-8794.80 (-4.770)	-5186.03 (-2.723)	-7629.97 (-1.479)
MD	-2645.41 (-1.020)	10103.03 (2.944)	7755.48 (2.638)	5829.46 (2.248)	-13036.71 (-2.351)
JURAT	-1500.48 (-4.106)	-2363.03 (-4.313)	-768.46 (-3.086)	-60.10 (-.253)	1557.45 (2.338)
CONS	-17316.77 (-1.453)	-38826.22 (-2.562)	5951.86 (.507)	73427.62 (5.518)	-75300.1 (-1.748)
OBS	2607	2210	2318	1463	695
F-STAT	66.12	81.52	129.93	107.10	27.99
R-square	.2489	.3254	.4229	.4899	.3479
B-P[2]	51.36	379.46	363.93	93.78	62.13

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]All are significant at the .001 level, so weighted least squares results reported.

P
P
U
V

TABLE 3A.4
REGRESSION RESULTS FROM SAMPLE WITH BOTH SAVERS AND DISSAVERS USING DSAV1[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	.1517 (2.158)	.1269 (1.558)	-.9032 (-7.982)	.5991 (2.903)
PERMINCSQR	-3.8e-06 (-1.488)	-5.3e-06 (-1.651)	.00003 (5.305)	-9.5e-06 (-1.151)
UINDX	-12.34 (-1.648)	32.27 (2.792)	6.93 (.651)	.2391 (.012)
VARINC	1.2e-06 (.246)	-.00001 (-.897)	9.8e-07 (.168)	-.00002 (-1.323)
AGE	7.27 (.271)	63.36 (1.831)	-197.79 (-5.592)	265.79 (3.097)
SPOUSEINC	.875 (.005)	-294.84 (-1.122)	2188.44 (7.360)	-572.73 (-1.053)
NC	-21.62 (-.759)	-203.84 (-2.039)	-262.85 (-4.256)	172.38 (2.226)
TENCJ	1.86 (.207)	-38.19 (-3.236)	-4.021 (-.312)	-37.08 (-1.542)
DRACE	-144.86 (-.759)	-138.47 (-.431)	-2327.40 (-7.492)	-1157.36 (-2.274)
UNION	-68.85 (-.361)	427.94 (1.591)	1807.53 (5.443)	-869.18 (-1.456)
MD	-188.41 (-.390)	709.78 (1.227)	903.92 (1.818)	-766.34 (-.887)
JURAT	-40.16 (-.911)	-141.71 (-1.715)	-186.97 (-3.788)	-120.01 (-1.597)
CONS	-238.17 (-.157)	-4567.65 (-2.330)	17270.67 (7.866)	-17210.84 (-3.077)
OBS	1970	1771	1627	1001
F-STAT	1.69	5.62	19.14	4.21
R-square	.0111	.0399	.1336	.0525
B-P[2]	65.01	46.93	44.74	80.48

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]All are significant at the .001 level, so weighted least squares results are reported.

TABLE 3A.5
REGRESSION RESULTS FROM SAMPLE WITH BOTH SAVERS AND DISSAVERS USING DSAV2[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	.0763	.0595	-.1150	.3973
	(.563)	(.532)	(-.387)	(1.399)
PERMINCSQR	-2.1e-07	-2.2e-06	8.5e-06	-8.3e-06
	(-.039)	(-.537)	(.833)	(-.747)
UINDX	2.39	16.07	-16.29	-14.28
	(.192)	(1.432)	(-.857)	(-.686)
VARINC	-8.3e-08	-4.9e-06	.00002	-.00003
	(-.007)	(-.592)	(1.044)	(-.929)
AGE	65.12	121.43	69.36	139.54
	(1.505)	(3.244)	(.902)	(1.53)
SPOUSEINC	-532.69	-476.32	356.94	-286.72
	(-1.748)	(-1.943)	(.667)	(-.492)
NC	-92.98	-72.17	-104.41	112.81
	(-1.226)	(-1.485)	(-.708)	(1.314)
TENCJ	-8.66	-29.02	13.54	-20.85
	(-.578)	(-2.432)	(.580)	(-.850)
DRACE	-506.38	-720.52	-1692.38	-1903.34
	(-1.634)	(-2.656)	(-3.188)	(-3.149)
UNION	300.87	-308.16	-326.57	-6.547
	(.878)	(-1.101)	(-.449)	(-.009)
MD	2.133	675.90	1462.25	-834.22
	(.002)	(1.021)	(1.269)	(-.733)
JURAT	37.39	-85.29	-125.22	-79.83
	(.444)	(-1.175)	(-1.203)	(-.922)
CONS	-3408.94	-5760.06	-1214.63	-7302.29
	(-1.354)	(-2.680)	(-.241)	(-1.197)
OBS	2079	1860	1690	1026
F-STAT	1.80	4.99	5.55	1.79
R-square	.0377	.0339	.0413	.0403
B-P[2]	133.06	370.14	257.73	231.16

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]All are significant at the .001 level, so weighted least squares results are reported.

TABLE 3A.6
REGRESSION RESULTS FROM SAMPLE WITH BOTH SAVERS AND DISSAVERS USING DSAV3[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	-.2663 (-.872)	.6354 (1.810)	-.3171 (-.522)	1.028 (2.003)
PERMINCSQR	.00002 (1.990)	-.00002 (-1.367)	.00003 (1.242)	-.00001 (-.645)
UINDX	24.42 (.849)	55.98 (1.662)	-105.94 (-2.24)	50.11 (.991)
VARINC	-.00002 (-1.363)	8.6e-06 (.366)	2.4e-06 (.102)	.00003 (.529)
AGE	264.09 (2.91)	-50.23 (-.494)	-.6651 (-.004)	194.51 (1.053)
SPOUSEINC	-1898.71 (-2.785)	-520.06 (-.662)	2218.98 (1.708)	1432.19 (1.053)
NC	-149.06 (-1.035)	-281.12 (-1.374)	376.43 (1.023)	598.67 (1.634)
TENCJ	2.82 (.073)	-6.37 (-.173)	17.17 (.308)	35.43 (.581)
DRACE	-2251.41 (-3.021)	542.91 (.649)	-4760.31 (-3.682)	-3707.63 (-1.968)
UNION	-2217.67 (-2.684)	1028.32 (1.040)	-638.18 (-.363)	-1597.96 (-1.026)
MD	2038.31 (1.722)	834.93 (.624)	1096.40 (.532)	-1147.29 (-.511)
JURAT	-384.62 (-2.408)	29.87 (.131)	-139.49 (-.575)	69.94 (.295)
CONS	-8704.50 (-1.646)	-4460.45 (-.699)	12755.35 (1.175)	-17944.23 (-1.426)
OBS	2603	2259	2006	1231
F-STAT	9.87	4.88	8.17	4.41
R-square	.0472	.0275	.0506	.0449
B-P[2]	267.85	483.20	155.26	77.18

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]All are significant at the .001 level, so weighted least squares results are reported.

TABLE 3A.7a
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE DSAV1$_t$[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	.2805 (4.314)	.0412 (.326)	-1.445 (-7.677)	-.6023 (-2.132)
PERMINCSQR	-5.18e-06 (-2.032)	161e-06 (.303)	.000054 (6.507)	.000019 (1.590)
UINDX	7.835 (1.177)	86.38 (5.275)	57.30 (3.446)	-5.39 (-.170)
VARINC	8.23e-07 (.221)	-.000019 (-1.225)	.000013 (.919)	9.21e-06 (.654)
AGE	142.93 (5.655)	66.30 (1.166)	-352.04 (-6.779)	360.72 (2.687)
SPOUSEINC	-404.68 (-2.232)	-777.569 (-1.902)	2780.85 (6.215)	3959.70 (4.635)
NC	-107.27 (-2.376)	-329.38 (-1.992)	-630.27 (-6.759)	-117.87 (-.698)
TENCJ	26.80 (2.930)	-24.72 (-1.484)	19.05 (1.029)	-50.78 (-1.428)
DRACE	-1100.94 (-6.698)	-1741.85 (-4.55)	-2947.69 (-7.277)	-5411.49 (-7.018)
UNION	-937.71 (-4.444)	1077.10 (2.680)	1100.00 (1.822)	4829.23 (6.555)
MD	-1277.69 (-1.353)	-2096.60 (-3.937)	433.41 (.591)	1980.50 (1.360)
JURAT	-123.33 (-2.882)	216.86 (2.051)	-304.71 (-3.723)	2.187 (.014)
CONS	-5176.00 (-3.227)	-4642.42 (-1.569)	28359.97 (8.945)	-16803.66 (-1.934)
OBS	1063	1073	996	513
F-STAT	35.67	29.03	42.41	34.60
R-square	.3063	.2626	.3593	.4736
B-P	33.91[2]	26.29[3]	43.43[2]	53.30[2]

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]Significant at the .001 level, so weighted least squares results are reported.

[3]Significant at the .01 level, so weighted least squares results are reported.

TABLE 3A.7b
REGRESSION RESULTS FROM SAMPLE WITH NEGATIVE DSAV1[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	.1335	-.0546	-.2883	.2310
	(1.360)	(-1.280)	(-4.056)	(1.014)
PERMINCSQR	-4.6e-06	-2.8e-07	-3.2e-06	-.00002
	(-1.242)	(-.259)	(-1.459)	(-1.757)
UINDX	-21.33	-10.79	17.66	-2.37
	(-2.059)	(-1.205)	(2.093)	(-.108)
VARINC	-7.8e-06	2.7e-06	-1.8e-06	.00001
	(-2.541)	(1.120)	(-.433)	(.610)
AGE	-104.80	-66.56	-68.92	66.90
	(-3.564)	(-2.193)	(-2.089)	(.648)
SPOUSEINC	368.66	466.84	1342.05	21.63
	(1.565)	(2.156)	(4.255)	(.031)
NC	29.00	131.00	416.66	547.80
	(.799)	(3.287)	(1.668)	(3.932)
TENCJ	5.67	-40.18	-2.75	-111.92
	(.567)	(-3.636)	(-.264)	(-3.619)
DRACE	1942.84	1072.15	1225.46	1336.83
	(8.372)	(4.747)	(4.033)	(2.122)
UNION	-122.13	77.47	1184.21	942.73
	(-.556)	(.325)	(3.287)	(1.346)
MD	616.52	1707.26	1422.03	-10.04
	(.899)	(1.657)	(1.283)	(-.012)
JURAT	62.85	101.54	-41.88	200.12
	(1.309)	(1.714)	(-.657)	(2.028)
CONS	1779.35	669.81	338.53	-9315.91
	(.992)	(.332)	(.153)	(-1.477)
OBS	907	698	631	488
F-STAT	26.41	24.16	26.75	13.75
R-square	.2774	.3143	.3601	.2734
B-P	31.11[2]	28.90[2]	30.67[2]	22.59[3]

[1]t-statistics are given in parentheses beneath the coefficient values.
[2]Significant at the .001 level, so weighted least squares results are reported.
[3]Significant at the .05 level, so weighted least squares results are reported.

TABLE 3A.8a
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE $DSAV2_t$[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	.2469 (1.372)	.0705 (.435)	1.559 (5.717)	-1.583 (-3.188)
PERMINCSQR	-2.64e-06 (-.381)	5.49e-06 (.859)	-.00002 (-3.016)	.00008 (8.024)
UINDX	55.37 (3.580)	55.82 (3.723)	-40.66 (-.902)	25.83 (.235)
VARINC	.00001 (.999)	4.32e-06 (.716)	4.65e-06 (.321)	3.12e-06 (.106)
AGE	361.97 (6.053)	139.82 (2.872)	574.85 (3.339)	274.17 (.765)
SPOUSEINC	-1077.37 (-2.658)	-606.52 (-1.649)	-2812.47 (-2.062)	-6448.93 (-2.433)
NC	-111.86 (-1.027)	-127.56 (-1.320)	-955.39 (-2.059)	-318.25 (-.293)
TENCJ	18.18 (.934)	8.79 (.567)	53.30 (.975)	292.16 (3.162)
DRACE	-1395.58 (-3.480)	-1487.97 (-4.260)	-2779.28 (-1.558)	-4539.09 (-1.246)
UNION	-876.35 (-2.007)	-409.63 (-1.111)	-4966.66 (-3.703)	-5210.87 (-2.029)
MD	-1885.95 (-1.572)	-2361.98 (-3.540)	-2587.32 (-1.058)	-7546.40 (-1.723)
JURAT	1.372 (.012)	-45.51 (-.429)	-492.23 (-1.793)	8.59 (.020)
CONS	-17804.6 (-5.144)	-6038.40 (-2.133)	-29236.96 (-2.586)	2286.76 (.090)
OBS	1157	1111	999	523
F-STAT	24.05	31.87	11.96	23.85
R-square	.2146	.2739	.1270	.3594
B-P	130.16[2]	317.52[2]	21.18[3]	154.86[2]

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]Significant at the .001 level, so weighted least squares results are reported.

[3]Not significant at the .05 level, so ordinary least squares results are reported.

TABLE 3A.8b
REGRESSION RESULTS FROM SAMPLE WITH NEGATIVE DSAV2$_t$[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	.2654 (1.515)	.0859 (.806)	-.3194 (-.750)	2.5213 (6.380)
PERMINCSQR	-7.7e-06 (-1.261)	-.00001 (-1.968)	-6.9e-07 (-.051)	-.00008 (-4.677)
UINDX	-16.88 (-1.235)	-22.81 (-2.131)	-19.20 (-.978)	53.24 (1.208)
VARINC	.00002 (2.102)	-3.5e-06 (-.630)	-1.6e-06 (-.238)	-.00013 (-2.160)
AGE	-146.31 (-2.886)	-78.04 (-2.642)	-309.54 (3.576)	738.28 (4.177)
SPOUSEINC	-219.18 (-.544)	427.09 (1.579)	-146.74 (-.243)	-6190.78 (-4.502)
NC	-6.92 (-.071)	120.72 (2.379)	570.61 (1.942)	335.99 (.805)
TENCJ	5.70 (.329)	-30.16 (-2.704)	-1.34 (-.055)	-201.71 (-4.579)
DRACE	2246.06 (6.174)	1240.88 (5.002)	2248.18 (2.755)	2641.06 (2.071)
UNION	-2.55 (-.006)	132.85 (.498)	3357.56 (4.068)	-1022.52 (-.549)
MD	1629.08 (1.977)	1117.98 (1.102)	6316.75 (4.350)	-3648.74 (-2.153)
JURAT	109.17 (1.172)	128.80 (1.579)	-11.74 (-.082)	32.62 (.162)
CONS	1065.05 (.356)	1957.33 (1.024)	8768.36 (1.410)	-58551.8 (-5.163)
OBS	922	749	691	503
F-STAT	21.30	23.29	29.10	26.05
R-square	.2335	.2915	.3582	.4087
B-P	23.70[3]	121.56[2]	197.70[2]	22.13[3]

[1] t-statistics are given in parentheses beneath the coefficient values.
[2] Significant at the .001 level, so weighted least squares results are reported.
[3] Significant at the .05 level, so weighted least squares results are reported.

TABLE 3A.9a
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE DSAV3[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	-1.080 (-2.682)	.1675 (.515)	1.483 (2.335)	-.0855 (-.151)
PERMINCSQR	.00005 (3.616)	.00001 (1.017)	-4.18e-06 (-.271)	.00005 (2.155)
UINDX	62.49 (1.821)	170.53 (5.352)	-124.17 (-1.366)	86.57 (1.768)
VARINC	-7.30e-06 (-.407)	2.43e-06 (.182)	.00002 (.577)	.00037 (4.028)
AGE	418.57 (3.363)	67.49 (.650)	135.42 (.394)	400.46 (2.166)
SPOUSEINC	23.74 (.027)	-133.26 (-.176)	-6408.25 (-2.337)	469.87 (.347)
NC	285.25 (1.245)	-99.77 (-.595)	683.20 (.766)	89.87 (.420)
TENCJ	123.81 (2.491)	105.04 (2.458)	225.25 (2.041)	111.17 (1.451)
DRACE	-4299.25 (-4.948)	-2090.89 (-2.582)	-8587.14 (-2.543)	-9721.94 (-5.063)
UNION	-4373.23 (-4.425)	-1417.47 (-1.326)	-12945.74 (-4.720)	-1312.88 (-.848)
MD	527.65 (.347)	-2525.62 (-1.645)	299.38 (.606)	2125.30 (.260)
JURAT	-824.94 (-3.571)	147.31 (.752)	-689.82 (-1.272)	129.84 (.446)
CONS	-4821.28 (-.681)	-7569.63 (-1.235)	11056 (.495)	-20417.59 (-1.347)
OBS	1633	1348	1285	747
F-STAT	55.30	47.27	10.07	32.14
R-square	.3074	.3152	.0868	.3627
B-P	219.80[2]	62.82[2]	19.66[3]	46.54[2]

[1]t-statistics are given in parentheses beneath the coefficient values.
[2]Significant at the .001 level, so weighted least squares results are reported.
[3]Not significant at the .05 level, so ordinary least squares results are reported.

TABLE 3A.9b
REGRESSION RESULTS FROM SAMPLE WITH NEGATIVE DSAV3[1]

	1966-69	1969-71	1971-76	1976-81
PERMINC	-.3007	-.6239	1.962	-.3653
	(-.876)	(-1.185)	(1.224)	(-1.346)
PERMINCSQR	.00001	2.6e-06	-.00007	3.9e-07
	(.986)	(.156)	(-1.144)	(.073)
UINDX	-27.63	-91.96	-655.54	-32.03
	(-.777)	(-2.232)	(-8.132)	(-.717)
VARINC	.00004	.00002	.00001	.00011
	(1.533)	(1.130)	(.260)	(3.561)
AGE	78.40	-513.14	-1476.97	103.93
	(.710)	(-3.448)	(-3.952)	(.646)
SPOUSEINC	-2047.4	505.35	6202.55	2317.29
	(-2.073)	(.504)	(1.955)	(1.724)
NC	-603.56	204.22	-1096.29	-601.86
	(-2.874)	(.757)	(-1.240)	(-.619)
TENCJ	-27.37	139.86	191.91	-27.14
	(-.516)	(2.855)	(1.310)	(-.453)
DRACE	5273.51	1398.08	20762.5	335.91
	(5.418)	(1.355)	(6.783)	(.310)
UNION	-1318.72	4843.31	1587.26	3842.23
	(-1.147)	(3.694)	(.362)	(2.291)
MD	1568.62	1343.54	-2100.76	-4181.49
	(1.283)	(.544)	(-.470)	(-2.340)
JURAT	701.29	575.25	-1155.75	-470.76
	(3.453)	(1.859)	(-2.207)	(-2.925)
CONS	-12278.81	22325.43	100474	-6111.48
	(-2.057)	(2.394)	(3.770)	(-.621)
OBS	970	911	721	484
F-STAT	26.87	28.44	18.84	24.88
R-square	.2674	.2916	.2570	.4072
B-P[2]	29.00	353.01	85.80	33.54

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]All are significant at the .001 level, so weighted least squares results are reported.

TABLE 3A.10
AGGREGATE SAVINGS REGRESSION RESULTS FOR 1966
UNION vs. NON-UNION[1,2,3]

	SAV1		SAV2		SAV3	
	N-U	U	N-U	U	N-U	U
PERMINC	-.349 (-2.84)	.1735 (.834)	-.466 (-1.98)	.1592 (.807)	1.95 (3.67)	.231 (.208)
PERMINCSQR	.00002 (4.39)	-1e-06 (-.145)	.00004 (3.86)	2e-06 (.322)	-.00002 (-.76)	.00005 (1.52)
UINDX	15.00 (.896)	17.80 (1.52)	.0092 (.003)	39.38 (3.12)	284.29 (3.829)	179.19 (1.59)
VARINC	4e-07 (.064)	-3e-06 (-.36)	-.00003 (-1.16)	-6e-06 (-.757)	.00004 (.829)	.00001 (.468)
AGE	309.51 (5.60)	91.38 (2.26)	400.26 (4.805)	87.97 (1.785)	1063.62 (4.857)	1198.1 (3.39)
SPOUSEINC	-773.27 (-1.93)	-452.90 (-1.84)	-3028.6 (-4.57)	-618.92 (-2.28)	-13469 (-5.37)	-3368.7 (-1.18)
NC	-286.71 (-2.56)	-257.73 (-6.54)	-410.80 (-1.89)	-323.52 (-8.15)	-1561.1 (-3.68)	-1807.9 (-2.36)
TENCJ	31.74 (1.33)	-2.29 (-.157)	31.51 (.795)	-14.64 (-.964)	763.36 (7.91)	80.22 (.611)
MD	-4081.0 (-4.50)	-1079.6 (-.284)	-2878.8 (-1.94)	-2021.3 (-.409)	9070.8 (2.63)	-2120.1 (-.418)
JURAT	-173.39 (-1.94)	58.41 (.85)	-254.26 (-1.52)	93.26 (1.335)	-895.72 (-2.04)	-777.61 (-.985)
CONS	-6402.9 (-2.09)	-3582.0 (-.771)	-8618.6 (-1.79)	-3485.2 (-.616)	-61321 (-5.11)	-54323 (-2.37)
OBS	1147	724	1236	793	1612	995
F-STAT	41.58	29.79	36.25	31.08	87.67	6.57
R-square	.2871	.3148	.2456	.3042	.3759	.0626
B-P	48.98	36.49	23.48	27.52	32.72	17.41[4]

[1]N-U signifies respondents not in a union while U represents those who are union members.
[2]t-statistics are given in parentheses beneath the coefficient values.
[3]Weighted least squares results reported unless otherwise indicated.
[4]Ordinary least squares results reported because of low B-P statistic.

TABLE 3A.11
AGGREGATE SAVINGS REGRESSION RESULTS FOR 1971
UNION vs. NON-UNION[1,2,3]

	SAV1		SAV2		SAV3	
	N-U	U	N-U	U	N-U	U
PERMINC	-.7966 (-5.46)	.4393 (2.50)	-.4715 (-1.63)	.3110 (2.048)	-1.20 (-1.60)	.094 (.115)
PERMINCSQR	.00003 (5.62)	-7e-06 (-1.21)	.00004 (3.748)	6e-06 (1.01)	.0001 (3.26)	.00005 (1.65)
UINDX	38.35 (2.13)	73.53 (4.41)	22.85 (.848)	37.72 (2.149)	344.12 (4.90)	203.7 (3.01)
VARINC	.00001 (.681)	.00002 (2.80)	.00002 (.671)	-3e-07 (-.089)	-.00009 (-1.46)	4e-06 (.195)
AGE	290.38 (3.41)	162.60 (2.55)	430.07 (3.896)	288.82 (4.74)	648.90 (2.08)	344.44 (1.44)
SPOUSEINC	-947.30 (-1.34)	-387.49 (-.92)	-3591.7 (-4.08)	-1289.1 (-3.05)	-13378 (-3.97)	-3489.2 (-2.18)
NC	-531.80 (-1.93)	-245.39 (-2.98)	-467.26 (-1.55)	-380.97 (-4.69)	-3023.2 (-4.76)	-1432.2 (-3.53)
TENCJ	86.77 (3.68)	-3.23 (-.184)	121.51 (3.696)	-2.75 (-.173)	771.40 (5.26)	-26.49 (-.381)
MD	3947.1 (4.58)	-3714.3 (-1.66)	817.68 (.588)	-4002.5 (-3.16)	13252 (1.62)	3989.1 (.802)
JURAT	91.70 (.787)	102.59 (1.22)	-94.71 (-.546)	-30.52 (-.394)	-1765.3 (-4.00)	-923.09 (-3.01)
CONS	-13352 (-2.73)	-11345 (-2.76)	-18227 (-2.70)	-13732 (-4.05)	-23347 (-1.14)	-13770 (-.898)
OBS	1011	659	1093	712	1408	910
F-STAT	45.78	27.50	42.35	32.39	93.21	83.66
R-square	.3349	.3182	.3010	.3370	.4233	.5059
B-P	36.60	28.40	207.67	27.13	219.93	22.75

[1]N-U signifies respondents not in a union while U represents those who are union members.
[2]t-statistics are given in parentheses beneath the coefficient values.
[3]Weighted least squares results reported unless otherwise indicated.

SA

PE
PI
U
V

TABLE 3A.12
SAVING REGRESSION RESULTS FOR PERIOD 1966-69 WHEN SAVING IS POSITIVE
UNION vs. NON-UNION[1,2,3,4]

	DSAV1		DSAV2		DSAV3	
	N-U	U	N-U	U	N-U	U
PERMINC	.2347 (3.351)	.3083 (1.40)	.2739 (1.52)	.0658 (.195)	-1.50 (-2.54)	-1.37 (-1.45)
PERMINCSQR	-1e-06 (-.425)	-5e-06 (-.579)	2e-06 (.289)	8e-06 (.867)	.00008 (3.55)	.00003 (.758)
UINDX	-.4061 (-.036)	10.52 (.965)	20.49 (1.03)	15.61 (.453)	174.68 (2.56)	269.34 (4.89)
VARINC	.00003 (3.451)	-2e-06 (-.433)	.00005 (3.76)	-4e-06 (-.41)	-8e-06 (-.23)	-.00006 (-1.46)
AGE	88.39 (2.714)	188.89 (3.64)	189.00 (3.39)	365.97 (3.41)	639.15 (3.12)	-248.43 (-.971)
SPOUSEINC	-219.17 (-.753)	-55.49 (-.175)	-1659.2 (-3.14)	-607.51 (-.67)	-1862.2 (-1.14)	6627.0 (4.27)
NC	-72.70 (-1.01)	-205.06 (-3.33)	-88.45 (-.618)	-617.01 (-2.46)	-124.59 (-.309)	663.58 (2.02)
TENCJ	57.48 (3.035)	16.08 (1.05)	101.03 (4.79)	.3432 (.009)	578.96 (5.828)	128.86 (1.62)
MD	-1127.0 (-1.99)	-1773.5 (-.608)	-1858.6 (-1.50)	-1437.9 (-.96)	7306.0 (2.62)	195.62 (.093)
JURAT	-85.50 (-1.29)	-117.18 (-.898)	-122.26 (-.958)	169.94 (.714)	-797.77 (-2.11)	-1762.9 (-2.82)
CONS	-3165.9 (-1.68)	-8702.9 (-2.06)	-8561.5 (-2.40)	-16558 (-2.38)	-31671 (-2.58)	17119 (1.15)
OBS	634	429	681	476	979	654
F-STAT	25.76	19.88	28.83	3.47	42.25	27.47
R-square	.3126	.3435	.3213	.0694	.3244	.3197
B-P	21.18	21.75	80.43	6.76[5]	153.41	26.23

[1]N-U signifies respondents not in a union while U represents those who are union members.
[2]t-statistics are given in parentheses beneath the coefficient values.
[3]Weighted least squares results reported unless otherwise indicated.
[4]Results of regressions conditional upon saving being negative available upon request.
[5]Ordinary least squares results reported because of low B-P statistic.

TABLE 3A.13a
LOGIT RESULTS USING SAV1[1]
PERMINC>$5000 (1976 $'s)

	1966	1969	1971	1976	1981
PERMINC	.00019 (10.121)	.00020 (9.593)	.00017 (8.195)	.00012 (4.165)	.00015 (4.308)
PERMINCSQR	-2.55e-09 (-6.702)	-2.79e-09 (-7.018)	-2.44e-09 (-6.131)	-1.33e-09 (-2.049)	-2.1e-09 (-3.230)
UINDX	.0053 (1.373)	.0083 (1.973)	-.0040 (-1.155)	.0102 (1.935)	.0135 (2.394)
VARINC	-7.61e-10 (-.966)	-1.83e-09 (-1.939)	-9.06e-10 (-1.090)	-2.24e-09 (-2.312)	-6.8e-09 (-2.804)
AGE	.0306 (2.567)	.0316 (2.445)	.0343 (2.662)	.0038 (.215)	.0039 (.157)
SPOUSEINC	-.0087 (-.089)	.0952 (.908)	-.0882 (-.848)	.1540 (1.138)	.6864 (3.314)
NC	-.0968 (-3.609)	-.1112 (-3.431)	-.1430 (-4.354)	-.0619 (-1.175)	-.0458 (-.436)
TENCJ	.0089 (1.980)	.0116 (2.610)	.0034 (.809)	.0067 (1.375)	.0013 (1.764)
DRACE	-1.013 (-9.717)	-1.088 (-9.403)	-1.020 (-9.066)	-1.169 (-8.267)	-1.269 (-5.911)
UNION	-.1647 (-1.755)	-.2640 (-2.601)	-.0397 (-.394)	-.1410 (-1.089)	-.2076 (-1.086)
MD	-.2786 (-1.591)	-.2427 (-1.312)	-.2244 (-1.272)	-.0974 (-.493)	-.8272 (-2.925)
JURAT	-.0414 (-1.642)	-.0754 (-2.155)	-.0251 (-1.236)	.0191 (.898)	-.0256 (-.936)
CONS	-2.597 (-3.570)	-3.015 (-3.625)	-1.911 (-2.294)	-1.368 (-1.120)	-1.474 (-.819)
OBS	2747	2326	2388	1484	710
LOG LIKELIHOOD	-1521.72	-1300.90	-1345.74	-818.60	-392.44
chi2	469.06	418.58	315.63	201.82	124.87

[1]t-statistics are given in parentheses beneath the coefficient values.

TABLE 3A.13b
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE SAV1$_t$[1]
PERMINC>$5000 (1976 $'s)

	1966	1969	1971	1976	1981
PERMINC	-.0912 (-.958)	.1626 (1.301)	.6125 (3.389)	.2110 (1.130)	-.0211 (-.035)
PERMINCSQR	6.71e-06 (2.024)	1.45e-06 (.337)	-.00001 (-1.704)	3.09e-06 (.457)	.000018 (.916)
UINDX	37.21 (4.162)	14.71 (1.522)	3.933 (.385)	15.44 (1.122)	-62.95 (-2.078)
VARINC	4.2e-07 (.114)	-4.76e-06 (-1.009)	5.22e-06 (.497)	-5.48e-06 (-2.023)	-.00001 (-1.267)
AGE	170.63 (5.852)	255.88 (6.978)	193.42 (4.216)	176.13 (2.411)	611.88 (2.593)
SPOUSEINC	-668.50 (-3.556)	-611.75 (-2.618)	-1624.81 (-4.842)	541.91 (1.284)	-2368.14 (-2.166)
NC	-98.54 (-3.172)	-86.53 (-1.412)	-439.58 (-3.565)	-739.18 (-6.556)	-1266.81 (-5.408)
TENCJ	2.751 (.273)	21.18 (1.805)	26.57 (1.993)	17.19 (.970)	28.55 (.613)
DRACE	-2083.76 (-9.775)	-2078.08 (-8.707)	-1744.68 (-5.646)	-2222.92 (-5.795)	-4077.09 (-4.362)
UNION	-532.72 (-2.683)	-1011.47 (-3.822)	-971.49 (-2.825)	-708.08 (-1.548)	-1888.89 (-1.696)
MD	-214.35 (-.174)	-4036.96 (-1.456)	-2335.03 (-2.697)	1219.67 (1.701)	4299.82 (3.411)
JURAT	6.580 (.147)	-20.26 (-.306)	-60.54 (-1.001)	165.38 (2.712)	70.38 (.436)
CONS	-6035.43 (-2.931)	-7728.78 (-2.210)	-7533.23 (-2.432)	-10748.58 (-2.198)	-29398 (-1.721)
OBS	1820	1505	1615	1023	469
F-STAT	53.03	49.37	54.99	43.09	12.21
R-square	.2761	.3008	.3085	.3568	.2583
B-P	77.90[2]	81.12[2]	53.13[2]	31.20[3]	42.91[2]

[1]t-statistics are given in parentheses beneath the coefficient values.
[2]Significant at the .001 level, so weighted least squares results reported.
[3]Significant at the .005 level, so weighted least squares results reported.

TABLE 3A.14a
LOGIT RESULTS USING SAV2[1]
PERMINC>$5000 (1976 $'s)

	1966	1969	1971	1976	1981
PERMINC	.00019 (7.891)	.00025 (10.872)	.00019 (8.501)	.00015 (4.951)	.00019 (5.285)
PERMINCSQR	-2.06e-09 (-3.516)	-3.44e-09 (-7.915)	-2.48e-09 (-5.356)	-1.76e-09 (-2.388)	-2.73e-09 (-4.050)
UINDX	.0044 (1.070)	.0061 (1.336)	-.0021 (-.553)	.0099 (1.802)	.0169 (2.826)
VARINC	-8.26e-10 (-.869)	-2.72e-09 (-2.723)	-1.36e-09 (-1.477)	-2.79e-09 (-2.723)	-6.26e-09 (-2.674)
AGE	.0318 (2.497)	.0319 (2.284)	.0425 (3.065)	.0017 (.092)	-.0091 (-.346)
SPOUSEINC	-.0012 (-.011)	.0047 (.042)	-.1547 (-1.383)	.1671 (1.173)	.7535 (3.420)
NC	-.1263 (-4.520)	-.1106 (-3.250)	-.0955 (-2.822)	-.0695 (-1.281)	.0566 (.529)
TENCJ	.0185 (3.809)	.0134 (2.774)	.0074 (1.648)	.0112 (2.202)	.0113 (1.694)
DRACE	-1.015 (-9.448)	-1.098 (-9.245)	-1.036 (-8.920)	-1.106 (-7.600)	-1.240 (-5.690)
UNION	-.1488 (-1.479)	-.2197 (-1.992)	-.1075 (-.993)	-.1875 (-1.379)	-.3444 (-1.728)
MD	-.1831 (-1.012)	-.2484 (-1.289)	-.2387 (-1.295)	-.2863 (-1.390)	-.8427 (-2.876)
JURAT	-.0473 (-1.754)	-.1095 (-2.916)	-.0351 (-1.605)	.0197 (.870)	-.0267 (-.932)
CONS	-2.539 (-3.266)	-2.879 (-3.224)	-2.515 (-2.813)	-1.309 (-1.021)	-1.166 (-.624)
OBS	2747	2326	2388	1484	710
LOG LIKELIHOOD	-1372.67	-1152.22	-1206.24	-758.03	-364.72
chi2	523.32	472.13	361.64	221.62	137.98

[1]t-statistics are given in parentheses beneath the coefficient values.

TABLE 3A.14b
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE SAV2,[1]
PERMINC>$5000 (1976 $'s)

	1966	1969	1971	1976	1981
PERMINC	-.3058 (-1.174)	-.4934 (-1.573)	.6732 (2.190)	.4002 (1.199)	1.771 (1.890)
PERMINCSQR	.00002 (1.993)	.000027 (2.496)	-5.29e-06 (-.498)	3.30e-06 (.258)	-.00003 (-.801)
UINDX	51.95 (2.775)	98.55 (4.796)	19.67 (1.203)	28.96 (1.492)	30.05 (.569)
VARINC	-.00002 (-1.215)	-.00001 (-.657)	.00001 (.705)	6.45e-06 (.247)	-.00006 (-.528)
AGE	294.06 (4.256)	525.43 (6.833)	351.20 (5.007)	256.91 (2.652)	1153.83 (2.706)
SPOUSEINC	-1311.32 (-2.955)	-1369.40 (-2.685)	-2423.05 (-4.983)	-394.10 (-.713)	-777.33 (-.449)
NC	-148.56 (-1.185)	-262.76 (-2.161)	-388.08 (-3.022)	-965.41 (-5.175)	-529.49 (-1.156)
TENCJ	-9.784 (-.398)	13.83 (.570)	67.45 (3.246)	17.90 (.844)	46.07 (.713)
DRACE	-3172.36 (-6.564)	-2779.67 (-5.449)	-2670.37 (-5.368)	-3555.87 (-6.921)	-3716.12 (-1.902)
UNION	-1350.35 (-2.875)	-1039.37 (-1.834)	-2364.92 (-4.679)	-1816.64 (-2.836)	-5389.09 (-2.822)
MD	-5683.96 (-4.745)	-3539.18 (-1.623)	-3462.90 (-3.589)	1163.80 (1.451)	1650.90 (.660)
JURAT	-187.85 (-1.585)	-95.86 (-.549)	32.94 (.346)	95.44 (1.152)	-22.159 (-.081)
CONS	-3712.47 (-.886)	-21401.53 (-4.036)	-16206.48 (-3.450)	-15208.71 (-2.291)	-80341.11 (-2.729)
OBS	1972	1665	1749	1080	497
F-STAT	41.65	37.59	63.09	38.14	11.49
R-square	.2165	.2283	.3209	.3172	.2358
B-P	32.54[3]	230.77[2]	330.21[2]	83.81[2]	24.05[4]

[1]t-statistics are given in parentheses beneath the coefficient values.
[2]Significant at the .001 level, so weighted least squares results reported.
[3]Significant at the .005 level, so weighted least squares results reported.
[4]Significant at the .025 level, so weighted least squares results reported.

TABLE 3A.15a
LOGIT RESULTS USING SAV3[1]
PERMINC>$5000 (1976 $'s)

	1966	1969	1971	1976	1981
PERMINC	.00019 (5.809)	.00024 (6.133)	.00024 (5.011)	.00013 (.874)	.00004 (.173)
PERMINCSQR	-2.50e-09 (-3.307)	-3.09e-09 (-3.477)	-2.80e-09 (-2.158)	2.73e-09 (.480)	6.93e-09 (.829)
UINDX	-.0124 (-2.033)	-.0148 (-2.160)	-.0120 (-1.959)	.0047 (.498)	-.0044 (-.433)
VARINC	-7.86e-10 (-.585)	-2.02e-09 (-1.187)	4.49e-10 (.194)	-2.33e-09 (-1.191)	-1.13e-08 (-3.128)
AGE	.0108 (.582)	.0518 (2.450)	.0528 (2.321)	.0634 (1.847)	.0319 (.674)
SPOUSEINC	-.0281 (-.185)	-.1076 (-.621)	-.2849 (-1.537)	.2629 (.959)	-.0097 (-.024)
NC	-.0476 (-1.309)	-.0612 (-1.347)	-.0661 (-1.460)	-.0784 (-1.067)	.1999 (1.036)
TENCJ	.0312 (4.118)	.0215 (2.820)	.0203 (2.625)	.0180 (1.828)	.0294 (2.178)
DRACE	-1.430 (-9.654)	-1.200 (-7.232)	-1.128 (-6.335)	-1.288 (-5.394)	-.9275 (-2.790)
UNION	-.4211 (-2.854)	-.7509 (-4.438)	-.3619 (-2.011)	-.7153 (-2.912)	-1.034 (-2.894)
MD	.4425 (2.205)	.6858 (2.984)	.4267 (1.748)	1.039 (3.864)	.9707 (2.546)
JURAT	-.1172 (-3.208)	-.1532 (-2.944)	-.0532 (-1.559)	-.0602 (-1.545)	-.0050 (-.100)
CONS	.8715 (.791)	-1.484 (-1.121)	-1.725 (-1.186)	-3.393 (-1.407)	-1.231 (-.345)
OBS	2747	2326	2388	1484	710
LOG LIKELIHOOD	-744.85	-596.79	-546.83	-294.37	-144.30
chi2	354.05	293.94	227.75	200.39	88.40

[1]t-statistics are given in parentheses beneath the coefficient values.

TABLE 3A.15b
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE SAV3,[1]
PERMINC>$5000 (1976 $'s)

	1966	1969	1971	1976	1981
PERMINC	-1.6614 (-1.880)	-2.391 (-2.214)	1.206 (1.432)	-1.615 (-2.097)	1.002 (.620)
PERMINCSQR	.00008 (2.382)	.00011 (2.952)	6.57e-06 (.218)	.00013 (4.742)	.00004 (.728)
UINDX	284.83 (4.123)	614.93 (7.931)	145.82 (3.249)	28.06 (.505)	208.84 (1.768)
VARINC	.00002 (.841)	-.00013 (-2.393)	.000023 (1.345)	-.00010 (-1.583)	.00026 (1.602)
AGE	626.51 (2.686)	1035.15 (3.840)	304.97 (1.519)	364.24 (1.486)	541.44 (1.049)
SPOUSEINC	-665.75 (-.360)	-5353.10 (-2.863)	-4715.60 (-2.816)	-7676.17 (-4.784)	5713.43 (1.448)
NC	510.31 (1.313)	-118.90 (-.220)	-537.95 (-1.290)	-113.03 (-.352)	-318.65 (-.309)
TENCJ	157.99 (1.817)	-67.89 (-.758)	15.19 (.215)	199.34 (2.805)	621.04 (3.736)
DRACE	-9252.60 (-5.540)	-12855.36 (-7.081)	-11764.37 (-8.076)	-18132.21 (-11.072)	-33576.59 (-8.577)
UNION	-5163.29 (-2.534)	-7131.22 (-2.663)	-8511.95 (-4.267)	-10951.33 (-5.033)	-17472.31 (-4.316)
MD	-6003.23 (-1.877)	9507.97 (2.543)	9093.57 (3.859)	10542.53 (3.287)	17060.3 (3.812)
JURAT	-1659.25 (-4.079)	-2307.68 (-4.090)	-957.86 (-3.574)	281.34 (.994)	-949.27 (-1.988)
CONS	-2684.83 (-.181)	-44507.74 (-2.572)	-4486.63 (-.338)	10739.65 (.635)	-17195.95 (-.444)
OBS	2459	2099	2199	1373	657
F-STAT	61.91	75.97	116.06	101.43	41.36
R-square	.2476	.3213	.4084	.4923	.4550
B-P[2]	48.69	369.84	354.48	88.83	62.09

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]All are significant at the .001 level, so weighted least squares results reported.

TABLE 3A.16a
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE DSAV1,[1]
PERMINC>$5000 (1976 $'s)

	1966-69	1969-71	1971-76	1976-81
PERMINC	.2694 (2.766)	.9624 (4.203)	.4125 (1.924)	-1.747 (-4.125)
PERMINCSQR	-4.63e-06 (-1.379)	-.000026 (-3.012)	-1.88e-06 (-.224)	.00006 (3.588)
UINDX	9.92 (1.419)	58.92 (3.824)	-43.57 (-3.483)	-28.03 (-.823)
VARINC	2.90e-07 (.075)	-.00002 (-1.726)	-3.96e-07 (-.039)	-3.79e-06 (-.282)
AGE	160.74 (5.101)	53.26 (.950)	89.20 (2.003)	267.42 (1.831)
SPOUSEINC	-432.01 (-2.308)	-1154.66 (-3.291)	-702.84 (-2.099)	4313.22 (4.872)
NC	-114.11 (-2.356)	-270.28 (-1.933)	-436.41 (-6.823)	-61.96 (-.356)
TENCJ	23.23 (2.123)	6.48 (.424)	-32.89 (-2.395)	3.13 (.072)
DRACE	-1192.11 (-6.617)	-363.25 (-1.067)	-729.87 (-2.537)	-6013.30 (-7.109)
UNION	-1037.11 (-4.204)	-1353.47 (-3.471)	-301.64 (-.805)	5036.24 (6.739)
MD	-1993.41 (-1.481)	-1100.80 (-1.497)	147.73 (.256)	1858.74 (1.007)
JURAT	-128.76 (-2.572)	-149.65 (-1.266)	-101.50 (-1.679)	-25.68 (-.149)
CONS	-5224.90 (-2.311)	-8002.14 (-2.203)	-558.05 (-.182)	-2930.83 (-.288)
OBS	1032	1041	959	498
F-STAT	35.35	23.42	36.27	37.67
R-square	.3108	.2285	.3326	.5024
B-P	32.92[2]	26.44[3]	43.25[2]	51.34[2]

[1]t-statistics are given in parentheses beneath the coefficient values.
[2]Significant at the .001 level, so weighted least squares results are reported.
[2]Significant at the .01 level, so weighted least squares results are reported.

TABLE 3A.16b
REGRESSION RESULTS FROM SAMPLE WITH NEGATIVE DSAV1[1]
PERMINC>$5000 (1976 $'s)

	1966-69	1969-71	1971-76	1976-81
PERMINC	.3659 (2.623)	-.0984 (-1.884)	-.3349 (-4.111)	-.0762 (-.306)
PERMINCSQR	-.00001 (-2.279)	7.5e-07 (.824)	-3.0e-06 (-1.972)	-5.2e-06 (-.577)
UINDX	-19.21 (-1.668)	-8.81 (-.941)	19.33 (2.311)	-37.26 (-2.236)
VARINC	-.00001 (-4.434)	2.7e-06 (1.169)	-5.5e-06 (-1.103)	3.2e-06 (.237)
AGE	-116.04 (-3.573)	-68.20 (-2.043)	-68.34 (-1.596)	-64.29 (-.748)
SPOUSEINC	401.31 (1.617)	554.36 (2.654)	1420.95 (4.223)	673.29 (1.248)
NC	13.06 (.317)	132.65 (3.044)	412.85 (1.623)	667.67 (6.898)
TENCJ	8.45 (.813)	-27.94 (-2.212)	-5.60 (-.479)	-28.63 (-1.235)
DRACE	2075.46 (8.441)	990.59 (4.338)	1035.91 (3.258)	1182.18 (2.359)
UNION	-186.48 (-.781)	66.23 (.275)	921.10 (2.516)	2364.92 (4.648)
MD	-241.90 (-.243)	559.89 (.305)	2208.79 (1.874)	-606.68 (-.890)
JURAT	40.90 (.750)	104.52 (1.747)	-23.60 (-.353)	78.27 (1.000)
CONS	1527.50 (.709)	2012.38 (.740)	196.39 (.065)	2475.70 (.440)
OBS	875	671	604	456
F-STAT	29.58	22.07	34.52	18.57
R-square	.3085	.3037	.4316	.3527
B-P	30.01[2]	28.58[2]	30.50[2]	24.12[3]

[1] t-statistics are given in parentheses beneath the coefficient values.

[2] Significant at the .001 level, so weighted least squares results are reported.

[3] Significant at the .025 level, so weighted least squares results are reported.

TABLE 3A.17a
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE DSAV2,[1]
PERMINC>$5000 (1976 $'s)

	1966-69	1969-71	1971-76	1976-81
PERMINC	.1522 (.661)	.7127 (3.076)	.0683 (.226)	-1.669 (-4.002)
PERMINCSQR	2.78e-07 (.034)	-.00002 (-1.841)	.00001 (1.061)	.00006 (3.699)
UINDX	67.49 (4.281)	53.02 (3.731)	-50.03 (-3.002)	56.88 (1.493)
VARINC	.00002 (1.379)	3.60e-06 (.569)	.00002 (1.710)	.00001 (3.648)
AGE	376.89 (6.027)	146.59 (3.063)	90.56 (1.547)	166.16 (1.276)
SPOUSEINC	-921.12 (-2.234)	-946.21 (-2.731)	-373.75 (-.821)	2346.08 (2.534)
NC	-107.53 (-1.036)	-117.83 (-1.218)	-352.01 (-3.432)	56.16 (.200)
TENCJ	23.98 (1.232)	13.58 (.924)	-30.95 (-1.671)	22.59 (.507)
DRACE	-1266.52 (-3.098)	-1129.69 (-3.477)	-1704.40 (-4.201)	-6613.49 (-7.540)
UNION	-989.76 (-2.213)	-1208.08 (-3.257)	124.83 (.254)	3687.97 (4.626)
MD	-2663.43 (-1.728)	-1065.48 (-1.629)	335.51 (.389)	357.59 (.064)
JURAT	41.21 (.330)	-139.40 (-1.313)	-143.92 (-1.965)	160.54 (.850)
CONS	-18252.19 (-4.473)	-11109.33 (-3.446)	1531.21 (.387)	-1109.28 (-.106)
OBS	1124	1078	960	506
F-STAT	25.90	33.16	19.04	31.93
R-square	.2325	.2882	.2072	.4571
B-P	130.16[2]	313.91[2]	21.60[3]	150.89[2]

[1]t-statistics are given in parentheses beneath the coefficient values.
[2]Significant at the .001 level, so weighted least squares results are reported.
[3]Significant at the .05 level, so weighted least squares results are reported.

TABLE 3A.17b
REGRESSION RESULTS FROM SAMPLE WITH NEGATIVE DSAV2,[1]
PERMINC>$5000 (1976 $'s)

	1966-69	1969-71	1971-76	1976-81
PERMINC	.0712 (.307)	.0785 (.416)	.1515 (.284)	-.1931 (-.901)
PERMINCSQR	-1.3e-06 (-.161)	-9.7e-06 (-1.217)	-.00002 (-1.132)	-4.3e-06 (-.563)
UINDX	-28.42 (-1.865)	-20.24 (-1.798)	-27.23 (-1.257)	-24.86 (-1.506)
VARINC	.00003 (2.519)	-5.2e-06 (-.866)	2.1e-06 (.412)	.00001 (.699)
AGE	-166.02 (-3.243)	-96.64 (-2.866)	-271.05 (-2.865)	24.37 (.343)
SPOUSEINC	-13.76 (-.035)	294.95 (1.022)	-253.62 (-.352)	94.66 (.212)
NC	-117.32 (-1.029)	125.42 (2.260)	560.76 (1.914)	920.19 (6.152)
TENCJ	12.61 (.688)	-20.94 (-1.609)	-.1877 (-.007)	5.23 (.296)
DRACE	2156.03 (5.645)	1086.12 (4.260)	3112.55 (3.103)	569.28 (1.228)
UNION	68.06 (.162)	60.71 (.194)	4124.05 (4.774)	3328.53 (5.226)
MD	845.87 (.976)	1287.46 (.727)	6948.03 (4.554)	-457.17 (-.692)
JURAT	56.56 (.612)	155.54 (1.960)	-194.54 (-1.246)	113.82 (1.701)
CONS	4904.23 (1.456)	2577.47 (.953)	4022.88 (.554)	-4381.39 (-.890)
OBS	887	722	665	472
F-STAT	21.31	20.06	28.41	21.35
R-square	.2407	.2689	.3616	.3768
B-P	23.42[3]	120.07[2]	197.90[2]	25.35[3]

[1]t-statistics are given in parentheses beneath the coefficient values.
[2]Significant at the .001 level, so weighted least squares results are reported.
[3]Significant at the .025 level, so weighted least squares results are reported.

TABLE 3A.18a
REGRESSION RESULTS FROM SAMPLE WITH POSITIVE DSAV3[1]
PERMINC>$5000 (1976 $'s)

	1966-69	1969-71	1971-76	1976-81
PERMINC	-1.834 (-3.559)	.6295 (1.276)	1.821 (2.394)	-.3338 (-.384)
PERMINCSQR	.00008 (4.363)	-2.91e-06 (-.154)	-.00001 (-.616)	.00006 (1.694)
UINDX	55.71 (1.641)	204.65 (5.837)	-139.31 (-1.489)	101.35 (1.524)
VARINC	-5.07e-06 (-.297)	6.75e-06 (.404)	.00002 (.592)	.00039 (4.158)
AGE	375.32 (2.857)	38.75 (.320)	128.90 (.357)	415.37 (1.843)
SPOUSEINC	337.39 (.396)	-865.51 (-1.041)	-6610.13 (-2.334)	-2856.40 (-1.585)
NC	321.82 (1.492)	-225.75 (-1.212)	767.15 (.815)	153.32 (.478)
TENCJ	102.98 (2.033)	97.05 (2.035)	183.13 (1.567)	45.72 (.534)
DRACE	-4358.48 (-5.048)	-753.00 (-.841)	-7934.98 (-2.200)	-8880.73 (-4.510)
UNION	-4492.32 (-4.449)	-1845.80 (-1.479)	-13035.07 (-4.633)	92.79 (.047)
MD	-66.56 (-.031)	2654.33 (1.342)	1757.72 (.319)	6914.24 (.528)
JURAT	-849.53 (-3.701)	-66.06 (-.282)	-688.80 (-1.216)	-133.80 (-.376)
CONS	3914.08 (.487)	-15026.9 (-1.899)	10828.40 (.447)	-22201.50 (-1.106)
OBS	1524	1281	1218	704
F-STAT	52.84	41.53	9.23	32.39
R-square	.3125	.2986	.0842	.3787
B-P	209.55[2]	60.59[2]	18.27[3]	44.49[2]

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]Significant at the .001 level, so weighted least squares results are reported.

[3]Not significant at the .05 level, so ordinary least squares results are reported.

TABLE 3A.18b
REGRESSION RESULTS FROM SAMPLE WITH NEGATIVE DSAV3,[1]
PERMINC>$5000 (1976 $'s)

	1966-69	1969-71	1971-76	1976-81
PERMINC	.0449 (.083)	-1.153 (-1.811)	2.153 (1.270)	-.5259 (-1.897)
PERMINCSQR	-2.4e-06 (-.107)	.00002 (1.098)	-.00008 (-1.334)	2.5e-06 (.418)
UINDX	56.32 (1.416)	-105.42 (-2.519)	-668.10 (-8.187)	-25.47 (-.609)
VARINC	.00005 (1.662)	.00002 (1.399)	.00003 (.647)	.00008 (2.597)
AGE	-25.05 (-.189)	-427.63 (-2.804)	-1030.06 (-3.007)	-72.75 (-.452)
SPOUSEINC	-3116.91 (-2.876)	389.26 (.392)	5215.49 (1.788)	38.92 (.031)
NC	-470.23 (-1.977)	385.88 (1.617)	-724.57 (-1.031)	1494.93 (1.527)
TENCJ	24.92 (.413)	174.69 (3.631)	19.20 (.147)	-14.80 (-.262)
DRACE	5866.36 (5.684)	1184.45 (1.168)	9957.92 (3.889)	863.59 (.844)
UNION	-2138.87 (-1.717)	6182.44 (4.007)	5825.89 (1.482)	6168.06 (3.465)
MD	2382.63 (1.917)	1663.50 (.485)	-1676.23 (-.475)	-2485.22 (-1.287)
JURAT	601.01 (2.512)	445.59 (1.408)	-391.60 (-.853)	-224.05 (-1.309)
CONS	-14408.57 (-1.812)	20681.15 (2.034)	76066.79 (3.064)	1554.90 (.140)
OBS	895	843	671	436
F-STAT	22.68	28.48	16.06	27.45
R-square	.2505	.3084	.2409	.4576
B-P	27.83[3]	346.81[2]	80.18[2]	32.79[2]

[1] t-statistics are given in parentheses beneath the coefficient values.
[2] Significant at the .001 level, so weighted least squares results are reported.
[3] Significant at the .01 level, so weighted least squares results are reported.

APPENDIX 3B

APPENDIX 3B

TABLE 3B.1
FIXED-EFFECTS PANEL REGRESSIONS[1,2]
ENTIRE SAMPLE

	SAV1	SAV2	SAV3	DSAV1	DSAV2	DSAV3
FAMLABINC	-.0159 (-.402)	.2342 (2.209)	-.603 (-2.79)	-.0142 (-.164)	-.1613 (-.720)	-1.469 (-3.12)
LABINCSQR	1.37e-06 (2.362)	1.02e-07 (.066)	8.04e-06 (2.551)	3.26e-06 (2.417)	.000014 (3.977)	.00004 (5.83)
SPOUSEINC	-17.262 (-.040)	-1501.35 (-1.297)	1432.03 (.607)	-258.67 (-.280)	-3155.66 (-1.326)	1162.02 (.232)
UINDX	23.40 (1.240)	40.797 (.809)	94.699 (.921)	53.570 (1.552)	24.495 (.275)	119.94 (.642)
NC	254.346 (1.628)	220.61 (.528)	85.579 (.101)	481.61 (1.489)	45.840 (.055)	-597.42 (-.341)
TENCJ	-22.330 (-1.077)	-64.626 (-1.166)	96.21 (.852)	-27.632 (-.723)	64.093 (.651)	.892 (.004)
MD	117.732 (.123)	-1616.4 (-.633)	3575.39 (.687)	1518.55 (.733)	358.527 (.067)	1180.60 (.105)
JURAT	217.564 (2.654)	103.25 (.471)	314.561 (.704)	437.27 (2.887)	-125.57 (-.322)	265.346 (.324)
REAL INT	4071.54 (12.426)	4773.36 (5.447)	5989.34 (3.355)	3985.60 (7.315)	3976.13 (2.833)	4102.60 (1.391)
DD1	13972.4 (11.443)	17503.1 (5.360)	23858.58 (3.587)			
DD2	937.208 (2.160)	2931.84 (2.526)	-509.508 (-.216)	-8054.3 (-7.301)	-8300.9 (-2.921)	-14759 (-2.47)
DD3	4929.5 (7.992)	5717.03 (3.466)	6274.31 (1.867)	1103.26 (1.626)	-613.30 (-.351)	1674.34 (.456)
CONS	-326.45 (-1.184)	-815.52 (-1.106)	4004.93 (2.667)	-6358.1 (-6.195)	-6083.81 (-2.301)	-8561.5 (-1.54)
OBS	5961	5961	5961	3436	3436	3436
F-STAT	17.06	4.52	3.34	8.67	5.44	6.24
R-square	.0333	.0090	.0067	.0271	.0172	.0197

[1] t-statistics are given in parentheses beneath the coefficient values.

[2] Age and the time dummies, D1, D2, and D3, are collinear, so age is dropped from the regressions.

[3] For the regressions on saving, DSAV1, DSAV2, and DSAV3, D1 is collinear with D2 and D3 and is dropped from the regression.

TABLE 3B.2
FIXED-EFFECTS PANEL REGRESSIONS[1,2]
RESPONDENTS WITH FAMILY INCOME GREATER THAN $5000

	SAV1	SAV2	SAV3	DSAV1	DSAV2	DSAV3
FAMLABINC	-.0233 (-.563)	.1506 (1.188)	-.2055 (-.844)	-.1394 (-1.525)	-.485 (-1.748)	-1.664 (-3.04)
LABINCSQR	1.57e-06 (2.798)	-3.9e-07 (-.228)	5.47e-06 (1.652)	5.19e-06 (3.897)	.00001 (3.628)	.00005 (5.766)
SPOUSEINC	-161.58 (-.386)	-1642.2 (-1.278)	-2535.60 (-1.026)	-65.112 (-.074)	-1218.9 (-.455)	-3957.3 (-.748)
UINDX	24.91 (1.312)	38.52 (.661)	70.237 (.627)	57.31 (1.684)	107.88 (1.045)	160.393 (.786)
NC	277.51 (1.758)	276.6 (.571)	772.96 (.831)	263.62 (.792)	-412.87 (-.409)	-401.10 (-.201)
TENCJ	17.74 (.778)	-15.09 (-.216)	186.50 (1.388)	27.10 (.637)	36.35 (.281)	122.52 (.480)
MD	-979.36 (-1.005)	-2183.9 (-.731)	1704.57 (.297)	-1511.6 (-.722)	-2848.79 (-.448)	2657.04 (.212)
JURAT	138.45 (1.734)	148.12 (.605)	479.36 (1.019)	353.08 (2.145)	409.33 (.923)	965.31 (1.101)
REAL INT	3872.8 (11.96)	4965.7 (5.001)	7475.99 (3.917)	3845.1 (7.289)	4441.2 (2.774)	7241.82 (2.289)
DD1[3]	13066.2 (10.86)	18105 (4.905)	28148.4 (3.967)			
DD2	735.06 (1.685)	3104.1 (2.32)	781.80 (.304)	-7378.3 (-6.825)	-9384.3 (-2.860)	-19440 (-3.00)
DD3	4806.8 (7.68)	6202.09 (3.229)	8547.3 (2.315)	1709.06 (2.448)	-1111.0 (-.524)	-232.20 (-.055)
CONS	-266.37 (-.965)	-799.90 (-.945)	2806.4 (1.724)	-6331.0 (-6.379)	-7420.5 (-2.463)	-13001 (-2.18)
OBS	4801	4801	4801	2724	2724	2724
F-STAT	17.24	2.69	2.73	10.04	3.31	6.44
R-square	.0414	.0067	.0068	.0391	.0133	.0254

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]Age and the time dummies, D1, D2, and D3, are collinear, so age is dropped from the regressions.

[3]For the regressions on saving, DSAV1, DSAV2, and DSAV3, D1 is collinear with D2 and D3 and is dropped from the regression.

TABLE 3B.3
FIXED-EFFECTS PANEL REGRESSIONS[1,2]
RESPONDENTS WHO ARE NOT UNION MEMBERS

	SAV1	SAV2	SAV3	DSAV1	DSAV2	DSAV3
FAMLABINC	.0194 (.343)	.3471 (2.191)	-.7736 (-2.417)	.0190 (.154)	-.0777 (-.236)	-1.682 (-2.45)
LABINCSQR	1.56e-06 (1.91)	7e-08 (.031)	.00001 (2.265)	3.58e-06 (1.955)	.00002 (3.205)	.00005 (4.908)
SPOUSEINC	47.74 (.072)	-2161.01 (-1.162)	2131.89 (.567)	-118.84 (-.083)	-4937.42 (-1.284)	2379.7 (.297)
UINDX	6.06 (.217)	31.60 (.405)	71.91 (.456)	43.18 (.834)	21.07 (.152)	141.39 (.491)
NC	346.32 (1.431)	253.37 (.375)	-14.49 (-.011)	798.23 (1.586)	-40.67 (-.030)	-830.46 (-.296)
TENCJ	-19.75 (-.642)	-75.75 (-.881)	91.47 (.527)	-15.87 (-.281)	103.00 (.681)	-84.569 (-.269)
MD	569.07 (.397)	-1907.0 (-.476)	5483.02 (.677)	2987.63 (.990)	1538.13 (.190)	809.39 (.048)
JURAT	280.67 (2.338)	140.04 (.417)	486.27 (.717)	571.42 (2.569)	-316.80 (-.532)	295.42 (.238)
REAL INT	4618.85 (9.259)	5418.24 (3.886)	7000.0 (2.485)	4464.35 (5.336)	4236.64 (1.892)	5113.43 (1.097)
DD1[3]	15862.1 (8.511)	20329.9 (3.903)	30185.4 (2.868)			
DD2	916.43 (1.403)	3843.07 (2.105)	666.94 (.181)	-9161.7 (-5.431)	-9272.7 (-2.054)	-19972 (-2.13)
DD3	5479.88 (5.937)	6194.18 (2.401)	8575.79 (1.645)	1071.32 (1.066)	-1511.50 (-.562)	2720.05 (.486)
CONS	-283.24 (-.679)	-1120.45 (-.961)	4018.11 (1.705)	-7206.50 (-4.561)	-6638.87 (-1.57)	-11772 (-1.34)
OBS	3706	3706	3706	2138	2138	2138
F-STAT	10.58	3.21	2.35	5.61	4.14	4.85
R-square	.0332	.0103	.0076	.0282	.0210	.0245

[1]t-statistics are given in parentheses beneath the coefficient values.

[2]Age and the time dummies, D1, D2, and D3, are collinear, so age is dropped from the regressions.

[3]For the regressions on saving, DSAV1, DSAV2, and DSAV3, D1 is collinear with D2 and D3 and is dropped from the regression.

TABLE 3B.4
FIXED-EFFECTS PANEL REGRESSIONS[1,2]
RESPONDENTS WHO ARE UNION MEMBERS

	SAV1	SAV2	SAV3	DSAV1	DSAV2	DSAV3
FAMLABINC	-.0820 (-2.14)	-.0209 (-.452)	-.1500 (-1.191)	.0173 (.842)	.0672 (.652)	-.1814 (-.603)
LABINCSQR	5.77e-07 (1.002)	-1.6e-07 (-.236)	1.85e-06 (.979)	-2.9e-07 (-.187)	-1.5e-06 (-.824)	4.6e-06 (.862)
SPOUSEINC	1.693 (.005)	-32.26 (-.074)	-165.29 (-.139)	-405.58 (-.553)	-14.35 (-.016)	-686.17 (-.270)
UINDX	53.07 (3.159)	69.23 (3.408)	97.78 (1.771)	77.72 (2.671)	60.01 (1.735)	61.86 (.613)
NC	90.04 (.699)	150.48 (.966)	157.56 (.372)	91.04 (.356)	129.22 (.425)	-395.32 (-.466)
TENCJ	-21.94 (-1.193)	-28.09 (-1.263)	70.76 (1.17)	-51.11 (-1.537)	-12.34 (-.312)	102.40 (.888)
MD	-662.44 (-.802)	-1247.93 (-1.249)	1083.01 (.399)	-1915.64 (-1.035)	-2405.46 (-1.093)	3378.84 (.526)
JURAT	93.07 (1.243)	55.56 (.614)	-179.79 (-.730)	156.16 (1.171)	168.41 (1.062)	-336.27 (-.727)
REAL INT	3102.10 (11.195)	3710.35 (11.072)	4420.99 (4.853)	3218.00 (7.342)	3709.66 (7.119)	2854.24 (1.879)
DD1[3]	10727.3 (10.439)	13165.2 (10.593)	13448.3 (3.981)			
DD2	1026.48 (2.733)	1602.42 (3.527)	-2631.31 (-2.131)	-6244.89 (-6.957)	-7325.48 (-6.864)	-7573.6 (-2.43)
DD3	4088.74 (7.586)	5238.44 (8.037)	2188.77 (1.235)	1324.13 (2.277)	1250.42 (1.808)	-353.20 (-.175)
CONS	-363.05 (-1.532)	-376.46 (-1.313)	4458.43 (5.721)	-4843.30 (-5.879)	-5530.00 (-5.646)	-2497.9 (-.875)
OBS	2255	2255	2255	1298	1298	1298
F-STAT	13.84	12.41	5.10	6.66	5.79	1.20
R-square	.0690	.0623	.0266	.0539	.0472	.0101

[1] t-statistics are given in parentheses beneath the coefficient values.

[2] Age and the time dummies, D1, D2, and D3, are collinear, so age is dropped from the regressions.

[3] For the regressions on saving, DSAV1, DSAV2, and DSAV3, D1 is collinear with D2 and D3 and is dropped from the regression.

APPENDIX 3C

APPENDIX 3C

TABLE 3C.1
INDEX OF UNEMPLOYMENT INSURANCE GENEROSITY

State	UINDX66	UINDX69	UINDX71	UINDX76	UINDX81
ALAB	56.5	56.7	66.3	71.0	69.5
ALAS	41.9	40.1	41.9	51.2	61.4
ARIZ	57.8	54.2	54.9	66.9	65.4
ARK	59.7	65.1	67.3	64.4	79.8
CAL	82.0	78.0	78.1	75.3	74.2
COLO	66.7	65.4	60.0	65.6	81.8
CONN	81.7	104.7	123.7	100.2	94.4
DEL	96.5	78.0	88.1	112.8	107.5
D.C.	57.3	62.0	70.0	76.3	62.2
FLA	40.8	41.4	42.5	74.4	66.0
GA	56.4	57.6	60.0	74.4	76.6
HAWAII	97.4	81.0	107.9	111.4	113.0
IDAHO	73.2	69.7	67.8	59.9	82.2
ILL	70.6	67.0	74.0	79.8	113.3
IND	61.2	59.0	64.0	64.1	74.0
IOWA	63.4	71.7	77.5	99.5	123.8
KAN	67.4	72.5	71.5	79.6	106.9
KY	53.5	58.1	62.7	71.4	93.6
LA	63.1	74.9	71.1	67.5	107.5
MAINE	51.3	60.6	66.7	71.7	89.5
MD	71.9	77.5	81.4	77.5	81.6
MASS	81.2	81.9	99.2	82.7	85.2
MICH	65.0	69.9	72.4	69.4	85.8
MINN	55.1	65.9	74.7	96.5	116.7
MISS	47.8	48.3	51.2	53.5	68.3
MO	52.1	53.9	61.2	66.5	77.1
MONT	55.7	52.3	53.7	65.6	88.5
NEB	66.6	62.3	71.5	76.9	89.9
NEV	82.7	66.7	76.8	81.5	101.4
N.H.	58.5	61.4	80.4	74.1	90.4

TABLE 3C.1
INDEX OF UNEMPLOYMENT INSURANCE GENEROSITY (con't)

State	UINDX66	UINDX69	UINDX71	UINDX76	UINDX81
N.J.	76.8	88.9	99.9	85.4	103.1
N.MEX	53.5	49.0	53.1	49.5	61.7
N.Y.	77.9	77.9	86.6	73.4	71.3
N.CAR	57.7	58.4	66.2	85.4	89.2
N.DAK	76.4	57.0	50.9	74.6	107.7
OHIO	60.1	65.2	67.6	87.7	101.1
OKLA	42.1	45.0	52.3	59.3	77.2
OREG	62.1	62.5	62.6	65.2	91.0
PA	63.9	70.7	75.8	92.5	111.3
R.I.	86.8	93.2	103.5	91.7	97.0
S.CAR	65.3	68.7	73.7	74.8	77.8
S.DAK	48.3	95.0	43.5	65.9	89.9
TENN	54.1	59.5	62.6	63.1	77.0
TEX	51.6	54.9	59.2	53.1	66.8
UTAH	62.9	58.9	61.2	67.5	92.5
VT	62.4	67.9	83.6	77.0	88.7
VA	53.7	53.1	62.2	80.8	95.3
WASH	53.7	53.3	89.8	56.5	87.3
W.VA	41.2	41.8	45.8	55.9	87.4
WIS	80.7	78.1	81.7	84.3	105.5
WYO	63.5	80.8	77.1	81.2	124.2

REFERENCES

Baily, M., 1978, "Some Aspects of Optimal Unemployment Insurance," *Journal of Public Economics*, 10:379-402.

Barsky, R., Mankiw, N. and S. Zeldes, 1986, "Ricardian Consumers with Keynesian Propensities," *American Economic Review*, 76:676-91.

Beenstock, M. and V. Brasse, 1986, *Insurance for Unemployment*, London: Allen & Unwin Ltd.

Bils, M., 1985, "Real Wages Over the Business Cycle: Evidence from Panel Data," *Journal of Political Economy*, 93:666-89.

Breush, T. and A. Pagan, 1979, "A Simple Test for Heteroskedasticity and Random Coefficient Variation," *Econometrica*, 47:1287-94.

Bureau of Labor Statistics, 1983, *Handbook of Labor Statistics*, Bulletin 2175, Washington, D.C.

Caballero, R., 1991, "Earnings Uncertainty and Aggregate Wealth Accumulation," *American Economic Review*, 81:859-71.

Chow, G., 1960, "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," *Econometrica*, 28:591-605.

Cragg, J., 1971, "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods," *Econometrica*, 39:829-44.

Cragg, J., 1983, "More Efficient Estimation in the Presence of Heteroscedasticity of Unknown Form," *Econometrica*, 51:751-63.

Dardanoni, V., 1991, "Precautionary Savings Under Income Uncertainty: A Cross-Sectional Analysis," *Applied Economics*, 23:153-60.

Diamond, P. and J. Hausman, 1984, "Individual Retirement and Savings Behavior," *Journal of Public Economics*, 23:81-114.

Dynan, K., 1991, "How Prudent are Consumers?" mimeo (October), Harvard University.

Feldstein, M., 1974, "Unemployment Compensation: Adverse Incentives and Distributional Anomalies," *National Tax Journal*, 27:231-44.

Flemming, J., 1978, "Some Aspects of Optimal Unemployment Insurance: Search, Leisure, Savings and Capital Market Imperfections," *Journal of Public Economics*, 10:403-25.

Hamermesh, D., 1979, "Entitlement Effects, Unemployment Insurance and Employment Decisions," *Economic Inquiry*, 17:317-32.

Hansen, W. and J. Byers, eds., 1990, *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press.

Jianakoplos, N., Menchik, P. and F. Irvine, 1989, "Using Panel Data to Assess the Bias in Cross-Sectional Inferences of Life-Cycle Changes in the Level and Composition of Household Wealth," in *The Measurement of Saving, Investment, and Wealth*, eds. R. Lipsey and H. Tice, Chicago: University of Chicago Press, pp. 553-644.

Jianakoplos, N. and P. Menchik, 1992, "Wealth Mobility," mimeo (August), Michigan State University.

Judge, G., Griffiths, W., Carter-Hill, R., Lutkepohl, H. and T.-C. Lee, 1986, *The Theory and Practice of Econometrics*, John Wiley, New York.

Kotlikoff, L., 1979, "Testing the Theory of Social Security and Life Cycle Accumulation," *American Economic Review*, 69:396-410.

Kuehlwein, M., 1991, "A Test for the Presence of Precautionary Saving," *Economics Letters*, 37:471-75.

Leland, H., 1968, "Saving and Uncertainty: The Precautionary Demand for Saving," *Quarterly Journal of Economics*, 82:153-63.

McLaughlin, E., Millar, J. and K. Cooke, 1989, *Work and Welfare Benefits*, Brookfield, VT: Gower Publishing Co.

Reubens, B., 1990, "Unemployment Insurance in Western Europe: Responses to High Unemployment, 1973-1983," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 173-206.

Rubin, M., 1990, "Federal-State Relations in Unemployment Insurance," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 207-43.

Skinner, J., 1988, "Risky Income, Life Cycle Consumption, and Precautionary Savings," *Journal of Monetary Economics*, 22:237-255.

Sobol, M., 1979, "Factors Influencing Private Capital Accumulation on the 'Eve of Retirement'," *Review of Economics and Statistics*, 61:585-93.

Summers, L. and C. Carroll, 1987, "Why is U.S. National Saving So Low?" *Brookings Papers on Economic Activity*, 2:607-35.

Topel, R., 1990, "Financing Unemployment Insurance: History, Incentives, and Reform," in *Unemployment Insurance: The Second Half-Century*, Madison, WI: The University of Wisconsin Press, pp. 108-35.

U.S. Bureau of the Census, 1967, *Statistical Abstract of the United States: 1967*, 89th edition, Washington, D.C.

U.S. Bureau of the Census, 1970, *Statistical Abstract of the United States: 1970*, 92nd edition, Washington, D.C.

U.S. Bureau of the Census, 1972, *Statistical Abstract of the United States: 1972*, 94th edition, Washington, D.C.

U.S. Bureau of the Census, 1977, *Statistical Abstract of the United States: 1977*, 99th edition, Washington, D.C.

U.S. Bureau of the Census, 1982, *Statistical Abstract of the United States: 1982*, 104th edition, Washington, D.C.

Vroman, W., 1990, *Unemployment Insurance Trust Fund Adequacy in the 1990s*, Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.