AN ECONOMETRIC ANALYSIS OF SOCIAL SECURITY AND SAVING

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Abstract

This paper examines the contention by Martin Feldstein that Social Security has effectively reduced private saving by substituting post-retirement income transfers for personal saving during an individual's working years. It includes a review of the relevant literature as well as a theoretical discussion and empirical tests of his hypotheses.
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Introduction

In 1936, the United States created a mandatory saving and income redistribution program designed to supplement the retirement income of senior citizens. Recently, this program has come under fire from economists like Martin Feldstein who charge that it has been responsible for some of the observed decline in the US saving rate. This paper will duplicate the work done by Feldstein in his 1974 article called “Social Security, Induced Retirement, and Aggregate Capital Accumulation” which was published in the *Journal of Political Economy*. In doing so, the increase in wealth due to Social Security will be considered as the primary cause of lower aggregate saving in the United States during the past sixty years.

The link between saving and investment has been well established by economic research. The observed decreases in the US saving rate in recent history are therefore a source of concern. A number of factors are possible causes of these decreases; chief among them is the creation of Social Security, which is effectively a mandatory savings program. As agents anticipate a greater amount of post-retirement income due to Social Security payments, they feel less need to voluntarily contribute to private saving plans while still in the labor force. This offsetting behavior has had the effect of reducing private saving and thereby restricting the amount of funds available for investment.

This paper will first examine the economic literature on Feldstein's work. Next, an attempt will be made to explicate the theory underlying his contentions about the effect of Social Security on saving. Finally, I will attempt to duplicate Feldstein's regression results and re-interpret their importance to private saving.
Literature Review

A considerable amount of economic literature has been dedicated to the question of determinants of saving. More recently, this debate has come to focus on Social Security as one of the factors affecting saving. Martin Feldstein began the discussion of Social Security’s effect on saving with a time-series analysis of US macroeconomic data; this work has been followed by a large body of literature discussing Feldstein’s results. His results have come under fire on both empirical and theoretical grounds, but the heart of his analysis seems to remain untouched.

Martin Feldstein’s 1974 article in the *Journal of Political Economy* entitled “Social Security, Induced Retirement, and Aggregate Capital Accumulation” was the first thorough examination of the effect of Social Security on saving. In his article, Feldstein considers how the relationship between disposable income, household wealth, and personal consumption has changed since the introduction of Social Security. The effect of Social Security is measured by the introduction of a Social Security Wealth variable that measures “the present value in year t of the retirement benefits that could eventually be claimed by all those who are either in the labor force or already retired in year t.” (Feldstein 911) This variable takes two forms, SSW and SSWN, which measure gross and net social security wealth respectively. The net SSW measurement takes into account the taxes which are paid into Social Security, however the gross measure may be more appropriate because the disposable income variable already accounts for taxes paid. For purposes of simplification, only the more appropriate gross measure of Social Security Wealth is used in this study.
Feldstein’s theoretical argument is that Social Security will have a two-fold effect upon saving. By guaranteeing income to retirees, the asset-substitution effect will decrease saving during an agent’s working years. At the same time, the availability of Social Security benefits at age 62 and the high effective tax rate on retiree earnings after 65 has the effect of inducing retirement. This early retirement inducement causes agents to save more during their working years to offset a longer retirement period. The relative magnitudes of the respective effects determine whether the introduction of Social Security has increased or decreased saving.

According to Feldstein’s article, the introduction of Social Security has indeed negatively affected the aggregate saving level of the United States, and he updates this conclusion in his 1996 article for the National Tax Journal in which he corrects some computational errors from the earlier article and introduces another twenty years of data to the analysis. His conclusion that Social Security reduces saving is once again confirmed by empirical analyses, and he estimates that Social Security decreased private saving by $416 billion dollars in 1992 alone, a reduction of 63% when contrasted with the $248 billion dollars actually saved in 1992.

The most comprehensive attempt by other economists to duplicate Feldstein’s research comes in Leimer and Lesnoy’s 1982 article “Confirmations and Contradictions: Social Security and Private Savings: New Time Series Evidence.” They critique his work in three areas. First, they discovered a programming error in his calculation of the SSW variables that Feldstein corrects in his response (Feldstein 1982). Second, they criticize several of the assumptions underlying the construction of the SSW variable that I will discuss in the description of the variable. Finally, they observe that the relationship
between Social Security and saving is highly dependent on the time period on which the analysis focuses. This may be a result of the relatively small number of years in the sample or may reflect differing expectations of the Social Security system on the part of various generations. Ultimately, the core of Feldstein’s analysis survives these charges although they do succeed in questioning the validity of his estimates of the magnitude of the decreases in saving that can be ascribed to Social Security.

Feldstein’s theoretical view of Social Security and saving is also not without its detractors. The model of intergenerational altruism proposed by Barro specifically contradicts Feldstein’s assumption that, when faced with higher levels of guaranteed future income, agents will decrease voluntary saving. Barro (1974) asserts that older generations realize the higher taxes that will be necessary for their sustenance if the promised level of benefits is to be provided. This realization prompts people to adjust their saving behavior accordingly to prevent an increased burden upon younger generations who will be forced to finance the benefits through higher taxes. He tests this by using the same consumer expenditure function as Feldstein but also includes variables measuring the government surplus, the unemployment rate, and the stock of durable goods. These variables could be used to compensate for the effect of government debt on private wealth as current government debt translates into a future tax liability.

The significant debate on Feldstein’s analysis warrants further empirical tests of his hypothesis; however, a more detailed review of his extended life cycle model is necessary before such tests can be carried out.
Theory

Feldstein proposes an extension of the life cycle model of savings to incorporate the effect of Social Security on saving. Under such a model, individuals dissave when very young by borrowing against future earnings and save while in their prime earning years to finance another period of dissaving when retired. Feldstein asserts that the introduction of Social Security has two effects on individual’s saving. These two effects are illustrated in the figure below which is drawn from Feldstein’s 1974 article.

![Figure 1](image)

The horizontal axis measures income and consumption before retirement while the vertical axis measures income and consumption after retirement (assumed to be age 65). Point A is the initial endowment of an individual who will be fully retired after age 65 in the absence of Social Security. Given prevailing interest rates, he chooses to save some portion of his income corresponding to Point I, consuming $C_{1A}$ during his working
years and saving $Y_{1A} - C_{1A}$ times the interest rate implied by the slope of the budget constraint for consumption in retirement. The introduction of a social security tax moves the individual’s initial endowment to Point B if it is assumed that the tax is exactly enough to cover the benefits of the Social Security program at the market rate of interest. Because the introduction of the tax does not affect the individual’s budget line or preferences, he still chooses Point I as his optimal allocation of resources over the two periods, however the introduction of the tax has reduced his savings from $Y_{1A} - C_{1A}$ to $Y_{1B} - C_{1A}$. This results in an effective reduction of $Y_{1A} - Y_{1B}$ (the amount of the tax) in saving for retirement.

Feldstein contrasts this example with one of an individual who intended to work past age 65 in the absence of Social Security. In this example, Point C is the individual’s initial endowment, leading him to choose Point II as the new optimal allocation of income and consumption over the two periods. The introduction of Social Security induces retirement at age 65, shifting the individual’s initial endowment to Point B by eliminating income in period 2 altogether and removing the amount of the tax ($Y_{1A} - Y_{1B}$) from income possible for consumption or saving in period 1. With this change in his initial endowment, Point I becomes the optimal choice with the effect of changing saving from $Y_{1A} - C_{1C}$ to $Y_{1B} - C_{1A}$. In Figure 1, the two amounts are roughly equivalent although it is easy to see how different assumptions about the individual’s behavior could yield either a net increase or net decrease in saving.

Empirical tests on individual data could resolve the ambiguity about the relative weights of the two effects demonstrated above, however Feldstein chooses to address the more general proclivities of the population by using aggregate data to test the effect of
Social Security on saving. In order to perform such tests, a box model for generating the data must be created. In standard econometric modeling, the Gaussian Error Box model serves to simulate the effect of inherent randomness and measurement error because the values of the data on which the regressions are being performed are not necessarily the true values. The GEB justifies the attachment of an error term to the regressions used and allows tests of the validity of the results based on the underlying assumptions of the box model. These assumptions include that errors drawn from the box (and estimated by residuals) average zero, are uniformly distributed, are independent of each other, and are not correlated with any X variable. Of particular concern in Feldstein’s analysis is the possibility of autocorrelation, a violation of the third assumption that errors are independent of each other, which is often not the case in time-series data. This is merely a theoretical concern, and it can easily be tested after empirical analysis of the data is undertaken.
**Data Description**

The data for testing Feldstein’s hypothesis about the effect of Social Security on savings was obtained from several locations. The consumption and disposable income variables are the respective components of national income and were obtained from the *Historical Abstract of the United States* and the *Statistical Abstract of the United States*. The other variables, Social Security Wealth and household wealth, are given in the appendix of Feldstein’s 1996 article entitled “Social Security & Saving: New Time Series Evidence.”

Per Capita Consumption measures the amount of income which is not being saved because savings is income minus consumption and, therefore, the path of savings can be analyzed using consumption. The data on consumption comes from two sources. Data from the years 1930 to 1970 were obtained from *The Historical Abstract of the United States* in Series F 17-30 which gives the information in constant 1958 dollars. Data for the years 1959 to 1992 were obtained from *The Statistical Abstract of the United States* in Table B-29 which gives the information in constant 1992 dollars. After converting both series to constant 1987 dollars using a CPI deflator created by Humberto Barreto with data from *The Historical Abstract of the United States* (Series R 188), I noticed that the data from the overlapping years did not coincide. To account for this, I applied a correction factor to the data from 1930 to 1958 that is based on the average percent difference between the values in 1959 through 1970. The result can be seen on the graphs in Appendix A plots the unadjusted series and the adjusted series respectively.

Per Capita Disposable Income, calculated by subtracting taxes from national income, was computed in a similar manner. *The Historical Abstract of the United States*
gave data for the years 1930 to 1970 in Series F 17-30 in constant 1958 dollars. Data for the years 1959 to 1992 were obtained from *The Statistical Abstract of the United States*’s Table B-29 which gives the information in constant 1992 dollars. Upon comparison in 1987 dollars, the overlapping data did not coincide so a similar correction factor was applied. Comparison of the adjusted and unadjusted series may be seen in Appendix B. Disposable income and its lagged value are theoretically significant determinants of saving because individuals base their saving on how much income they draw in a given year as well as the amount of income they drew in the previous year as individuals tend to smooth consumption over periods by borrowing against future earnings if necessary.

The remaining variables, which measure aggregate Social Security Wealth and Household Wealth come from the Appendix to Feldstein’s 1996 article in the National Tax Journal. These were transformed into per Capita figures using a population time series obtained from the *Statistical Abstract of the United States*. Household wealth measures the net worth of each household in the United States and may affect saving by indicating the ability for individuals to direct superfluous income to saving as well as being the best indicator of the post-retirement standard of living that an individual expects to have to finance through saving.

The Social Security Wealth variable was computed by Feldstein, and he defines it as “the present value in year t of all the retirement benefits which could be claimed by all those who are either in the labor force or already retired in year t.” (Feldstein 911) He assumes that the level of benefits from Social Security rises over time but notes that the ratio of benefits to disposable income has varied around the mean of 0.41 without any trend and so he assumes that benefits from Social Security will amount to .41 times
disposable income in year \( t + 65 - a \), where \( a \) is the current age of the individual covered. He adds to this a factor that accounts for the future value of disposable income by projecting the current rate of its growth and adjusting the value of SSW accordingly. Finally, the sum of these benefits is actuarially adjusted to account for the probable amount of time that benefits will be drawn. In his 1996 article, Feldstein also revises the definition to account for the major change in the Social Security benefit structure that occurred after the 1972 revision of Social Security laws. The effect of these changes was an almost 20% increase in benefit levels and is easily seen in Appendix C on the time-series graph of SSW. The graph of SSW over time also shows how SSW has accumulated at different rates during its history. Although changes in the law in 1952 and 1972 are responsible for the discontinuities observed during those years as they raised expected benefit levels, most of the growth in SSW is driven by growth in real disposable income. A comparison of the adjusted disposable income figures in Appendix B with the SSW figure in appendix C shows how, especially during the 1940's, 1960's, and 1980's, growth in SSW was driven by growth in disposable income. In this manner, Feldstein attempts to account for the role of Social Security in replacing private wealth accumulated by saving.

Leimer and Lesnoy (1982) criticize several of the assumptions underlying Feldstein’s construction of the SSW variable. First, they note that the ratio of benefits to disposable income has varied considerably during the time period in question and so they dispute Feldstein’s use of 0.41 to measure the rising path of benefits. More importantly, they question how accurately individuals perceive the accumulation of Social Security wealth and whether, even if Feldstein’s estimation of its value is correct, these
calculations match those on which individuals act. Nonetheless, I will use Feldstein’s estimation for it has largely withstood criticism since his 1974 article and serves as the most likely basis on which individuals act.
**Empirical Results**

The regression equation below is drawn from Feldstein (1974) and will be used to test the relationship between Social Security and saving empirically:

\[ C = B_0 + B_1 \times YD + B_2 \times YD_{t-1} + B_3 \times SSW + B_4 \times W + \varepsilon \]

where \( C \) is per capita Consumption, \( YD \) is per capita Disposable Income, \( YD_{t-1} \) is lagged per capita Disposable Income, \( SSW \) is per capita Social Security Wealth, and \( W \) is per capita Household Wealth. The following hypothesis will be tested with the regression equation:

Null: \( B_3 = 0 \), implying that the effect of Social Security Wealth on saving is not a significant predictor of saving.

Alternative: \( B_3 \) is different from zero, implying that Social Security Wealth does bear on saving. If \( B_3 \) is positive then \( SSW \) increases consumption, thereby decreasing saving as the asset-substitution effect overcomes the effect or earlier induced retirement. Conversely, if \( B_3 \) is negative then \( SSW \) increases saving as the effect of earlier induced retirement overcomes the asset-substitution effect.

Three different time periods will be used to analyze Feldstein’s hypothesis about the effect of Social Security on saving. The first of these is the period from 1930 to 1992 which has the virtue of including several years when the value of Social Security Wealth was zero, however they also include the years of 1941 to 1946 in which World War II lowered consumption significantly independent of factors included in the model. To allow for this 1941 through 1946 are excluded from the second model. Finally, the third model considers the post-war period exclusively and, as this is the period in which saving has declined most significantly, it is the most interesting period to consider. In the table
below the results of regressions from each time period are shown and, as the presence of autocorrelation was detected in all three, corrected models are shown as well. The corrections were done under the assumptions of the AR1 model of first order autocorrelation.

Table 1: Regression Results

<table>
<thead>
<tr>
<th>Regression Number</th>
<th>Time Period</th>
<th>Intercept</th>
<th>YD</th>
<th>YD_{t-1}</th>
<th>SSW</th>
<th>W</th>
<th>Method</th>
<th>D-W Stat/ Rho-hat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1930-1992</td>
<td>-84.9</td>
<td>.412</td>
<td>.084</td>
<td>.033</td>
<td>.067</td>
<td>OLS</td>
<td>.592</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(391.5)</td>
<td>(.139)</td>
<td>(.123)</td>
<td>(.024)</td>
<td>(.012)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>1930-1992</td>
<td>57.9</td>
<td>.568</td>
<td>.064</td>
<td>.029</td>
<td>.036</td>
<td>GLS</td>
<td>1.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(117.2)</td>
<td>(.098)</td>
<td>(.082)</td>
<td>(.015)</td>
<td>(.012)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>1930-1992 (excluding 1941-46)</td>
<td>216.2</td>
<td>.630</td>
<td>.068</td>
<td>.021</td>
<td>.026</td>
<td>OLS</td>
<td>.646</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(218.5)</td>
<td>(.078)</td>
<td>(.073)</td>
<td>(.013)</td>
<td>(.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>1930-1992 (excluding 1941-46)</td>
<td>65.5</td>
<td>.557</td>
<td>.062</td>
<td>.030</td>
<td>.039</td>
<td>GLS</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(146.2)</td>
<td>(.100)</td>
<td>(.084)</td>
<td>(.015)</td>
<td>(.012)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>1947-1992</td>
<td>-17.3</td>
<td>.679</td>
<td>.131</td>
<td>.008</td>
<td>.016</td>
<td>OLS</td>
<td>.635</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(287.4)</td>
<td>(.107)</td>
<td>(.110)</td>
<td>(.017)</td>
<td>(.010)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>1947-1992</td>
<td>66.5</td>
<td>.556</td>
<td>.061</td>
<td>.039</td>
<td>.039</td>
<td>GLS</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(149.9)</td>
<td>(.101)</td>
<td>(.084)</td>
<td>(.015)</td>
<td>(.012)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 tells several things about the relationship between Social Security and saving. First, it indicates that the coefficient of SSW hovers just at the 5% threshold for a
t-test which indicates that there is only an approximately five percent chance that the apparent relationship between Social Security and saving is due to chance alone. Second, the presence of autocorrelation can be detected not only in the regressions which used Ordinary Least Squares to estimate coefficient values but also in the regressions corrected under the AR1 model which used Generalized Least Squares to correct for autocorrelation. Finally, the coefficient estimates for all three corrected regressions are approximately 0.03 and this estimate can be used to measure the importance of the effect that Social Security Wealth has on saving.

The three regressions using GLS to correct for autocorrelation report the following t-ratios: Regression 2 - 1.98; Regression 4 - 1.97; Regression 6 - 1.96. The traditional threshold for the acceptable t-ratios is 2.0 or greater implying a greater than or equal to 95 percent chance that the observed relationship is due to chance alone. As can be seen, the results of these regressions indicate a slightly greater than five percent chance that the observed relationship between Social Security Wealth and saving is due to chance alone, which raises the issue of their significance. For the purpose of continuing to follow Feldstein's analysis, I will act as though the significance of the coefficient estimates have passed the traditional threshold of significance even though they appear to fall slightly short. One reason this may be acceptable is that analysis of the regressions corrected for autocorrelation still reveals that the regression results have imprecise confidence intervals.

As can be seen in Table 1, a Durbin-Watson test for autocorrelation still reveals a high likelihood that the observed correlation between a residual and its lagged component
is not due to chance alone. Below are plots of the lagged residuals of Regressions 2, 4, and 6 as a function of residuals in time $t$. 
As can be seen in the plots of residuals in time t against lagged residuals from time t-1, there is evidence that even the use of Generalized Least Squares has been unable to eliminate the apparent relationship between the individual draws from the Gaussian Error Box. This relationship, confirmed by the Durbin - Watson Statistics for Regressions 2, 4, and 6, indicates that one of the assumptions of the box model (that the draws are unrelated to each other) has been violated, calling the validity of the results must be called into question. Furthermore, the inability of the AR1 model to correct for the autocorrelation indicated in Regressions 1, 3, and 5 indicates that the relationship between the draws from the Gaussian Error Box may not be the first-order autocorrelation that was assumed. Nonetheless, other forms of correcting the error are unavailable because of their complexity therefore, having made note of the lack of a satisfactory solution to the detected autocorrelation, the analysis will have to continue using the best corrected estimates from Regressions 2, 4, and 6.

The next step in analyzing the results of the regression analysis is to interpret the coefficient estimates on the SSW variable. Although the confidence intervals do not
quite pass the threshold for significance and the problems with autocorrelation have not been solved, Regressions 2, 4, and 6 all assign a value of roughly 0.03 to the coefficient of Social Security Wealth. The value implies that for each dollar increase in per capita Social Security Wealth, per capita consumption can be expected to rise by 3 cents; as consumption is the inverse of saving, one could assert that each additional dollar of SSW decrease saving by 3%. In 1992, Social Security Wealth amounted to $15,116.7 billion in current dollars, implying an increase of $453 billion in consumption. Because total personal saving in 1992 was only $248 billion, the coefficient estimate on Social Security Wealth implies a 64.6% reduction in total personal saving due to accumulated Social Security wealth.

In contrast, Feldstein (1996) reports a coefficient estimate of .028 with a Standard Error of .013 for Regression 4, which covers the entire sample period excluding the war years of 1941-46. His version of the regression also succeeds in reducing autocorrelation to an acceptable level with a Durbin-Watson statistic of 1.89, which is not significantly different from the value of 2 it would have in the absence of any autocorrelation. His coefficient estimate for Social Security Wealth implies a slightly lower effect of such wealth on consumption as each additional dollar of wealth from Social Security implies a 2.8% increase in consumption. This translates to a $400 billion dollar decrease in saving in 1992, a decrease of 61.7% in saving.

Direct comparison between my results and Feldstein's is difficult because slightly different constructions were likely used for income and consumption variables as, more than likely, different deflators were used to convert the data to 1987 dollars. Additionally, he used a different (and more sophisticated) method for correcting the
autocorrelation detected which would explain the significance of his results while mine failed to pass the five percent threshold. On the whole, the trends in my data match those of Feldstein and even predict fairly similar levels of importance for the effect of Social Security on saving, but I was unable to exactly replicate Feldstein's results.
Conclusion

The theoretical effects of Social Security on saving are two-fold and contradictory, however empirical analysis can discern the relative importance of the asset-substitution and induced retirement effects by measuring the overall effect of accumulated Social Security Wealth on saving. Through regression analysis of consumption patterns during the period 1930 to 1992, the effect of Social Security can be ascertained while controlling for the effects of disposable income and household wealth. The results of this analysis imply a quantifiable effect of Social Security on saving that can be measured against current levels of saving to impute the overall increase or decrease in saving caused by the accumulation of Social Security Wealth.

My empirical results seem to indicate that Social Security does, in fact, decrease personal saving by inducing agents to substitute Social Security Wealth accumulated through taxes for private saving. Even though the evidence seems strong for such a linkage, the confidence intervals on my coefficient estimates fall just short of traditionally acceptable levels. In addition, the continued presence of autocorrelation in my corrected regressions indicates that first order autocorrelation is probably not present, calling for a more sophisticated method of correction.

The difficulties I had with correcting autocorrelation are the primary avenue for improving my research. The continued presence of autocorrelation indicates that, while the coefficient estimates are on average correct, the confidence intervals indicating the likelihood that the observed relationship is due to chance alone are not correctly estimated. Until this difficulty is resolved, the further question of whether the standard errors of my coefficient estimates indicate significance or not is moot. Further
improvements in the analysis would include the use of additional variables to measure theoretical criticism of Feldstein's hypothesis. These would include measures of government debt (as suggested by Barro) or corporate retained earnings, which have also changed significantly in the survey period and possibly affect saving. Finally, any speculation about the effect of Social Security on saving must account for the fact that the determinants of saving in general have not been satisfactorily accounted for. Until the general determinants of saving are better understood, questions of the impact of a specific program upon it could be considered premature.
Appendix A: Per Capita Consumption Figures

Unadjusted per Capita Consumption (1987 Dollars)

Adjusted per Capita Consumption (1987 Dollars)
Appendix B: Per Capita Disposable Income Figures

Unadjusted per Capita Disposable Income (1987 Dollars)

Adjusted per Capita Disposable Income (1987 Dollars)
Appendix C: Gross SSW and Household Wealth Figures

Gross per Capita Social Security Wealth (1987 Dollars)

Per Capita Household Wealth (1987 Dollars)
Bibliography


*Historical Abstract of the United States*. Series F 17-30 & Series R 188.


*Statistical Abstract of the United States*. Table B-29.