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The Effects of Social Security on Private Saving

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THE EFFECTS OF SOCIAL SECURITY ON PRIVATE SAVING

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Zhenghong Lu

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THE EFFECTS OF SOCIAL SECURITY ON PRIVATE SAVING

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The purpose of this paper is to re-estimate the impact of Social Security on aggregate private saving behavior by using new time series data for the period 1947 through 1993.

The analysis is based on the life-cycle hypothesis developed by Modigliani and Ando. Feldstein’s extended life-cycle model, incorporating Social Security Wealth (SSW) into the traditional life-cycle model, provides the building block for this paper.

A Generalized Least Squares (GLS) procedure is used to perform the time series analysis in order to avoid autocorrelation, which is usually associated with the Ordinary Least Squares (OLS) procedure. Compared with OLS estimations, the results from the GLS procedure do not indicate a large divergence regarding the statistical significance of the coefficient of SSW as well as those of other variables included except the smaller estimated parameter values.

The major finding in this paper is that SSW does depress potential personal and private saving. The result support Feldstein’s 1974 findings, but the magnitude of the
coefficient of SSW is smaller. Feldstein's estimations, by using OLS, indicated that SSW reduced potential personal saving by 50% and induced total private saving to decrease by 38%. Our estimates imply that SSW reduces personal and private savings by 44% and 13%, respectively.

The most important finding in this paper is that if SSW reduces total private saving by 13%, in the long run the decrease in the rate of private saving would also depress the private capital stock by 13%, which implies a substantial reduction in GDP and a lower level of real income.
CHAPTER I
INTRODUCTION

Social Security -- officially, Old Age, Survivors, and Disability Insurance (OASDI) -- is the largest spending program of the U. S. federal government. In December 1993, 42,245,700 persons received Social Security benefits, 62% (26,104,300) were retired workers, 12% (5,077,300) were nondisabled widows and widowers, and 26% (10,983,782) of the beneficiaries were receiving payments on the basis of disability. During the 4-year short period from December 1989 to December 1993, total OASDI beneficiaries rose by 8% (from 39,151,400 to 42,245,700). Benefit payments from the Disability Insurance (DI) Trust Fund, which pays benefits to disabled workers and their families, increased by 51%, from $22.9 billion (in 1993 dollars) in 1989 to $34.6 billion in 1993. During the same period, benefit payments from the Old -- Age and Survivors Insurance (OASI) Trust Fund increased from $208 billion to $267.8 billion -- an increase of 29%. In 1994, total Social Security expenditures are estimated at $320.5 billion, which is 22% of federal expenditures and 5% of GDP.

Originally, the Social Security program (begun in 1935) was broadly similar to a private insurance system. During their working years, individuals deposited some portion of their salaries into a fund. Over time, the fund would accumulate interest, and
on retirement, the principal and accrued interest would be used to pay benefits. Such a scheme is called fully funded. In 1939 the system was converted to a pay-as-you-go basis, meaning the benefits paid to current retirees come from payments made by those who are presently working. Each generation of retirees is supported by payments made by the current generation of workers, not by drawing down an accumulated fund. An important reason for switching to a pay-as-you-go approach was the perception that the savings of many of the elderly had been wiped out by the Great Depression, and they deserved to be supported at a level higher than that possible with only a few years of contributions. This perception stemmed from a concern about social adequacy, which meant that the benefits paid would provide a certain standard of living for all contributors (Myers, R.J., 1985). Although the OASDI places considerable emphasis on individual equity (i.e., the contributor receives benefits directly related to the amount of his or her contributions) through the provision guaranteeing that total benefits payable with respect to a covered worker would always at least equal his/her taxes paid, the OASDI benefit structure has shown a trend away from individual-equity principles and toward more social adequacy over the years.

As a consequence of changes introduced in 1983, the system is now building up substantial surpluses in the Social Security Trust Fund. These funds are being accumulated to support the “baby boom generation” in retirement, without having to raise future payroll tax rates. The 74 million people born between 1946 and 1964 make up roughly 30 percent of the country’s current population. Currently, there are about 3.3 workers for every retiree; when all baby boomers retire in 2030s, that number is expected
to fall to 1.9. Hence, when baby boomers retire, there will be a smaller proportion of the population working to produce the output that must be shared by workers and retirees alike. If their retirement were to be financed on a pay-as-you-go basis, by the year 2030, Social Security taxes would absorb one third of the nation’s payroll. To avoid such a dramatic rise in payroll tax rates in a short period of time, the 1983 Social Security reforms raised current taxes in anticipation of the baby boomer’s retirement.

Social Security tax revenues currently exceed benefit payments. In contrast, when the baby boom generation is retired, tax revenues will fall below benefit payments. The shortfall will be financed by drawing down the trust fund balance. According to the Social Security Board of Trustees’ *Status of the Social Security and Medicare Programs: A Summary of the 1994 Annual Reports*, the combined OASI and DI trust funds will run out of funds in 2029 -- in thirty-five years. However, combined OASDI expenditures (Social Security cash benefits) will exceed current tax income beginning in 2013. Thus, current tax income plus a portion of annual interest income will be needed to meet expenditures for the years 2013 through 2018; moreover, current tax income, annual interest income, plus a proportion of the principle balance in the trust funds will be needed for the years 2019-2029.

The prospects for the system have been described as the “financial crisis” of Social Security, which generated widespread concern and skepticism. Due to the complexity of the Social Security system itself, almost all of its specific provisions are potential targets for reform from the political and economic standpoint. Looking at the system’s fundamental structure, two main factors are attributed to the financial problem of Social
Security. One is the annual cost-of-living adjustment (COLA), which occurred each July 1 until the 1983 Social Security amendments changed to the date January 1. This adjustment increases benefits going to current retirees by the amount of inflation each year, as measured by the consumer price index. COLA is often blamed on an over-response to the inflation which causes a potential deficit in Social Security accounts. The second factor is wage indexing that is considered to be the real source of the system's long-term troubles because of the "double indexing" problem. The initial Social Security benefit a worker received upon retiring was computed in two steps. First, the worker's gross wages before the date of retirement were added up and averaged over the number of months worked to determine an average monthly wage (AMW). Several brackets obtained by splitting AMW was then multiplied by an array of percentages called the "marginal benefit rates," which were set by law. The product was the worker's initial Social Security benefit. The 1972 Social Security amendments provided for the annual adjustment of the marginal benefit rates for each year's retirees by the amount of inflation during the years. While wages earned in distant past were, of course, not adjusted for recent inflation, wages earned in the years immediately preceding retirement would have been largely adjusted for inflation. Consequently, one part of the benefit computation, the AMW, was already partially adjusted for inflation by the marketplace. This double indexing results in sharp increases in benefits for new retirees just entering the Social Security system.

Some economists have argued that the Social Security system influences people's behavior in a way that is detrimental to the economy's efficient operation. Most of the
discussion has focused on the impact Social Security has on saving behavior and labor supply decisions.

The starting point for most work on Social Security and saving is the life-cycle theory of saving, which suggests that individual consumption and saving decisions are based on lifetime considerations. During their working lives, individuals save some portion of their incomes to accumulate wealth, from which they can finance consumption during retirement. These funds can be invested until they are wanted, thus permanently increasing society’s capital stock. The introduction of a Social Security system can substantially alter the amount of lifetime saving. Such changes are the consequences of three effects.

First, if workers view Social Security taxes as a means of “saving” for their future retirement benefits, they will tend to save less on their own. This phenomenon is referred to as the wealth substitution effect. As discussed earlier, however, with a pay-as-you-go system, the contributions are not all saved, or, do not go into a Trust Fund -- part is paid out immediately to current beneficiaries. Thus, there is no public saving corresponding to the loss of private saving, which means that there will be a reduction in the total amount of capital accumulation.

Second, Social Security may induce people to retire earlier than they otherwise would have. More and more Americans are retiring from their career jobs while still in good health, and comparatively few take other jobs afterward; those that do typically work only part-time. Among the factors that have been proposed to explain the low labor force participation of the elderly is the Social Security earnings test. In fact, the
1983 Social Security amendments were designed to offset what were believed to be important distortions to the labor supply. Under the earnings test, for individuals between ages 62 (when benefits can first be received) and 70, benefits are reduced by a certain amount per dollar of earnings once earnings exceed a certain limit. Benefits lost as a result of this test -- either explicitly because individuals earn too much on a postretirement job or implicitly because they have not yet retired and started receiving benefits -- are recouped later with an actuarial increase. The earnings test does not apply after age 70. If older individuals face a continuous choice of work hours without fixed costs or take account of the actuarial adjustment of Social Security benefits postponed as a result of the earnings test, the earnings limit should not affect their labor supply before age 65. The earnings test does affect elders’ reentry if they behave myopically responding to current benefits rather than Social Security wealth according to the study of Reimers and Honig in 1993. One of the reasons is that individuals lack the relevant knowledge of the Social Security rules or confidence in the stability of the Social Security system. If the length of retirement increases, individuals have more nonworking years during which consumption must be financed, but fewer working years to accumulate funds. This retirement effect tends to increase saving.

Finally, suppose an important reason for saving is the bequest motive -- people want to leave inheritances for their children. If people realize that the Social Security system tends to shift income from children (worker/taxpayer) to parents (retirees/benefit recipients), they will increase their saving to reduce the impact of Social Security on their children’s incomes, thus the so-called bequest effect.
Given that the three effects work in different directions, on the basis of theory alone it cannot be known how Social Security affects aggregate saving behavior. Econometric analysis is necessary.

In an influential article in the *Journal of Political Economy*, Martin Feldstein (1974) estimated that the introduction of the Social Security system had reduced personal saving by 50% and depressed private saving by 38%. His conclusions were based on a consumer-expenditure function estimated with U.S. time-series data and incorporating a Social Security Wealth (SSW) variable of his construction.

The purpose of this paper is to re-estimate the effects of Social Security on private saving by using a larger sample period from 1947 to 1993. A larger sample size would show us stronger statistical inference regarding the impact of Social Security on aggregate saving behavior. In the present paper, some additional variables are also included in order to examine their effects on the implied impacts of SSW. Since autocorrelation is suspected to be associated with time series data, generalized least squares (GLS) estimators are employed in the paper. Compared with ordinary least squares (OLS) estimators, the same statistical inference is derived but values of the coefficients of interest are smaller. The major finding of this paper is that the re-estimation results support Feldstein's conclusions but the coefficient of SSW is smaller.

The structure of this paper is as follows:

Chapter I presents introduction of this paper. Chapter II provides a brief review of the literature. Chapter III presents the theoretical foundation of the model for the entire analysis. Chapter IV presents the empirical results and the findings of this paper. Finally,
Chapter V provides a summary of the paper and its main conclusions.
The Social Security system influences the economy through its effects on private saving, labor supply and the distribution of income. Several economists have presented the theoretical and empirical evidence in support of the contention that the growth of Social Security and specific characteristics of the system have contributed to poor economic performance by reducing both labor supply and aggregate saving. Other economists have challenged almost every one of these arguments. In essence, the theoretical debate about the economic effects of Social Security centers on one of the key unresolved analytical issues in economics, the question of how long a planning horizon individuals have and how much information they incorporate into their economic decisions.

The most frequently used paradigm is the “life-cycle model” developed by Franco Modigliani, Richard Brumberg and Albert Ando (1963), according to which people base their decisions about saving, labor supply and other economically relevant behavior on their anticipated lifetime wealth, earnings, and the rate of returns on savings. Based on their preferences for leisure and consumption, in the present and at various points in the future, people decide how much to work, to consume, to save or dissave during their lifetime.
In a controversial study, Feldstein (1974) estimated that Social Security affects an individual's saving through two opposing forces. One is the “wealth substitution effect” which reduces saving, the other one is the “retirement effect” which increases saving. The net effect on an individual's saving depends upon the relative strengths of these offsetting forces. Feldstein (1976) refers to the theoretical basis of his analysis as the “extended life-cycle model” that is adapted from the “life-cycle model” consumption function, where private voluntary intergenerational transfers are excluded. All saving during the working years is for the purpose of providing consumption during the period of retirement.

Feldstein introduces two new variables. The key variable is an estimate of Social Security wealth (SSW). Two definitions are used: gross SSW is the present value of the retirement benefits anticipated by individuals; net SSW is defined as the gross SSW minus the present value of the Social Security taxes anticipated by current workers. The other variable used by Feldstein is corporate retained earnings. In essence, this is a proxy for the permanent component of capital gains.

The estimated equation is as follows:

\[ C_t = \beta_0 + \beta_1 YP_t + \beta_2 RE_t + \beta_3 W_t + \beta_4 SSW_t \]

Where \( C_t \) is consumer expenditure in period \( t \), \( YP_t \) is disposable income in period \( t \), \( RE_t \) is corporate retained earnings in period \( t \), \( W_t \) is the household net wealth at the beginning of period \( t \), SSW is Social Security wealth at the beginning of period \( t \), \( \beta_0 \) is constant, and \( \beta_1, \beta_2, \beta_3 \) and \( \beta_4 \) are coefficients to be determined by the regression. The equation is estimated using aggregate U.S. data, deflated to constant 1958 dollars and divided by population. Equations are estimated for two periods: 1929-71 excluding 1941-
46, and 1947-71. The method of estimation is ordinary least squares. Feldstein found a positive and statistically significant value for the coefficient of SSW (gross). This positive sign suggests that increases in SSW increase present consumption and, hence, decrease saving. Thus, the wealth substitution effect dominates the retirement and bequest effects.

Feldstein's study spawned a considerable amount of controversy, much of which centered on whether his equation contains all the explanatory variables that it should. In particular, Feldstein's regression equation did not include the unemployment rate variable. Munnell (1977) has suggested that it was an important determinant of the aggregate amount of saving, because during years of high unemployment people were likely to draw down their savings to maintain their standard of living. She argued further that Feldstein's failure to include the unemployment rate in the equation tended to make his coefficient on the SSW variable appear higher than it actually was. When Munnell estimated an equation similar to Feldstein's, but included the unemployment rate, she found that SSW still reduced private saving, but the magnitude was only about 10 percent of that found by Feldstein.

In another major contribution, Darby (1979) argued that using the zero bequest life-cycle model to explain aggregate saving and capital holdings had serious limitations. He extended his earlier research on the permanent-income consumption function by incorporating Feldstein's social security wealth variable in the specification. Although his results vary, depending upon the specification used and the periods covered, he concluded that the effect was probably smaller than that estimated by Feldstein.

The life-cycle model presumes that people plan to consume all of their income and
wealth over their expected lifetime. Observed bequests are thus unplanned, arising from the fact that people do not know when they will die. The biggest challenge toward the life-cycle model from the "Multigenerational Model" rests on the proposition that Social Security will affect private intergenerational transfers by increasing the bequests of the elderly and reducing the gifts they receive. It argues that many people leave bequests intentionally; some evidence suggests that the desire to accumulate assets for bequests may account for a large share of private saving in the United States (Kotlifoff and Summers 1981). There are various motives for bequests. Some people may seek to extend their own power and influence beyond their natural lives through gifts to charities, family members, or others. Some people may wish to bind progeny or other relatives to themselves during life with the promise of a postmortem gift. Others may simply wish to leave pleasant memories of themselves through a final act of generosity. In short, people may draw satisfaction from leaving the bequest, not from the anticipated pleasure from consumption by the heirs.

Barro (1978) suggested that the introduction of Social Security was likely to lead to offsetting changes in private intergenerational transfers so that the negative effect of Social Security on private saving was reduced or eliminated. His empirical evidence consisted of a consumer-expenditure function similar to that of Feldstein but with additional variables included in the specification (the government surplus, the unemployment rate, and the stock of durable goods). Barro found that the coefficient of Social Security wealth was not significantly differently from zero. In Feldstein's (1977) reply to Barro, he regarded the idea that there may be some induced changes in voluntary
transfers as a further source of ambiguity but did not accept Barro's' assumption that these changes fully offset the effect of Social Security.

Leimer and Lesnoy (1982) presented new evidence that cast considerable doubts on Feldstein's conclusion. They argued that the SSW variable used by Feldstein was seriously flawed as a result of a computer-programming error. Simply correcting this error substantially changed the estimated effect of Social Security on saving. They also suggested a variety of modifications to the SSW variable to incorporate alternative employee perceptions and actuarial assumptions. They found evidence that Social Security might even have increased private saving.

The limitations of using time-series data to study these issues have been realized by economists including Feldstein himself. In his reply to Leimer and Lesnoy (1982), Feldstein mentioned that personal saving was inherently a dynamic process that depended on expectations about future income and retirement benefits in ways that cannot be fully captured by the current income level and the actuarial present value of Social Security benefits. He also suggested using other types of data to examine the effect of Social Security. Although each type has its own problem, the biases that arise in one framework are not the same as those that arise in another.

Feldstein had studied two different bodies of microeconomic household data (Feldstein 1976) and international cross-section data (Feldstein 1977) for two different samples of years. Each study used a function specification implied by the extended lifecycle model for that type of data. The evidence in each of the studies showed that Social Security reduces personal and private saving. Feldstein concluded that Social Security had
detrimental influences on economic efficient operations.
CHAPTER III
THEORETICAL FOUNDATION

1. Traditional “Life-Cycle” Model

The life-cycle model builds on the theory that household consumption depends not only on current income but also on income expected in the future. It is assumed that households live for only two periods, the first period is regarded as “the present” and then the second period would be treated as “the future.” These two periods are not necessarily equal in length. This simplified framework is known as the “two-period” model.

Since, in any period, the household’s income is defined as the sum of output in the period and the interest received on the stock of bonds that were held at the end of the previous period

\[ Y = Q + rB_{-1} \]

where \( Y \) is the household’s current income, \( Q \) is the current output, \( r \) is the interest rate, and \( B_{-1} \) represents the stock of bonds held by households at the end of the previous period.

In the two-period model, we suppose that a household inherits no assets \( (B_0 = 0) \) and finishes life with no assets \( (B_2 = 0) \), and an individual is not allowed to die in debt.

According to the two-period model, the intertemporal budget constraint is

\[ C_1 + C_2/(1 + r) = Q_1 + Q_2/(1+r) = W_i \]
where W stands for wealth.

Equation (3.2) states that the present value of consumption must be equal to the present value of output. The present value of output can also be considered to be the household’s wealth ($W_1$) at the beginning of the first period. The present-value condition indicates that a household can choose any combination of consumption through time ($C_1$ and $C_2$), as long as the present value of consumption equals the present value of income. Households must live within their means, not period to period but over the course of their lifetime.

The two-period model can be represented in graphic form, and the utility maximization point could be found by employing the intertemporal budget constraint and the household’s indifference curve. In Figure 3-1, the horizontal axis represents variables in the first period, and the vertical axis represents variables in the second period. Point A is the endowment point, which reflects the particular combination of first and second period output of the household. If we rewrite the budget constraint as $C_2 = Q_2 - (1+r)C_1 + (1+r)Q_1$, it is easy to demonstrate that the budget constraint is a straight line with slope of $-(1+r)$ that goes through point ($C_1$, $C_2$), shown as line BC in Figure 3-1. This line represents all the possible consumption possibilities that the household can choose in the two periods. Thus, the household can shift future income to the present by borrowing at the rate r, or it can shift present output to the future by lending at the rate r. We assume that the household derives utility from consumption in each period. Like any other familiar utility function, the intertemporal utility function $UL(C_1,C_2)$ can be shown graphically by an indifference curve. The household maximizes its utility by finding equilibrium point A,
where the indifference curve is tangent to the budget constraint, as shown in Figure 3-1.

The life-cycle theory developed by Modigliani and Brumberg in 1953 (presented in Modigani and Ando 1963 study) starts from the utility function of the individual consumer. The aggregate consumption function for the community can be obtained by summing the individual consumption functions. The basic assumptions are as follows:

Assumption 1: the population distribution by age and income is constant.

Assumption 2: the utility function is homogeneous with respect to consumption at different points in time; or, equivalently, the individual’s tastes towards present consumption and future consumption does not change (i.e., stable indifference curves).
These assumptions can be shown to imply that total consumption of a person at age 1 (or, more generally, of a household headed by such a person) will be proportional to the present value of total assets accruing to him/her over his/her life, or

\( c^i = k^i \text{ pv}^i \)  

(3.3)

where \( k^i \) is a proportionality factor which will depend on the specific form of the utility function, the rate of return on assets, and the present age of the person, but not on the present value of total assets \( \text{pv}^i \).

If \( \text{pv}^i = \lambda^i \text{PV} (\Sigma \lambda^i = 1) \)

where \( \text{PV} \) represents the present value of assets as a whole society.

Then, rewriting equation (3.3), we obtain \( c^i = \Sigma k^i \lambda^i \text{PV} \), thus,

\( (3.4) \quad C = KP\text{V} \)

where \( C \) is the aggregate consumption function.

\( \text{PV}_0 \) in period "0" could be divided into two parts, the present value of future labor income and the present value of future property income, or,

\[ \text{PV}_0 = \sum_{t=1}^{\text{death}} \frac{Y_t^L}{(1+r)^t} + \sum_{t=1}^{\text{death}} \frac{Y_t^P}{(1+r)^t} \]

where \( Y_t^L \) is labor income, and \( Y_t^P \) is property income. If the market is perfectly competitive, the present value of future property income would equal the current value of the assets, \( a_0 \), then

\[ \text{PV}_0 = \sum_{t=1}^{\text{death}} \frac{Y_t^L}{(1+r)^t} + a_0 \]
(3.5) 

\[ Y_0^{L} + \sum_{t=1}^{death} \frac{\gamma_t^L}{(1+r)^t} + a_0 \]

If we make the further assumption that the expected future income in year 0 is the average present value of future labor income, or,

\[ Y^e = \frac{1}{T} \left[ \sum_{t=1}^{death} \frac{\gamma_t^L}{(1+r)^t} \right] \]

according to equation (3.5), we have

(3.6) 

\[ PV_0 = Y_0^{L} + TY^e + a_0 \]

If we further assume that expected future income in year 0 has a linear relationship with the current labor income, or,

\[ Y^e = \beta Y_0^L \]

then, from equation (3.6), we have

(3.7) 

\[ PV_0 = Y_0^{L} + T\beta Y_0^L + a_0 \]

\[ = (1 + T\beta)Y_0^L + a_0 \]

Using equations (3.4) and equation (3.7), the aggregate consumption function
could be obtained

\[ C = K(1 + T\beta)Y_0^L + Ka_0 \]

(3.8) \[ C = \alpha Y_0^L + Ka_0 \]

The above equation implies that aggregate consumption behavior could be described by a simple aggregate consumption function, linear in aggregate labor income \((Y_0^L)\) and wealth \((a_0)\). Modigliani and Ando estimated equation (3.8) by using time series data in their 1963 study. Note that \(\alpha\) is the parameter that is known as the marginal propensity to consume (MPC), which measures the increase in consumption when income goes up by one dollar, and it is expected that \(1 < \alpha < 1\) (i.e., income). Modigliani and Ando estimates the value of \(\alpha\) to be 0.7, and \(K\) to be 0.06.

In the short run, since the asset \(a_0\) is constant, equation (3.8) becomes

(3.9) \[ C_t = \beta_0 + \beta_1 Y_t^L \]

As seen in Figure 3-2, the line labeled \(C_0\) indicates that the aggregate consumption for a given year is a straight line with slope \(\beta_1\) and intercept \(\beta_0\), and it also implies that the MPC is less than the average propensity to consume (APC).

In the long run, according to equation (3.8) as well as Modigliani and Ando's finding, the aggregate consumption function is now
Dividing both sides of equation (3.10) by $Y_t^L$, then,

$$
\frac{C_t}{Y_t^L} = 0.7 \frac{Y^L_0}{Y_t^L} + 0.06 \frac{a_0}{Y_t^L}
$$

Since both $(a_0 / Y_t^L)$ and $(Y^L_0 / Y_t^L)$ are constant over the long run, so

$$
C_t = aY^L_0 + Ka_0
$$

$(C_t / Y_t^L)$ is also constant over time. So long as income keeps rising on its exponential trend, the growth in net worth will shift the short run consumption function in such a way that the observed consumption-income points will trace out the long-run consumption function (3.10) represented in Figure (3-2) by the line $C$ through the origin, $C_0$ and $C_1$ represent short-run consumption functions. Those points are illustrated by point A $(Y_o, C_o)$ and point B $(Y_1, C_1)$. The change of the vertical intercept in the short-run consumption function results from the accumulation (or decumulation) of wealth through saving. Suppose that a cyclical disturbance caused income to decline from $Y_1$ to $Y_1'$. The consumption $C_1'$ given by the short run consumption function $C_1$ implies a higher consumption-income ratio and a lower saving-income ratio. But in the long run, since the consumption-income ratio is constant, then so is the saving-income ratio, i.e., the MPC =
2. Extended Life-Cycle Model

Feldstein extended the traditional life-cycle model by incorporating Social Security wealth into the consumption function in order to analyze the effects of Social Security on private saving.

The distinctive contribution of the life-cycle model is its observation that income tends to fluctuate systematically over the course of a person’s life and that personal saving behavior is therefore crucially determined by one’s stage in his/her life cycle. When people are young their incomes are relatively low, and they often go into debt (dissave) because they know that they will earn more money later in their lives. During their working years, income rises to reach a peak around middle age, and they repay the debt incurred earlier.
and save for their retirement years. When retirement arrives, income from work goes to
zero and people consume their accumulated resources.

The most obvious implication of this familiar life-cycle model is that Social
Security, by providing income during retirement, reduces the required amount of saving
during working years. More specifically, if the combination of the Social Security tax and
the benefits that it finances has no income effect, and if the pattern of work and retirement
is fixed, the Social Security program will reduce savings by just enough to leave
consumption unchanged during retirement. This phenomenon is referred to as the “wealth
substitution effect.” There is, however, a second effect, (i.e., the “induced retirement
effect”) that would tend to increase personal saving. The net effect of Social Security on
saving depends on the relative strength of the two effects.

Simple indifference curve analysis can illustrate the dual effects of Social Security
on private saving. If we assume that all saving is for retirement purposes, ignoring saving
temporarily for contingencies, and bequests, then it is useful to think of the two-period
model where individuals earn income in period 1 (working year) and retire in period 2
(retirement year). Such a situation is presented graphically in Figure 3-3. We use the
horizontal axis to measure the individuals’ income and consumption during their working
year. Since we assume that all income not spent on consumption will be devoted to saving,
any point on the horizontal axis simultaneously indicates the individuals’ consumption and
saving. The vertical axis measures retirement income and consumption.

Suppose there is a person, Tom, who intends to retire fully after age 65 in the
absence of social security, and his earnings during the working year are represented by
Period II

retirement
year's
consumption

Figure 3-3. Dual -Effects of Social Security

point A, at which the retirement income is zero. AB is the intertemporal budget constraint
which shows the different consumption combinations across the time period. Point F
describes Tom 's initial position after the introduction of a social security tax. During his
working period, Tom chooses the point E1 along AB to consume OC and saves CA. If the
payroll tax is levied, Tom's disposable income will be reduced by the amount of the tax
TA. The introduction of social security does not change this budget constraint, since he
substitutes the tax for the saving which could assure his retirement consumption. Thus
Tom remains at the initial utility maximization point E1. The reduction in disposable
income implies that saving is reduced from CA to CT.

Consider a different situation under which there is another person, Bob, who would continue to work for some time after age 65. Point H indicates an initial position with positive earnings in the second period and the same level of first-period earnings as point A. The new equilibrium point is denoted by point E2, and the corresponding saving is the relatively small amount GA compared with CA. Apparently, Bob is on a higher indifference curve compared with Tom. If the social security program induces him to retire completely at age 65, his initial point will shift to point F, which means his period 1 disposable income is reduced by TA, while his period 2 disposable income is reduced to zero and not fully compensated by the social security benefit. The effect of introducing social security is, therefore, to increase saving from GA to TA.

Since the effects of social security on private saving work in different directions, it cannot be predicted how social security affects saving on the basis of theory alone. Econometric analysis is necessary.
CHAPTER IV
EMPIRICAL ANALYSIS

1. Modeling the Specification

The empirical study, especially the construction of the SSW variable, is based on the earlier work by Feldstein, Barro and Munnell. According to most of the previous studies, the same results could be derived by using gross SSW or net SSW. Thus, in this paper, we use gross SSW.

As was shown, the studies of Feldstein, Barro and Munnell present separate analysis for the periods 1927 through 1971 as well as the postwar period (i.e., 1947 through 1971). In this paper we use time series data for the postwar periods from 1947 to 1993, since the enlarged sample size will enable us to obtain stronger statistical inferences about the effects of SSW on private saving. The estimations presented below support the conclusion that Social Security depresses private saving.

Cross Social Security Wealth (SSWG) is defined as the present value in year t of the retirement benefits which could eventually be claimed by all those who are either in the labor force or already retired in year t. The calculation of these present values reflects survival probabilities and discount rate of future benefits. Net Social Security Wealth (SSWN) equals gross social security wealth minus the present value of the social security
taxes to be paid by those who are currently in the labor force.

The SSWG is calculated by employing the age groups based on the equation developed by Feldstein and Munnell. For a given age group, say 20-29 years, and for a given year, say 1970, the SSWG for male (or female) workers could be calculated as follows:

\[
SSW_{(1970,20-29)} = N_{(20-29)} \sum_{i=65}^{100} \frac{B}{YD} \cdot YD_{1970} \cdot \frac{(1+G)^{65-25}}{(1+D)^{65-25}} \cdot SP_{(25,i)} \cdot \frac{(1+G)^{-64}}{(1+D)^{-64}}
\]

where

- \( SSW_{(20-29,1970)} \) = present discounted value of social security benefits to be received by insured workers in the 20-29 age group in 1970,
- \( N_{(20-29)} \) = number of men in covered employment aged 20-29,
- \( B/YD_{(1970)} \) = average ratio of social security benefits to per capita disposable income for the period 1947 through 1993. There has been no trend in this ratio so that the average value is projected for the future,
- \( SP_{(25,i)} \) = The probability that a man at age 25 survives to age I (65, 66, etc). Survival probability is calculated based on the Period Life Table, 1989 published in the Annual Statistical Supplement, Social Security Bulletin, 1993. In this case, suppose at age 0, the number of lives is 100,000, at age 25, the number survived is 97,018, at age 65, the number survived is 73,627, then the probability of a man at age 25 surviving to age 65 = \( 73,627/97,018 = 0.7589 \)
\[
\frac{(1+G)}{(1+D)^{65-25}},
\]
where \( G \) is the growth term which insures that real per capita income increases at 2% per year until the man retires at age 65. \( D \) is the discount term applied to benefits from age 65 back to age 25, Feldstein estimated that the \( D \) was 3%.

\[
\frac{(1+G)}{(1+D)^{64}},
\]
where \( G \) insures that income continues to grow after retirement which is still 2%. \( D \) serves to discount benefits after retirement back to age 65 at 3%.

Before 1972, Social Security benefits were fixed by Congress in nominal terms as a function of a retiree’s previous average nominal earnings. From time to time, Congress adjusted the benefits of retirees so that over the postwar period there was no trend but fluctuations around a benefit level equivalent to about 40% of per capita disposable income. In 1972, Congress voted a major change in the way benefits are calculated and adjusted. Starting in that year, benefits would no longer be based on an average nominal earnings but instead be based on the retiree’s previous earnings relative to a national average of earnings in each previous year. In addition, an individual’s benefits after retirement would be automatically increased each year by the percentage rise in the consumer index (i.e., COLA). By these two indexing changes, Congress hoped to insulate Social Security from fluctuations in the price level and the inflation rate.

In the same 1972 legislation, Congress also raised Social Security benefits by approximately 20%. Since the indexing provisions would prevent this benefit increase from being eroded by future inflation, the change was intended by Congress as a permanent 20% rise in the level of benefits. In fact, the new method of indexing has not
worked as Congress intended. There was an error in the indexing formula that caused the benefits of new retirees to rise by much more than the increase in the general level of wages and prices. Between 1972 and 1993, the ratio of average benefits to the average per capita income varied around an average of 0.49 or 20% higher than its average of 0.41 during the period 1947 through 1972.

Although there is no doubt that the 1972 Social Security law caused a major change in the current and future level of Social Security benefits, it is not clear how this benefit change should be reflected in the SSW variable. Method for resolving this problem would be to raise all the SSW by 20% for the years beginning in 1972. This method is used in this paper. This 20% increase would reflect congressional intent and would ignore the unpredictable problems. A 20% increase of SSW would also correspond to the actual rise in the ratio of Social Security benefits to average income between the pre-1972 and the later period.

The construction of the SSW variable is an important building block in the analysis. As was shown in the Ando-Modigliani/Feldstein framework, consumer expenditure is related to a measure of household resources over its lifetime, which implies that the individual's current consumption depends not only on current income but also on expected future income. Under this theory, the appropriate measure of an individual's income is "permanent" income or average lifetime income. Also, we assume that the individual prefers a stable consumption pattern to an unstable one over one's lifetime.

According to the life cycle hypothesis, the following variables are components of average lifetime income: 1) current and lagged disposable income, 2) net retained
earnings, 3) net wealth of the household, and 4) social security wealth. It is worth mentioning the idea of incorporating the retained earnings variable in the extended consumption function. Retained earnings are defined as corporate saving; it will eventually be paid out in the form of dividends. If the firm chooses to save an additional dollar, overall private saving will be unchanged because households will respond by decreasing personal saving by the same amount. In other words, when households make their own saving compensate for changes in the firm’s saving, it is said that they “pierce the corporate veil.” The retained earnings variable, which was suggested by Feldstein, is considered as a household income variable that proxies for current and future capital gains. Omitting this variable will result in neglecting a significant portion of household income.

2. Data

The estimates are based on aggregate U.S. data for the time period 1947 to 1993. Unless otherwise indicated, all variables are in per capita 1987 dollars (Table 1), based on the implicit price deflator for personal consumption expenditure. The implicit price deflators for the period 1947 through 1959 are from the National Income and Product Accounts, 1929-1958 and 1959-1988 Table 7.1. And the deflators for the period from 1960 to 1993 come from the Economic Report of the President, 1994, Table B-5.

The definitions of the dependent and independent variables are presented as follows:

Dependent Variable:
C: Real per capita personal consumption expenditure, excluding the purchases of consumer durables, and including the flow of services rendered by the existing stock of consumer durables. Personal consumption expenditures 1947-1958 data were taken from U.S. Department of Commerce, *The National Income and Product Accounts, 1929-1958*, Table 1.2.; the data for 1959-1993 from *the Economic Report of the President, 1994*, Table B-6.

Independent Variable:


**LAG(YD):** Lagged real per capita disposable personal income.

**RE:** Real per capita retained earning. The measurement of RE is undistributed corporate profits with inventory valuation and capital consumption adjustments; the data from 1947-1958 are reported in U.S. Department of Commerce, *The National Income and Product Account, 1929-1958*, Table 5.1, and for the years 1959 through 1993 are presented in the *Economic Report of The President, 1994*, Table B-88.

**NW:** Real per capita private net worth. The data are from *Economic Report of the President, 1994*, Table B-113.

**UR:** Unemployment rate in the total labor force, the data for 1947-1958 are
The basic data required to calculate the Gross Social Security Wealth (SSW) variable are published in the annual statistical supplements of the Social Security Bulletin. SSW for 1947-1976 are given by Feldstein’s estimates in his 1977 study, and the data from 1977 through 1993 are estimated by the author of this paper.

3. Estimated Empirical Results

The estimated equation is as follows:

\[ C = \alpha_0 + \alpha_1 \text{SSW} + \alpha_2 \text{YD} + \alpha_3 \text{LAG(YD)} + \alpha_4 \text{NW} + \alpha_5 \text{RE} \]

A positive effect of current disposable income on consumer expenditure is expected. Based on the underlying life-cycle model, consumer expenditure would respond positively to the lagged disposable income if that variable is a positive predictor of future income, given the values of current disposable income and other included variables.

Although a positive effect of RE on consumer expenditure would be expected, the potential difficulty with the inclusion of the retained earning variable is that it treats the corporate saving decision as exogenous with respect to the personal saving decision. To the extent that shifts in corporate saving are correlated with shifts in personal saving (that have not been picked up by the other independent variables), there would be a downward bias in the estimated effect of retained earning on consumption expenditure.

A measure of household net worth is often stressed in empirical estimations of the
life-cycle model, which predicts a separate effect of wealth on consumption expenditure. Given other included variables, a positive sign on the estimated coefficient of the net worth variable is expected. The effect of Social Security wealth on consumer expenditure is, as indicated already, indeterminate.

In order to be comparable to the specifications of Barro and Munell, the unemployment rate, government surplus and consumer durable variables are also included in different consumption function equations.

First the model is estimated by using the ordinary least squares (OLS) procedure in SPSS. Equation 1 in Table 2 is shown as follows:

\[
\begin{align*}
C &= 753.94 + 0.017SSW + 0.349YD + 0.266\text{LAG}(YD) + 0.014NW + 0.248RE \\
\text{t} &= (0.0022) \quad (0.0000) \quad (0.0001) \quad (0.0001) \quad (0.0245) \\
F &= 11019.73 \quad \quad n = 46 \\
DW &= 1.218
\end{align*}
\]

It seems that all the coefficients of the explanatory variables are statistically significant, but the value of Durbin-Watson is relatively low. For \( K=5, \ n=46, \) at 0.05 significant level, \( d_L = 1.335 \) and \( d_U = 1.775, \) since \( DW < d_L, \) then it means that autocorrelation exists in this model. If we retest the DW statistic at the 0.01 significant level, it lies in the indecisive zone. Therefore, we can not conclude whether or not autocorrelation does exit. If it exists, the OLS estimators are still linear and unbiased but not efficient compared to the procedures that take autocorrelation into account. In short, the OLS estimators are not best linear unbiased estimators (BLUE). The consequences of autocorrelation can be quite serious; if a DW statistic lies in the indecisive zone, it may be
prudent to assume that autocorrelation exits. The visual graphic should be used in such a case. Figure 3-4 shows that the residuals do not exhibit a very distinctive behavior, they seem to be randomly distributed; but the existence of several outliers still could not exclude the possibility of autocorrelation.

Since the consequences of autocorrelation can be very serious and the cost of further testing can be high, some remedial measures should be chosen. In this paper, we use the Prais-Winsten transformation to transform the model and apply OLS to the transformed model which will give us the usual BLUE estimators. These estimators are called generalized least squares (GLS). The generalized difference equations are as follows:

\[
Y_t' = Y_t - \rho Y_{t-1}
\]

\[
X_t' = X_t - \rho X_{t-1}
\]

where, \( Y \) represents the dependent variable and \( X \) represents the independent variable, \( \rho \) is estimated from DW d statistic, i.e., \( \rho = 1 - d/2 \).

The transformed estimated equation 2 is given in Table 2, which can be shown as follows:

(2) \[ C = 408.45 + 0.01 SSW + 0.37 YD + 0.27 LAGYD + 0.013 NW + 0.323 RE \]

\[ t = \begin{array}{cccccc}
(0.0031) & (0.000) & (0.000) & (0.0011) & (0.0026)
\end{array} \]

\[ F = 5659.42 \quad n = 45 \]

Durbin-Watson Test = 1.838

A higher DW statistic indicates that autocorrelation is not likely to be present, and
Figure 3-5 shows randomly distributed residuals.

Compared with equation 1, the coefficient of SSW 0.01 is slightly smaller than that of 0.017 in equation 2, but the parameter values in both cases are all statistically significant.

In order to avoid possible autocorrelation, equation 2 is the final choice. We find that all the estimated partial coefficients in equation 2 have the signs that are expected by economic theory (except that of the estimated coefficient of SSW which is theoretically indeterminate).

The estimated coefficient on SSW implies that each one dollar increase in the expected social security benefit leads to a 0.01 dollar increase in consumption expenditures and a 0.01 dollar decrease in personal saving, other things being equal. On a 5% test level, for a two-tail test, since the P-value of the estimated coefficient of SSW is 0.0031<0.05, then we can reject the null hypothesis that the estimated coefficient on SSW is zero. It also indicates that the estimated coefficient on SSW is significantly different from zero, i.e., the social security program has a negative effect on private saving.

Since the P-values of the estimated coefficients on YD, LAGYD, NW and RE are 0.0000, 0.0000, 0.0011, and 0.026, respectively, we can conclude that each partial regression coefficient is significantly different from zero.

The estimated R-square can be interpreted as that 99.86% of the variation in consumption expenditure is explained by its linear dependence on SSW, RE, YD, LAGYD, and NW. The adjusted R-square indicates that 99.84% of the variance in the consumption expenditure is explained by its linear dependence on SSW, RE, YD,
LAGYD, and NW.

The overall significance of the model is examined with an F-test.

\[
F = \frac{R^2/(k-1)}{(1-R^2)/(n-k)}
\]

\[
= \frac{0.9986/(6-1)}{(1-0.9986)/(47-6)}
\]

\[
= 58500
\]

At the 5% test level, with 5 and 41 d.f., the critical F value is 2.45. Therefore, the five explanatory variables collectively have significant explanatory power on the dependent variable. Equations 3 through 6 in Table 2 present the different specifications, in which additional variables are added to the basic variables in equation 2: SSW, YD, LAG(YD), NW, and RE. The coefficient of unemployment rate (UR) included in equation 3 is not significantly different from zero, and the standard error is 763.38. Equation 3 also indicates that the coefficient of SSW increases slightly from 0.010 in equation 2 to 0.011 with the same standard error 0.0033.

Barro (1978) suggested that the unemployment variable should be the product of unemployment rate (UR) and disposable income (YD). Equation 4 re-estimates the specification by substituting UR*YD for UR. The coefficient of SSW stays unchanged at 0.01 with a standard error of 0.003. We can conclude that UR has no effect on the implied impact of SSW.

The government budget surplus (SUR) and consumer durable (DUR) variables are also included in Barro’s specification. He concluded that the coefficient of SSW was no longer statistically significant if those variables were included.

Equation 5 and 6 recalculated the estimation by adding SUR and DUR,
respectively. SUR still leaves the coefficient of SSW unchanged and itself is not statistically significant. The coefficient of DUR is not significant, but the coefficient of SSW decreases to 0.008 with standard error 0.004 and becomes less significant.

The results shown in equations 3 through 6 imply that the impact of SSW on aggregate saving behavior can be inferred from the original specification (i.e., equation 2; further specifications have little effect on the coefficient of SSW).

4. The Implication of SSW on Aggregate Saving

Feldstein (1974) estimates that the marginal propensity to consume Social Security wealth is 0.021 with a standard error of 0.006 based on time series data for the period 1929 through 1971 (excluding the years 1941 through 1946) by using the OLS procedure. He concludes that the implied effect of Social Security is to reduce personal saving to half of what it otherwise would be. By halving personal saving, Social Security reduced total private saving by 38 percent.

In this paper, the estimated coefficient of SSW is 0.01 with a standard error of 0.003, which are both less than Feldstein's results. Since Social Security wealth in 1993 was $15,198 billion (in 1993 dollars), the implied effect of SSW is to increase consumption expenditures by $152 billion, implying that the potential personal saving is reduced by the same amount. Total personal saving in 1993 was $196 billion (in 1993 dollars); thus, SSW will reduce personal saving by 44%. Since gross private saving (personal saving plus gross business saving) was $989 billion (in 1993 dollars), the implied effect of SSW is to depress potential gross private saving by 13%.
The magnitude of the effect of SSW on private saving shown in this paper is less than Feldstein's prediction, perhaps due to the larger sample size and a different estimation procedure.
Figure 3-4. Residual Analysis for OLS

Figure 3-5. Residual Analysis for GLS
<table>
<thead>
<tr>
<th>YEAR</th>
<th>C</th>
<th>SSW</th>
<th>YD</th>
<th>LAG(YD)</th>
<th>RE</th>
<th>NW</th>
<th>UR</th>
<th>URYD</th>
<th>SUR</th>
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<td>3,078.84</td>
<td>5,057.65</td>
<td>3,711.79</td>
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<td>277.74</td>
<td>0.02</td>
<td>84.45</td>
<td>314.23</td>
<td>106.25</td>
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<td>3,000.28</td>
<td>4,446.71</td>
<td>3,534.38</td>
<td>3,717.79</td>
<td>205.55</td>
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<td>3,921.96</td>
<td>3,534.38</td>
<td>120.61</td>
<td>17.142.65</td>
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<td>117.39</td>
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<td>6,787.32</td>
<td>3,910.33</td>
<td>3,921.96</td>
<td>150.75</td>
<td>17.179.47</td>
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<td>0.04</td>
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<td>4,016.23</td>
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<td>18.852.90</td>
<td>0.02</td>
<td>95.88</td>
<td>401.43</td>
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<td>19.410.76</td>
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<td>104.01</td>
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**Table 1. Values of Dependent and Independent Variables for GLS**
Table 2. Consumption Function Equations

<table>
<thead>
<tr>
<th>Equation</th>
<th>SSW</th>
<th>YD</th>
<th>LAG(YD)</th>
<th>NW</th>
<th>RE</th>
<th>UR</th>
<th>UR*YD</th>
<th>SUR</th>
<th>DUR</th>
<th>R-Square</th>
<th>SSR</th>
<th>DW</th>
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<td>0.014</td>
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<td></td>
<td></td>
<td></td>
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<td>1.218</td>
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<tr>
<td></td>
<td>(0.0053)</td>
<td>(0.061)</td>
<td>(0.059)</td>
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<td></td>
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<td>(0.0419)</td>
<td>(0.004)</td>
<td>(0.101)</td>
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<td>(0.045)</td>
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<td>(0.003)</td>
<td>(0.102)</td>
<td>(763 383)</td>
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<tr>
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</tr>
<tr>
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<td>(0.0037)</td>
<td>(0.046)</td>
<td>(0.042)</td>
<td>(0.004)</td>
<td>(0.107)</td>
<td>(0.127)</td>
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Note: Standard errors are shown in parentheses. SSR is the residual sum of square. DW is the Durbin-Watson statistics.
CHAPTER V
SUMMARY AND CONCLUSION

The Social Security system is considered as the public provision of pensions in the
U.S. Since it has become the biggest domestic spending program among other major
social insurance schemes, its social and economic impacts generate widespread concern
and controversy.

In this paper, the major characteristics of Social Security are presented in
Chapter I. The introduction of Social Security can substantially change the amount of
lifetime saving due to three effects. One is the "wealth substitution effect" which will lead
to a reduction of personal saving. And the other two effects, "induced retirement effect"
and "bequest effect," tend to increase saving.

Based on theoretical analysis, the impact of Social Security on private saving
would be ambiguous because those three effects work in different directions.

The objective in this paper is to estimate the implied impact of Social Security on
private saving by using empirical analysis based on the life-cycle hypothesis developed by
Modigliani, Ando and Feldstein. Time series analysis is utilized in this paper. The larger
sample size for the period 1947 through 1993 is used to compare the statistical inferences
with Feldstein’s 1974 findings. The autocorrelation usually associated with time series
data is corrected by employing GLS estimators rather than those of OLS.
The major finding in this paper is that SSW does depress personal and private saving. The research results support Feldstein's estimation, but the magnitude of the coefficient on SSW is smaller than his. Based on the estimation shown in Section IV, the SSW decreases personal saving and private saving by 44% and 13%, respectively.

The most important implication of the findings in this paper is that if SSW reduces total private saving by 13%, in the long run the decrease in the rate of private saving would also depress the private capital stock by 13%. The reduction in private capital stock implies a substantial reduction in GDP and a lower level of real national income.
REFERENCES


