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HAVE IRAS INCREASED U.S. SAVING? EVIDENCE FROM CONSUMER EXPENDITURE SURVEYS

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ABSTRACT

The vast majority of Individual Retirement Account contributions represent net new saving, based on evidence from the quarterly Consumer Expenditure Surveys (CES). The results are based on analysis of the relationship between IRA contributions and other financial asset saving. The data show almost no substitution of IRAs for other saving. While the core of the paper is based on cross-section analysis, important use is made of the CES panel of independent cross-sections that span the period during which IRAs were introduced. Estimates for the post 1982 period, when IRAs were available to all employees, are based on a flexible constrained optimization model, with the IRA limit the principle constraint. The implications of this model for saving in the absence of the IRA option match very closely the actual non-IRA financial asset saving behavior prior to 1982. IRA saving does not show up as other financial asset saving in the pre-IRA period.

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HAVE IRAS INCREASED U.S. SAVING?: EVIDENCE FROM CONSUMER EXPENDITURE SURVEYS

by

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Individual retirement accounts (IRAs) have become an immensely popular and important form of saving in the United States since 1982, when they became available to all employees. Any employee could contribute $2000 per year to an IRA account and a non-working spouse of an employee $250. Total contributions to these tax deferred saving plans were $5 billion in 1981, $28 billion in 1982, and will be about $45 billion in 1986 or roughly one-fourth of all personal saving. The net saving effect of these contributions is the subject of this paper.

Possibly the most contentious issue in the recent tax (1986) reform discussions was the treatment of IRAs. While the earlier proposals suggested substantial increases in the former limits, the Senate version of the bill would have eliminated the tax deductibility of all contributions and left the limits unchanged. The final bill leaves the limits as they were but phases out the tax deductibility of contributions for families earning over $40,000 and single persons earning over $25,000.

Two empirical questions played a central role in the discussions: one was the income levels of IRA users, the second was the net effect of IRAs on saving, the extent to which they were simply a substitute for other forms of saving. Based on the reports of a few experts, it became the conventional wisdom among many that the majority of IRA contributions were made by the wealthy. This is factually incorrect; 90 percent of contributions are made by individuals earning less than $50,000 per year and 70 percent of contributions by families earning less than this amount. The likelihood of contributing is much greater for high than low income persons, however. It also became conventional wisdom among many that the net saving effect was negligible, again based on the speculation of a few experts. The saving effect, however, is a much more difficult question to answer than the distribution of contributions by income. The much publicized decline in the U.S. saving rate gives particular significance to this question. Indeed, one of the primary motivations for the Economic Recovery Tax Act of 1981, that extended the availability of IRAs to all employees, was to increase saving.

The approach of the paper is to compare individual IRA contributions with changes in other forms of saving, in particular liquid financial assets. To the extent that IRAs are funded by transfers from previously accumulated assets, or are a substitute for new saving that would have taken place anyway, other financial assets are the most likely source of funds, at least in the short run. It is important to keep in mind that the question is not where the money was taken from at the time the IRA contribution was made. Because most people don't carry $2000 in cash, when asked where the money for an IRA contribution came from, they may respond that it came from a saving account, for example. But this is not an indication of the net saving effect. Rather the issue is what would have happened to the money in the saving account had it not been used to make the IRA contribution.

We concluded in previous work (Venti and Wise [1986a, 1986b]), based on data available at that time, that only a very small proportion of IRA contributions could have been funded by substitution of one form of saving for another. Those data were from the 1983 Survey of Consumer Finances (SCF). While that survey provided data on IRA contributions, it provided only qualitative information on associated changes in other financial assets, whether they were positive or negative. The analysis in this paper is based on Consumer Expenditure Surveys (CESs) for the period 1980 through the first quarter of 1984. These data provide not only accurate information on contributions to IRA accounts, but also associated dollar changes in other asset balances, such as conventional saving accounts. In addition, through independent quarterly cross sections, they provide aggregate time series evidence on IRA contributions and other saving, although there is no time series data on the same individual that is useful for our purposes.

I. Background and Descriptive Data

A. The Incentive Effects of IRAs

The widespread promotion of IRAs may have been the most important reason for their use. The advertisement has typically emphasized the avoidance of current taxes through IRA contributions, as well as the importance of prudent planning for retirement. They are available through almost any bank and through many other financial institutions.

Two aspects of IRAs provide a more traditional economic incentive to save through their use: one is that the contribution itself is tax deductible, the other is that the interest on the contribution accumulates tax free, with taxes paid only when funds are withdrawn from the account. A dollar of current consumption foregone and deposited in a conventional account would yield $\exp[r(1-t)T]$ after T years at an interest rate r and marginal tax rate t, if the marginal tax rate does not change with age. A dollar of foregone consumption placed in an IRA account would yield $1/(1-t)\exp[rT](1-t) = \exp[rT]$. Thus the ratio of the IRA to the conventional yield would be $\exp[rtT]$, increasing with the interest rate, the marginal tax rate, and the number of years that the funds are left in the account. For example, at $r = .1$, $t = .3$, and $T = 40$, the ratio is 3.32. If $T = 20$ the ratio is 1.82 and at $T = 10$ it is 1.35, at the same r and t. If $2000 were placed in an IRA account each year beginning at age 25, the after tax value of the account by age 65 would be $789,000; placed in a conventional saving account, the value would be only $320,000. Some persons may also benefit from lower tax rates when funds are withdrawn than when they are deposited.

On the other hand, once money is placed in an IRA account there is a ten percent penalty for withdrawal before the age of 59 and 1/2. In this sense, the IRA is less liquid than a conventional account. If funds are to be withdrawn before age 59 1/2, whether it would be better to save the money in an IRA or a conventional account again depends on r, t, and T. The yield from the two accounts would be the same at $T = \ln[(1-t)/(1-t-.1)]/rt$. For example, at $r = .1$ and $t = .3$, T is 5.14 years. It is 25.68 years at $r = .02$ and $t = .3$. Thus to the extent that these considerations are important, the incentive to save through IRAs because of their higher return should be greater for persons in higher tax brackets, and the disincentive because they are less liquid should be less the higher the tax bracket.

Some persons of course may consider the illiquidity of IRAs an advantage; it may help to ensure behavior that would not otherwise be followed. It may be a means of self-control. The fact that the opportunity is lost if a contribution is not made in the current year may serve the same purpose. One cannot, as with conventional saving, put it off--possibly a self delusion--until the next year.[1]

In addition, because of the higher return on IRAs, to achieve any given level of retirement income requires less saving if funds are placed in an IRA account than if they are placed in a

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[1]One might, for example, have a scheme in which the limit for the current year is added to next year's limit if a contribution is not made in the current year. Or, the contribution limit could cumulate more generally over time if contributions are not made during some period.

conventional account. For example, again at $r = .1$ and $t = .3$, to achieve a million dollars in retirement saving at age 65 would mean giving up $4,377 per year current consumption, beginning at age 25, if saving were through a conventional account, but only $1,775 if saving were through an IRA. This "income" effect raises the possibility that there could in fact be less saving with than without IRAs.

The effect of IRAs on saving is the net result of all of these factors, including their promotion, and it is thus important to choose an empirical specification that allows each to be reflected in the estimation of their saving effects. It may be tempting to think of IRAs and conventional saving accounts as equivalent assets, or goods, simply with different prices, in which case one might think of IRAs as only a price subsidy of conventional saving with a limit on the quantity that can be had at the subsidized price. But to the extent that consumers treat them as different assets or goods--possibly because one is intended for retirement and the other for short term saving or because one is less liquid than the other--and to the extent that the promotion has influenced their use, this view will not yield an adequate representation or forecast of the saving effect of IRAs. Indeed, the subsequent analysis indicates quite strongly that the two are not treated as equivalent by consumers.

B. Descriptive Data

The Consumer Expenditure Surveys are now conducted every three months with a new cohort of families entering each quarter and with each family surveyed for five consecutive quarters.[2] For the purposes of this analysis, self-employed persons who are not eligible for IRAs have been excluded from the sample.

The percent of families that made IRA contributions is shown in table 1 for the first nine quarters after all employees became eligible. The data are presented for two periods, five quarters in the first and four in the second. We refer to them as the first and second years respectively. The percents pertain to all of the respondents in the quarterly surveys for each period taken together.[3] The percent that contributed increased substantially between the first and second years in each income interval. In addition, the percent contributing increases sharply with income, from 3 or 4 percent in the lowest to 50 or 60 percent in the highest income interval. Nonetheless, the vast majority of contributing families have family incomes less than $50,000, 74 percent in the first and 70 percent in second year. About 90 percent of individual contributors have incomes less than this amount.[4]

Overall about 16 percent of the second year respondents contributed. It is shown below that most Americans in the past

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[2]The survey is weighted to represent the national urban population.

[3]The IRA data is based on responses to the question: "During the past 12 months, did [the household unit] place any money in a self-employed retirement plan such as an Individual Retirement Account (IRA and Keogh)?" and "If yes - How much?"

[4]See Venti and Wise [1985].

have saved very little, except in the form of housing; they have virtually no financial assets. The 16 percent should be interpreted in this light. Now approximately 20 percent of tax filers contribute to IRAs and some reports indicate that about 30 percent of filers have accounts.

The aggregate relationship between IRA contributions and other personal financial saving over time is shown in table 2. It shows IRA contributions and additions to other financial asset balances among respondents to each of the quarterly surveys between the first quarter of 1980 and the first quarter of 1984. While the percent making IRA contributions increased from 2 or 3 percent to 17 or 18 percent, the percent with an increase in other asset balances shows no trend at all, whether stocks and bonds are included or excluded.[5] The mean level of other saving also shows little trend, but because of outliers in the data, the averages

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[5]The data in the table come from two sets of questions in the CESs. The first asked: "During the past 12 months, did ... place any money in a self-employed retirement plan such as Individual Retirement Account (IRA & Keogh)?" and "If yes - How much?" The second set asked: "How does the amount your consumer unit had on the last day of (last month) compare with the amount your consumer unit had on the last day of (last month, one year ago) in -" and "If more or less - How much more (less)?" in:

a. Savings accounts in banks, savings and loans, credit unions, and similar accounts.
b. Checking accounts, brokerage accounts, and other similar accounts.
c. U.S. Saving Bonds.
d. Securities such as stocks, mutual funds, private bonds, government bonds, or treasury notes."

Other financial assets excluding stocks and bonds is comprised of a,b, and c. Other financial assets including stocks and bonds includes d as well.

fluctuate widely from quarter to quarter. For this reason the percent with an increase has been shown in the table.[6] A simple regression of the average of other financial saving on average IRA contributions, and time, yields essentially a zero coefficient on the IRA variable (.076 with a t-ratio of .117) when stocks and bonds are excluded.[7] Thus despite very large increases in IRA contributions over this period, there seems on average to have been no noticeable reduction in saving in other financial asset forms.

A summary of the saving behavior of IRA contributors compared to non-contributors is shown in table 3. It shows the percent of IRA contributors with an increase in other saving compared to the percent of non-contributors with an increase. The percent with an increase in other saving is almost invariably higher among contributors. Thus it is not possible to see in these data a tradeoff between IRAs and other saving. Rather the data suggest an individual specific saving effect with those that save in one form also more likely to save in other forms as well. The analysis below will show that this is largely explained by differences in measured variables like age and education, with little correlation between unmeasured determinants of IRA saving and saving in other forms.

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[6]The median is not used because it is almost always zero; a large number of respondents report no change in asset balances.

[7]When stocks and bonds are included the coefficient is .769 with a t-ratio of .706.

To put in perspective the magnitude of IRA contributions, it is helpful to have in mind the level of other asset balances. The median of all financial assets, including stocks and bonds, was $1125, based on the 1982:1 through 1984:1 panels. The median excluding stocks and bonds was $1000. Because of an oversight in the coding of collected data, it is not possible to calculate the equity value of housing for CES respondents, and thus there is no measure of nonliquid wealth, which is largely housing. The approximate level of nonliquid wealth of CES respondents can be inferred, however, from such data collected in the 1983 Survey of Consumer Finances. The median level of all financial assets among respondents to that survey was $1300. The median of total wealth was $22,900, the large majority of which was housing.[8] These data confirm the low personal saving of American households documented by others.[9] Thus financial asset balances, and even total wealth, are very low compared to the potential accrual from a $2000 or more annual IRA contribution.

If, as table 3 shows, IRA contributors save more in all forms than non-contributors, one would expect them to have accumulated

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[8]See Venti and Wise [1986a, 1986b]. Although the overall medians in the SCF and the CESs are approximately the same, the medians for the 50-100 thousand and the 100 thousand plus income groups are substantially larger according to the SCF--about $20,000 and $36,0000 respectively for all financial assets,including stocks and bonds. We do not know the reason for the difference in the two surveys, but the sample sizes of high income families are quite small in both.

[9]See for example Hurd and Shoven [1983], Diamond and Hausman [1984], and Kotlikoff [1984].

larger asset balances. Table 4 confirms this. But even among IRA contributors, other financial asset balances are relatively low. It is clear that most contributors have not been accumulating financial assets at a rate close to the potential from the maximum family contribution to an IRA. The average contribution of IRA contributor families--$2048 in the 1982:1 to 1984:1 period--is large relative to past saving.

II. The Statistical Model

The spirit of the statistical analysis is to consider the relationship between IRA contributions and other saving, recognizing the effect of the IRA limit, allowing for flexible substitution between IRA and other forms of saving, and using a specification that is commensurate with the cross section nature of the available data. It is important that the analysis allow for the possibility that individuals behave as if the two forms of saving were different "goods," but at the same time reveal them to be perfect substitutes if they are treated that way by individuals. For purposes of exposition, we begin with a simple stylized version of the model to introduce the main features of the approach. Then the details of the estimated model are set forth.

A. A Simple Illustration

Because only cross section data are available, we consider the allocation of current income Y to IRA saving S_1, to other forms of financial asset saving S_2, and to other uses C. The budget constraint is $C = Y - S_1 - S_2$, ignoring for the moment the tax advantages of IRAs. We need first to determine specifications for saving functions that fit unconstrained choices of S_1 and S_2. Then we select a decision function V that is consistent with these saving functions. And finally, using this decision function, we determine saving functions S_2 for persons who are constrained by the upper limit on S_1. In this way the constrained and unconstrained S_2 functional forms are consistent with each other.

Suppose that unconstrained S_1 and S_2 choices are matched by the relationships $S_1 = abY$ and $S_2 = (1-a)bY$, where b is the portion of income saved and a is the portion of saving that is allocated to S_1. This formulation is chosen to allow easy comparison with the estimated model. The decision function that is consistent with these functions is

$$V = [C]^{(1-b)}[S_1{}^a S_2{}^{(1-a)}]^b$$

(1)
$$= C^{(1-b)} S_1{}^{ab} S_2{}^{(1-a)b} .$$

The two forms of saving are allowed to be treated as distinct alternatives since one is relatively illiquid and presumably intended for retirement while the other is more liquid and may be intended for more short term purposes. In our case, the level of S_1 is limited by the maximum L and the choice of S_2 will depend on whether the choice of S_1 is constrained by its limit.[10] We now

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[10]General discussions of demand with rationing are found in Deaton [1981] and in Deaton and Muellbauer [1981].

let S_1 and S_2 represent unconstrained "desired" levels of saving in the two forms and s_1 and s_2 respectively, their realized observed values. Then

$$
(2) \qquad
\begin{aligned}
s_1 &= \begin{cases} abY & \text{if } S_1 < L \\ L & \text{if } S_1 > L \end{cases} \\
s_2 &= \begin{cases} (1-a)bY & \text{if } S_1 < L \\ [(1-a)b/(1-ab)](Y-L) & \text{if } S_1 > L. \end{cases}
\end{aligned}
$$

The last line is the optimal choice of S_2, according to equation (1), given that $S_1 = L$. Suppose finally that the desired levels S_1 and S_2 are determined in part by random disturbances e_1 and e_2. Assume that they are additive so that $S_1 = abY + e_1$ and $S_2 = (1-a)bY + e_2$. Then the observed saving values are given by

$$
(3) \qquad
\begin{aligned}
s_1 &= \begin{cases} abY + e_1 & \text{if } S_1 < L \\ L & \text{if } S_1 > L \end{cases} \\
s_2 &= \begin{cases} (1-a)bY + e_2 & \text{if } S_1 < L \\ \dfrac{(1-a)b}{(1-ab)}(Y-L) + \dfrac{(1-a)b}{(1-ab)} e_1 + e_2 & \text{if } S_1 > L \end{cases}
\end{aligned}
$$

Stylized versions of these functions are graphed in figure 1. The constrained choice of S_2 is sometimes denoted by S_2^*, and the income at which it becomes effective by Y^*. The last line in (3) is obtained by writing S_2^* as

$$S_2^* = (1-a)bY^* + [(1-a)b/(1-ab)](Y-Y^*) + e_2,$$

and substituting $Y^* = (L-e_1)/ab$, from $S_1 = abY^*+e_1 = L$. The disturbances are thus thought of as individual specific shift parameters.

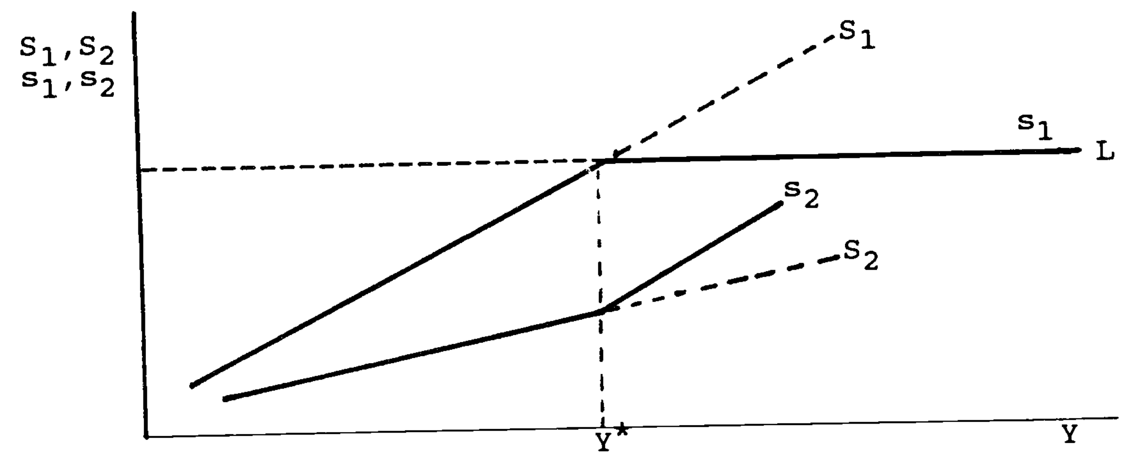

Figure 1

In the subsequent analysis, parameters analagous to a and b are parameterized as functions of individual characteristics like age. In this sense, the model may be thought of as the reduced form of a more structural life cycle model. For our purposes, however, the individual characteristics are used only to predict a and b for different families.

To describe the effect of IRAs on saving, having estimated the parameters of the model, we ask how saving would be affected if the IRA limit L were increased. In particular, what would savings have been during the period of estimation had the limit been higher? It would have had no effect on those not constrained by the existing limit. Persons at the limit would increase their IRA contributions by one dollar if the limit were increased by one dollar, i.e., $ds_1/dL = 1$. They would also reduce other saving by $dS_2^*/dL = (1-a)b/(1-ab)$. More generally, the effect of any limit increase can be determined by simulation. Given predicted a and b, and e_1 and e_2 randomly chosen from their estimated distributions, s_1 and s_2 are calculated using the unconstrained functions if the estimated S_1 is less than L and by the constrained functions if S_1 is greater than L. This procedure does not require that the coefficients on variables used to predict a and b be unbiased in the usual sense, only that the predictions of a and b themselves be unbiased. But it does assume that the decision function accurately fits individual choices. And the extrapolations of individual choices when the limit is raised depend on the assumed distribution of the disturbance terms e_1 and e_2. Checks on these assumptions can only be based on how well the estimated specification fits the observed data points and we will demonstrate that.

Using the panel of independent cross-sections that the data provide, however, we also present alternative--and in this case confirming--evidence on the effect of IRAs on saving. If IRAs were not available, L = 0, this specification predicts that the proportion of the marginal dollar of income devoted to saving--in the S_2 form only--would be $(1-a)b/(1-ab)$. To the extent that the model is accurate, this estimated marginal saving rate should be matched by the estimated marginal rate of non-IRA, S_2, saving prior to the availability of IRAs. With caveats to be explained, such a marginal rate can be obtained by estimating the constrained S_2 equation using 1980 and 1981 data, prior to the general availability of IRAs. In addition, the complete model will be estimated separately for the first and second years of the general availability of IRAs, allowing comparison of estimated desired levels of saving, summarized by b, as knowledge about IRAs apparently spread and their use increased, as shown in table 2.

B. <u>The Estimated Specification</u>

We concentrate on the potential substitution between IRAs and other liquid financial asset saving, assuming that in the short run at least IRAs are unlikely to be substituted for non-liquid wealth like housing. Maintaining the prior definitions, the current budget constraint is expanded to include taxes T before saving, the price $P_1 = 1 - t$ of IRA saving in terms of current consumption, and the price $P_2 = 1$ of other saving in terms of current consumption, where t is the marginal tax rate:

$$C = Y - T - P_1S_1 - P_2S_2 = Y - T - (1-t)S_1 - S_2 .$$[11]

[11]In principle, the marginal tax rate is determined in part by IRA contributions. But since the IRA limits narrowly restrict this influence, we treat t as exogenous.

At times Y - T is denoted by Y_T. Desired but not observed S_1 and desired as well as observed S_2 are allowed to be negative. In addition, the potential substitution between S_1 and S_2 is allowed to be quite flexible and distinct from the substitution between either form of saving and current consumption. Given current income, a decision function with these characteristics is

$$V = [C]^{1-b}\{[a(S_1-a_1)^k + (1-a)(S_2-a_2)^k]^{1/k}\}^b \tag{4}$$

This function has a tree structure with one branch current expenditure and the other saving. These two components are evaluated in a Cobb-Douglas manner with preference parameter b. The two forms of saving are evaluated according to a constant elasticity of substitution subfunction.[12] The parameter a indicates the relative preference for S_1 versus S_2; if a = .5, total saving is split equally between the two forms. The elasticity of substitution between S_1 and S_2 is $1/(1-k)$. The important feature of this functional form is that it allows greater substitution between the two forms of saving than between either of these and current consumption.

It also allows the IRA advantage to be reflected first in a lower cost of saving in terms of current income, through the current budget constraint, and in addition through different

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[12]This specification turns out to be a variant of the "S-branch" utility tree described by Brown and Heien [1972]. See also Sato [1967] and Blackorby, Boyce, and Russell [1978].

preferences for the two assets, possibly reflecting the different rates of return. Although the illustrations in section I-A show that the distinction between current cost and return may be an artificial one in strict economic terms--that the ultimate difference is one of yield only--consumers may understand better, and be influenced to a greater extent, by the current tax saving than by the tax free compounding of interest. Certainly the promotion of IRAs has tended to highlight the former. In practice, it is not possible to distinguish the quantitative effect of one from that of the other. Indeed, in practice it is not possible to distinguish with any precision the effect of the tax rate from the effect of other variables, income in particular. Nonetheless, both features of IRAs, as well as any effects of advertising or the contract-like nature of IRA saving provisions, are allowed to determine individual choices.

Maximization of (4) subject to the budget constraint yields unconstrained desired levels of S_1 and S_2

$$S_1 = a_1 + d_1(Y_T - P_1a_1 - P_2a_2)$$

$$S_2 = a_2 + d_2(Y_T - P_1a_1 - P_2a_2)$$

$$d_1 = \frac{(P_1/a)^{1/(k-1)}}{P_1(P_1/a)^{1/(k-1)} + P_2[P_2/(1-a)]^{1/(k-1)}} \cdot b \tag{5}$$

$$d_2 = (b - d_1P_1)/P_2$$

In addition to saving behavior under the model as described, two limiting versions of this specification are of special interest. They are considered first.

1. <u>If k = 0.</u>

The limiting case of (4) as k goes to 0 is a much simpler model than the general one and is much easier to estimate. In fact, the estimated value of k is close to zero and for simplicity many of the results are described assuming that it is zero. This case yields desired levels of S_1 and S_2 given by

$$S_1 = a_1 + \frac{ab}{P_1} \cdot [Y_T - P_1a_1 - P_2a_2] \tag{6}$$

$$S_2 = a_2 + \frac{(1-a)b}{P_2} \cdot [Y_T - P_1a_1 - P_2a_2]$$

and observed levels by[13]

[13]Although it is illegal to borrow against an IRA, funds can be withdrawn subject to the 10 percent penalty. But since negative contributions are not observed in the data set, we adopt the assumption of a zero lower limit.

$$
(7) \quad S_1 = \begin{cases} 0 & \text{if } S_1 < 0 \\ a_1 + \frac{ab}{P_1} \cdot [Y_T - P_1 a_1 - P_2 a_2] & \text{if } 0 < S_1 < L \\ L & \text{if } L < S_1 \end{cases}
$$

$$
S_2 = \begin{cases} a_2 + \frac{(1-a)b}{(1-ab)P_2} \cdot [Y_T - P_2 a_2] & \text{if } S_1 < 0 \\ a_2 + \frac{(1-a)b}{P_2} \cdot [Y_T - P_1 a_1 - P_2 a_2] & \text{if } 0 < S_1 < L \\ a_2 + \frac{(1-a)b}{(1-ab)P_2} \cdot [Y_T - P_1 L - P_2 a_2] & \text{if } L < S_1 \end{cases}
$$

This specification is easily compared with the illustration in the previous section.

2. <u>If k = 1 and a = .5.</u>

Under this assumption, the elasticity of substitution between S_1 and S_2 is infinite and they are given equal weight in the preference function; they are perfect substitutes and are treated as a single asset. The decision function (4) becomes

$$
(8) \quad V = [C]^{1-b}[S_1+S_2 - (a_1+a_2)]^b
$$

Because the price of IRA saving is lower, saving is only through

S_1 if $S_1 < L$ and thereafter is through S_2, with

(9)

$$s_1 = \begin{cases} 0 & \text{if } S_1 < 0 \\ (a_1+a_2) + \frac{b}{P_1}[Y_T - P_1(a_1+a_2)] & \text{if } 0 < S_1 < L \\ L & \text{if } L < S_1 \end{cases}$$

$$s_2 = \begin{cases} 0 & \text{if } S_1 < L \\ (a_1+a_2-L) + \frac{b}{P_2}[Y_T - P_1L - P_2(a_1+a_2-L)] & \text{if } L < S_1 \end{cases}$$

In this case, the IRA tax advantage simply creates a kink in the intertemporal budget constraint describing the relationship between foregone current consumption and future consumption, and inframarginal arguments could be used to represent the incentive effects of IRAs on persons who would in their absence save more than the IRA limit. This possibility is clearly rejected by the data, however.

3. Other values of k

Unlike the $k = 0$ or $k = 1$ cases, there is no closed form solution to the constrained S_2 function for other values of k. In this case, the constrained functions, $S_2^*(0)$ when $S_1 < 0$ and $S_2^*(L)$ when $S_2 > L$, are defined only implicitly by the relationship

$$(10) \qquad \frac{P_2(1-b)[a(m-a_1)^k + (1-a)(S_2{*}-a_2)^k]}{(1-a)(S_2{*}-a_2)^{k-1}} = Y_T - P_1m - P_2S_2^*$$

where m is either 0 or L. It is derived by maximizing (4) subject to the budget constraint and with the additional constraint that $S_1 = m$. The observed levels of saving are

$$s_1 = \begin{cases} 0 & \text{if } S_1 < 0 \\ a_1 + d_1(Y_T - P_1a_1 - P_2a_2) & \text{if } 0 < S_1 < L \\ L & \text{if } L < S_1 \end{cases}$$

(11)

$$s_2 = \begin{cases} S_2^*(0) & \text{if } S_1 < 0 \\ a_2 + d_2(Y_T - P_1a_1 - P_2a_2) & \text{if } 0 < S_1 < 0 \\ S_2^*(L) & \text{if } L < S_1. \end{cases}$$

C. <u>Parameterization of a and b and Stochastic Specification</u>

To capture the wide variation in saving behavior among individuals, a and b are allowed to depend on individual attributes X. They are also restricted to be between 0 and 1 by using the form

(10)
$$b = F[X\underline{b}]$$
$$a = F[X\underline{a}]$$

where $F[\cdot]$ is the standard normal distribution function and $\underline{a}$ and $\underline{b}$ are vectors of parameters.

Finally, we allow the S_1 and S_2 functions to be shifted by additive disturbances e_1 and e_2 respectively. A random preference stochastic specification that makes each individual's choices formally consistent with the decision function (4) is obtained if a_1 and a_2 are assumed to be random, with additive disturbances. This specification is not tractable, however, when $S_2{}^*$ must be solved for implicitly. Experience with both forms in Venti and Wise [1986a, 1986b] shows that the results are not appreciably affected by this choice. The disturbances are assumed to be distributed bivariate normal with standard deviations c_1 and c_2 respectively and correlation r. The disturbance term for the constrained S_2 equation is obtained as described for the illustration in section A above and is denoted by $e_2{}^*$.

There are three possibilities for the observed values of S_1: 0, between 0 and L, and L. In principle, a continuously measured value of S_2 is available for each person, yielding three possible joint outcomes for each observation. In practice, however, about 40 percent of the sample reports no non-IRA saving, apparently reporting small changes as zero. Thus there is a large concentration of observations at zero, which is inconsistent with the normality assumption. To reflect the fact that some of the reported zeros are in fact positive and others negative, we randomly assign them categorical values, positive or negative. This yields three possible outcomes for S_2: the reported non-zero value, less than zero, or greater than zero. Thus for each of the three possible S_1 outcomes, there are three possible S_2 outcomes, or nine possibilities in all. Each of the associated probabilities is described in the appendix. Estimation, based on these probabilities, is by maximum likelihood.

III. Results

A. The Data

The definitions of the variables used in the analysis, together with summary statistics, are reported in table 5. Only a few need further explanation. The results reported here are based on a definition of other saving S_2 that excludes stocks and bonds. Results with other saving defined to include stocks and bonds are virtually the same.[14]

The variable indicating whether a person has a private pension plan is based on the response to a question that asks whether any employer or union "contribute(d)" in the past 12 months to a pension plan in which the respondent was enrolled. Only 39 percent answered yes. Other sources indicate that over 50 percent of employees are covered by private pension plans. Apparently many respondents who were in fact covered by a plan

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[14] It is not possible to include changes in consumer debt in non-IRA saving. Although it is illegal to borrow against an IRA, for some persons it would be possible to fund an IRA contribution indirectly by increasing consumer debt. Based on the median levels of debt in each of the CES quarterly surveys, however, we believe that increases in debt could not explain the results reported below. The medians of "total amount owed excluding auto and mortgage loans" for 1980, 81, 82, and 83 were $552, $564, $336, and $400 respectively. The median in the first quarter of 1984 was $400. Thus if anything, consumer debt declined over this period.

indicated that there was no employer contribution. Under the typical defined benefit plan, contributions to pension funds are not associated with individual workers, and some respondents in such cases may have been unaware of the employer contribution. Others may be covered by defined contribution plans with no employer contribution.

As mentioned above, although the CESs provide data on home and property values, and on consumer debt, the public use files do not report the amount of home mortgages. Thus it is not possible to obtain an accurate measure of non-liquid wealth. In its place, we use non-liquid assets--defined to include home and property values, plus stocks and bonds, minus consumer debt--and a variable indicating whether the respondent owns a home but has no mortgage. There is no measure for Social Security or private pension wealth.

B. Parameter Estimates

Results are reported for three time periods: (1) 1983:2 to 1984:1, the second year that IRAs were available to all employees; (2) 1982:1 to 1983:1, the first year of general availability; and (3) 1980:1 to 1981:4, before IRAs were generally available.[15]

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[15]Respondents were asked how much they contributed to an IRA account during the past 12 months. Contributions for a given tax year can be made until April 15 of the following year, or, the entire contribution for a year can be made on January 1 of that year. Thus part of the contribution reported in surveys conducted after 1982 could have been for the prior tax year and part for the current tax year. No matter what the survey quarter, however, the non-IRA saving always corresponds to the same 12 month period as the IRA contribution, which could of course be zero.

The key parameters in determining the effect of a limit change on saving are a, b, and k, together with the origin parameters and the residual variances. The substitution parameter k is the most difficult to estimate. Given the potential for the other parameters to adjust to fit the data as k varies, the likelihood function is quite flat with respect to k. The estimated value is always close to zero, however, and often slightly negative, indicating an elasticity of substitution between S_1 and S_2 of about 1.

Results with c_1 set equal to c_2, are shown in appendix table 1 (for the 1983:2 to 1984:1 period). In this case, the estimated value of k is -0.15, with a standard error of 0.06. Estimates with c_1 again set equal to c_2, but with k set to zero, are shown in appendix table 2. These results are virtually the same as those with k estimated. There would appear to be no appreciable effect from assuming k = 0 instead of the small estimated value. Simulations based on the two sets of estimates confirm this. Thus the results discussed below were obtained setting k equal to zero.

The other parameters are affected somewhat, however, by allowing the residual variances for the two equations to be different. The estimated variances are different and both are quite precisely measured.[16] Results with separately estimated variances but with k set to zero are shown in table 6. We take

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[16]And, allowing the disturbance variances to be different changes somewhat the estimated slope parameters, primarily because of the tradeoff between the two when fitting the data subject to the IRA limits.

these estimates as a base and discuss them first.

1. <u>1983:2 to 1984:1</u>

The estimated correlation coefficient is essentially zero, .01, indicating that unmeasured determinants of IRA and non-IRA saving are unrelated. In particular, it is <u>not</u> the case that, given measured attributes X, persons who make IRA contributions save less in other financial asset forms.

The averages of the predicted values of a and b provide a summary of the results. Recall that b is the proportion of the marginal dollar of after tax income that individuals would like to allocate to financial asset saving, both IRA and non-IRA. The proportion of this amount directed to IRA saving is a. It is important to keep in mind when interpreting these parameters that they represent rates of increase in the <u>desired</u> saving functions. Because of the negative origin parameters, desired saving is negative for a large portion of the sample and actual saving zero or negative, and this would still be true after an increase in income. And, the IRA limit restricts the realized effect of an income increase on IRA saving. Thus these marginal rates are not comparable to estimated marginal saving rates where there are no limit constraints or where the limits have not been accounted for in estimation. We call them latent increases to distinguish them from actual realized dollar increases in saving with income increases, the usual meaning of marginal saving rates.

The mean of the estimated total financial asset marginal saving rates is .206. The vast majority of this amount, 92.8

percent, would be allocated to IRAs. Thus there is a strong preference for IRA versus non-IRA saving. The latent increase in non-IRA saving with a dollar increase in after tax income is only 1.5 cents, indicated by d_2, the mean estimated value of ab. The latent increase in after tax income devoted to IRA saving is ab/(1-t)--the price of an IRA dollar is less than 1--about 24.6 cents averaged over the sample. These estimates are consistent with the observation that many IRA contributors had accumulated very little in non-IRA financial assets, and more generally with the finding that a large proportion of respondents had essentially no saving at all, other than housing.

The results are virtually the same if stocks and bonds are included in the definition of S_2.[17] Estimates were also obtained under the assumption that some respondents included IRA balances with bank saving accounts and other assets used to determine S_2, with little effect on the central conclusions.[18]

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[17]In this case, the estimated b is .176, a is .906, r is -.01, c_1 is 5.91, c_2 is 3.52, a_1 is -14.49, and a_2 is -.06.

[18]The key questions used in the analysis are reproduced in footnote 5. Although it seems unlikely to us that the typical respondent would have included "...self-employed retirement plan such as Individual Retirement Account ..." with "Savings accounts in banks, ...," some may have confused the two. A simple check shows that almost a third of the respondents made IRA contributions that were greater than their reported other saving balances. In these cases, the IRA was clearly not included with other saving. Of persons who reported beginning of year other saving balances less than their reported IRA contribution--those who would be most likely to have IRA contributions greater than end of year other saving balances--almost 70 percent reported year-end other saving balances less than their IRA contributions. Obviously, this group did not confuse the two. (The 70 percent would not be expected to be 100 percent because persons who make IRA contributions are also likely to save in other forms as well.) Finally, we assumed that 20 percent of those who had year-end saving balances greater than their reported IRA contributions did

If the two forms of saving are close substitutes, the proportion of marginal income devoted to S_2 saving should increase when the IRA limit is reached. Evidence on this question is provided by estimated values of this proportion for families at the IRA limit, before and after the limit is reached, d_2 and d_2*. If there were no limit, these families would on average increase non-IRA saving by 3.3 cents with a dollar increase in income. After the IRA limit is reached, a dollar increase in income is associated with an increase of 4.6 cents in non-IRA saving. The difference of 1.3 cents is very small relative to their average latent marginal propensity to save in the IRA form, 33.3 cents.

For comparison with estimates for years prior to the availability of IRAs, we consider the marginal effect of income on saving that is implied by these estimates, if there were no IRAs, that is, if the limit were 0. From equation (7) above, the marginal effect in this case is $(1 - a)b/(1 - ab)$. Its mean over persons in the sample, based on the parameter estimates in table 6, is .015. A dollar increase in after tax income would be

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include the IRA with other saving balances. The key parameter estimates were changed very little; the principle effect was to reduce somewhat the mean estimated S_2 saving. The analysis in Venti and Wise [1986b], based on the SCF in which the interpretation of the other saving response was much more ambiguous than in the CESs, was done using both interpretations for all respondents. Considerable sensitivity analysis based on the two interpretations of the responses to the key questions, as well as other assumptions, is reported there.

associated with an increase of less than 2 cents in financial asset saving.[19]

Finally, the relationship of individual attributes to the predicted values of a and b are of some interest, although the associated coefficients should not be assigned a behavioral interpretation. Families who have in the past accumulated more liquid financial assets are indeed more likely than others to continue saving more in this form, as indicated by the positive coefficient in the b equation, but liquid assets are in fact negatively related to the proportion allocated to IRAs. Total desired saving, as well as the desired proportion in IRAs, are larger for older persons. The more highly educated also have a greater propensity to save, suggesting that saving behavior varies widely in the population, as others have found.[20] Larger families save less.

2. <u>1982:1 to 1983:1</u>

Comparable estimates to those in table 6, but for the first year that IRAs were generally available, are shown in appendix table 3. The important difference between the two sets of estimates is that estimated desired marginal IRA saving increased from the earlier to the later period, apparently reflecting

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[19]Although small, the estimate does not seem unrealistic compared to the aggregate personal saving rate based on national accounts, which is in the range of 5 percent. And a large portion of this amount is in company pension plans, that are not included in the analysis here.

[20]See, for example, the survey of King [1985].

increasing awareness of IRAs and their advantages. The estimated total latent marginal saving rate in the earlier period is only .120 compared to .206 in the later period; the estimated proportion allocated to IRAs is about the same in the two periods, .888 versus .928.

3. <u>1980:1 to 1981:4</u>

Before 1982 only persons without private pension plans could contribute to IRAs and the limit was lower. Only about 3 percent of the CES respondents contributed in 1980 and 1981. As mentioned above, the model estimated for the later years provides estimates of implied saving behavior were IRAs not available. Other saving S_2 is given by the constrained saving function in equation (7), with the limit L set to zero. In particular, marginal saving is given by (1-a)b/(1-ab), with a mean of .015.

To check this prediction, a comparable estimate can be obtained directly from the data for the pre-1982 years. The only hindrance to exact comparability is that the earlier data do not report whether a person had a private pension plan and was thus ineligible for an IRA in these years. It is clear from the summary data, however, that IRAs were essentially unused and quite possibly most people who could have taken advantage of them were unaware of their availability. Certainly they were not widely advertised, as they were beginning in 1982. Thus we have estimated the constrained S_2 function for the 1981-1982 period, assuming that the IRA option was not available at all.[21] Because there is only one equation to estimate, it is not possible to estimate both a and b as functions of X; instead the marginal term (1-a)b/(1-ab) is estimated as a single function of X. The results are shown in table 7. The mean of the predicted marginal saving terms is .013, compared to .015, the value implied by the full model. Both of these estimates are consistent with the very low levels of financial asset balances reported above and with the low levels of total personal saving, currently in the 4 to 5 percent range, most of which is comprised of contributions to employer pension plans.[22]

These very low estimates compared to the much larger total marginal saving term for the later period (b = .206) also suggest that the IRA saving was not simply replacing other personal financial asset saving, of which there was very little. If this were the case, one would expect to see a relationship between income and saving in this early period that approximates the relationship for total saving in the post IRA period. It is clear that IRA saving in the later period does not show up as non-IRA financial asset saving in the pre-IRA period. Apparently desired saving was much higher in the later period. The results are summarized in the tabulation below:

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[21]The few persons who made contributions in those years were deleted from the sample.

[22]See for example Bernheim and Shoven [1987].

Time Period	$\underline{b}$	$\underline{a}$	$\underline{a}_1$	$\underline{a}_2$	$\frac{(1-a)b}{(1-ab)}$
1. 1983:2-1984:1	.206	.928	-15.92	-.30	.015
2. 1982:1-1983:1	.120	.888	-9.68	-.27	.015
3. 1980.1-1981:4	--	--	--	-.28	.013

Not only are the implied non IRA marginal savings rates based on the estimated model virtually the same as the actual observed rates prior to IRA availability, but the estimated intercept terms a_2 are essentially the same as well. According to these estimates, total desired marginal financial saving increased from .013 in the pre IRA period to .120 in the first year after their introduction, to .206 the following year.[23]

C. The Model Fit

Predicted versus actual percents of the sample with S_1 saving greater than 0 and at L are shown in table 8, together with the percents with positive S_2 saving. In general, the predicted values match the actual values very closely by income interval.[24]

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[23]The estimated intercept in the IRA equation, a_1, is much lower in the first than in the second period, but the error variance is higher in the first period as well, 5.82 versus 3.86.

[24]To obtain the actual S_2 values, the values reported at zero were randomly assigned to be positive or negative. The percents actually reported to be greater than zero ranged from 22 percent in the lowest income interval to 47 percent in the highest, compared with the range from 47 to 69 after random assignment of zeros.

In particular, the conditional percents with positive S_2 saving, for persons who are at the IRA limits of 0 and L, are close to the actual values. If anything, the model overpredicts positive S_2 saving among persons at the IRA limit. If the model were not adequately capturing actual substitution between S_1 and S_2, it should underpredict non-IRA saving by those who exceed the IRA limit.[25]

D. Simulations of the Saving Effect of Proposed and Adopted Legislation

For comparison, the effects of two plans are simulated. The first is the so-called Treasury I proposal of November 1984 (U.S. Department of Treasury, 1984) and the second is the recently adopted 1986 tax reform legislation. The early proposal was to increase the limit for an employed person from \$2000 to \$2500 and the limit for the spouse of an employed person from \$250 to \$2500. The new legislation maintains the previous provisions for persons

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[25]The predicted versus actual average dollar amounts of S_1 saving are \$348 and \$366 respectively; S_2 values are \$261 versus \$226. For persons with $s_1 = L$, the S_2 values are \$1670 versus \$1873. For those with $s_1 = 0$, the S_2 values are \$82 versus -\$6. In some cases, the average dollar amounts are affected substantially by extreme values of S_2 saving. We therefore eliminated the top 5% and the bottom 5% of the reported S_2 values and reestimated the parameters in table 6. The estimated parameters change very little. For example, b is .189 instead of .206 and a is .964 instead of .928. As expected, the estimated residual variances are smaller; c_1 is 4.97 versus 5.82 and c_2 is 1.53 versus 3.09. In this case, the predicted and actual average S_1 savings are \$262 versus \$272 and S_2 \$188 versus \$153. For those with $s_1 = L$, the S_2 values are \$552 versus \$335. For those with $s_1 = 0$, the S_2 values are \$152 versus \$121.

without a private pension plan. For persons covered by a private pension, it phases out the tax deduction of contributions by single person at incomes between $25,000 and $35,000 and for families filing joint returns at incomes between $40,000 and $50,000. Returns continue to accrue tax free.

The initial simulations indicate what would have happened, according to the model estimates, had these plans been in effect during the period of estimation, 1983:2 to 1984:1. Simulation of the effects of the first plan is straightforward. The second is more complicated for two reasons. First, it depends on private pension plan coverage, which is apparently underreported in the CESs, as explained above. Second, for the approximately 10 percent of the tax filers who have private pensions and higher incomes it eliminates the current tax deduction but not the tax-free compounding of returns.

Our model specification incorporates the contribution tax deduction in the budget constraint, in line with the promotion of IRAs. The specification also recognizes that the IRA should be preferred because the return accrues tax free. It does this by letting the preference parameter a in particular, as well as b, depend on income, age, and other individual attributes. The estimated coefficients on these attributes capture not only the direct effects of the attributes themselves but also any effect of the marginal tax rate, which, during the period of estimation, should be predicted well by these personal attributes. The marginal tax rate determines the relative return advantage of the

IRA over a conventional account. But we found that it was not possible to identify with any confidence the marginal tax rate effect itself, in particular, as distinct from the effect of income. The estimated effect is very sensitive to the specification, especially the way that income enters the model. Similar results are reported in Wise [1984 and 1985] and in Venti and Wise [1985]. King and Leape [1984] report little effect of the marginal tax rate on asset choice.

Thus while we have considerable confidence in the simulated effects of the limit increase proposal, the estimated effects of the current legislation may be less accurate. We have simply phased out the lower price, 1 - t, for persons with private pensions and with incomes above the appropriate limits.[26] To the extent that pension coverage is underreported in the CESs, the contribution reduction is underestimated. Simulations using the new tax rates in the budget constraint were also performed, but since the new rates have little effect overall the results are not reported here.[27]

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[26]The IRA price is assumed to be 1 - t at $40,000 and to move linearly to 1 at $50,000 for married persons filing joint returns, and similarly for single persons with incomes between $25,000 and $35,000.

[27]In this case, to the extent that the separate effect of the greater IRA return is important in determining the greater preference for them, it is not accurately reflected in the preference parameters since the relationship between tax rates and other parameters such as income has changed.

The simulated effects of the Treasury proposal and of the new law are shown in table 9. Predicted saving under the current plan is taken as a base for comparison. The Treasury plan would have increased IRA saving by 31 percent, with almost no reduction in other saving. Persons at the current limit would have increased their contributions by about 43 percent. The simulated changes in consumption, taxes, and other saving associated with the IRA increase are as follows:

	Amount	Percent
Change in IRA saving	+$1199	100.0
Change in other saving	-37	-3.1
Change in consumption	-793	-66.1
Change in taxes	-367	-30.8

By these estimates, almost two-thirds of the increase in IRA saving is funded by reduced consumption and about one-third by reduced taxes.[28] If stocks and bonds are included in S_2, the reduction in other saving is 5.7 percent, consumption is reduced by 64.6 percent, and taxes by 29.7 percent.

The new law will reduce contributions by an estimated 13 percent. The decrease is concentrated among families with incomes of $40,000 and above. If it is assumed that the reported pension coverage in the CES is correct for persons with incomes above this level ($25,000 for single persons), an upper bound on the

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[28] Very similar estimates are obtained using the parameters reported in appendix table 1, in which the elasticity parameter k was estimated, but the residual variances were constrained to be the same.

reduction can be obtained by assuming that the upper income families cannot contribute at all to IRAs if they have a private pension plan. Under this assumption, the reduction is 19 percent. With greater pension coverage than the CES reports, more persons would be restricted by the new law and both of these estimates would be somewhat larger. None of the simulated effects is changed much if marginal tax rates from the new bill are assumed.

IV. Summary and Discussion

The evidence presented here suggests that the vast majority of IRA saving represents net new saving, not accompanied by a reduction in other financial asset saving. Thus increases in the IRA limits such as those proposed in the November 1984 Treasury plan would lead to substantial increases in IRA saving and very little reduction in other saving. If the IRA limit were raised, about two-thirds of the increase in IRA saving would be funded by a decrease in current consumption and about one-third by reduced taxes; only a very small proportion would come from other saving. These conclusions are supported both by descriptive data and by the formal statistical analysis developed in the paper. Tabulations from the Consumer Expenditure Surveys show that:

- The sharp increase in IRA contributions beginning in 1983 was not accompanied by a reduction in other forms of financial asset saving.

- The financial asset holdings of 1982 and 1983 IRA contributors were much lower than would have been accumulated had prior saving been even a fraction of the typical IRA contribution.

- IRA contributors are much more likely than non-contributors to save in other forms, suggesting that the larger accumulated financial asset balances of contributors reflect this greater saving propensity.

The formal analysis indicates that:

- Individuals show a strong preference for IRA versus other forms of saving.

- Controlling for individual attributes like age and income, there is essentially no correlation between IRA contributions and other financial asset saving.

- There is very little substitution of IRA for other financial asset saving, consistent with the observation that most potential contributors and a large proportion of actual contributors had been saving very little before the advent of IRAs.

The model, estimated on post-IRA data, predicts well the actual relationship between income and financial asset saving prior to the advent of IRAs. In particular, saving in IRA accounts does not show up as other financial asset saving prior to the general availability of IRAs. The cross-section results for the 1983:2 to 1984:1 period correspond very closely to results based on the 1983 Survey of Consumer Finances.[29]

The analysis, however, does not rule out the long run substitution of IRAs for non-liquid assets, housing in particular. Our implicit measure of current consumption includes expenditures on housing and other durables. While we believe that there is little possibility for substitution in the short run and thus little effect on the results here, the substitution possibilities are greater over time.

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[29]See Venti and Wise [1986a,1986b].

The statistical analysis accounts for the important effects of the IRA limits and for the effect of the IRA constraint on non-IRA saving. In addition, it allows for flexible substitution between IRA and other financial saving. The model also allows the two forms of saving to be treated by individuals as distinct goods, but also allows the data to reveal them to be equally preferred and treated as perfect substitutes. In this case, the IRA saving of a small proportion of contributors might be thought of theoretically as inframarginal and thus having no new saving effect. The data, however, strongly reject this view. One explanation for this is simply that individuals think of IRA contributions as saving for retirement and distinct from other saving that might be intended for more short term purposes. And the intensive promotion of IRAs may have greatly increased the allocation of current income to them and thus the strong preference for them that is revealed by the data. Indeed the strong advertising of IRAs may have reshaped to some extent public attitudes toward saving for retirement. In this sense, it may be that an IRA, much like life insurance, is sold not bought.[30] Although the tax advantage of IRAs is surely part of the explanation for their popularity, the net saving effect that accompanies IRA contributions invites alternative explanations for their growth.

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[30] Such an argument was recently suggested by Summers [1985].

Saving schemes like IRAs have been available in Canada since 1956 and were greatly expanded and promoted in the early 1970's. It was at this time that personal saving rates in the U.S. and Canada, which until that time had been very similar, diverged, with substantially higher rates in Canada thereafter. Large increases in Registered Retirement Saving Plan limits are now contemplated in Canada. The United Kingdom has recently established two new tax-deferred saving programs. One, the Personal Pension Plan is directly patterned after the U.S. IRA, but is billed as a substitute for firm pension plans. The other, the Personal Equity Plan, has tax advantages equivalent to the IRA, but limited to and intended to encourage more widespread individual investment in the stock market. Similar plans are available in France and Belgium. Both are reported to have had substantial net saving effects, but we have seen no formal analysis of this.

Table 1. Percent with an IRA and Percent of All Contributors By Income Interval and Time Period

Income Interval ($1000's)	Time Period: 82:1 to 83:1 Percent with IRA	82:1 to 83:1 Percent of Contributors	83:2 to 84:1 Percent with IRA	83:2 to 84:1 Percent of Contributors
0-10	2.3	5.4	4.3	5.7
10-20	6.2	15.0	6.7	9.5
20-30	7.8	17.2	14.3	19.7
30-40	13.7	21.7	20.5	17.1
40-50	20.5	14.9	34.2	19.8
50-100	25.7	24.1	46.8	24.6
100+	50.7	1.7	57.5	3.7
All	9.8	100.0	16.4	100.0

Table 2. IRA Contributions and Changes in Other Financial Assets by Year and Quarter

Year and Quarter	Mean IRA Contribution	Proportion with IRA > 0	Proportion with Other Financial Saving > 0: Including Stocks and Bonds	Proportion with Other Financial Saving > 0: Excluding Stocks and Bonds
1980:1	75	.050	.262	.270
2	48	.029	.290	.277
3	42	.030	.309	.283
4	33	.020	.299	.264
1981:1	30	.031	.278	.253
2	59	.038	.277	.258
3	28	.019	.293	.289
4	56	.036	.248	.221
1982:1	89	.050	.320	.308
2	145	.105	.321	.304
3	192	.113	.314	.291
4	237	.116	.313	.287
1983:1	187	.107	.251	.222
2	465	.189	.317	.278
3	362	.172	.337	.310
4	333	.159	.285	.258
1984:1	344	.140	.299	.284

Table 3. Percent of Families with Increase in Financial Assets By IRA Contributor Status, 1982:1 to 1984:1

Income Interval ($1000's)	Excluding Stocks and Bonds		Including Stocks and Bonds	
	IRA Contributor	Non Contributor	IRA Contributor	Non Contributor
0-10	16.9	11.9	18.2	12.2
10-20	39.8	23.3	47.8	23.9
20-30	30.1	30.9	39.7	32.8
30-40	58.6	36.1	60.8	39.3
40-50	41.7	38.9	53.1	44.1
50-100	43.2	39.9	53.3	43.2
100+	57.1	30.9	72.6	45.3
All	41.9	26.2	50.1	27.8

Table 4. Median Liquid Assets of Families, by IRA Contributor Status, 1982:1 to 1984:1

Income Interval ($1000's)	Excluding Stocks and Bonds			Including Stocks and Bonds		
	All	IRA Contributor	Noncontributor	All	IRA Contributor	Noncontributor
0-10	85	3050	69	85	5200	69
10-20	391	2850	347	400	4563	350
20-30	1096	4225	1000	1287	5400	1050
30-40	2500	8020	1900	3250	14415	2500
40-50	3438	6500	3000	5277	11874	3850
50-100	6000	10500	4924	8967	19950	6000
100+	10600	13500	3100	15856	25000	5600
All	1000	6000	797	1125	11000	812

Table 5. Variable Definitions and Summary Statistics for 1983:2 to 1984:1

Variable	Definition	Mean	Standard Deviation
Age	Age in years	37.9	11.7
Income	After-tax family income in $1,000's	24.4	16.0
Unmarried	One if single; zero otherwise	0.34	0.47
Education	Years of education	13.2	3.3
Family size	Number of persons in family	3.0	1.6
Liquid assets	Dollar value of U.S. savings bonds, savings accounts, checking accounts, brokerage accounts, and other similar accounts, in $1,000's.	4.9	11.3
Nonliquid assets	Sum of value of homes property and stocks and bonds minus consumer debt, in $1,000's.	35.3	51.9
No mortgage	One if family owns home and has no mortgage; zero otherwise	0.09	0.28
Pension	One if family is covered by pension; zero otherwise	0.39	0.49

Table 6. Parameter Estimates with k = 0, 1983:2 to 1984:1

Variable	Estimate (Asymptotic Standard Error)	
Covariance terms:		
c_1	5.82 (0.44)	
c_2	3.09 (0.04)	
r	0.01 (0.02)	
Origin parameters:		
a_1	-15.92 (1.86)	
a_2	-0.30 (0.12)	
Determinants of b and a:	b	a
Income	-.0070 (.0008)	-.0154 (.0025)
Age	.0074 (.0014)	.0181 (.0040)
Unmarried	.0472 (.0341)	-.1702 (.0783)
Education	.0211 (.0053)	-.0049 (.0173)
Liquid Assets	.0101 (.0008)	-.0135 (.0017)
Nonliquid Assets	-.0000 (.0002)	.0013 (.0007)
No Mortgage	.0730 (.0439)	-.4225 (.1059)
Pension	.0281 (.0254)	.1037 (.0613)
Family Size	-.0372 (.0102)	-.0291 (.0219)
Constant	-1.1945 (.1576)	1.4542 (.4074)

Predicted over sample:

Mean b = 0.206
Mean a = 0.928
Mean d_1 = 0.246
Mean d_2 = 0.015

For families predicted to be at the IRA limit:

Mean d_1 = 0.333
Mean d_2 = 0.033
Mean d_2* = 0.046

Log-likelihood = -4591

Number of observations = 1872

Table 7. Parameter Estimates for Non-IRA Saving Prior to Availability of IRAs, 1980:1 to 1981:4

Variable	Estimate (Asymptotic Standard Error)
Disturbance covariance terms:	
c_1	--
c_2	2.48 (0.02)
r	--
Origin parameters:	
a_1	--
a_2	-0.28 (0.07)
Substitution parameter, k	--
Determinants of (1-a)b/(1-ab):	
Income	-.0089 (.0035)
Age	-.0199 (.0037)
Unmarried	-.5481 (.1031)
Education	.0136 (.0124)
Liquid assets	.0513 (.0036)
Nonliquid assets	.0008 (.0002)
No mortgage	.2445 (.1015)
Pension	--
Family size	-.1409 (.0335)
Constant	-1.4659 (.2352)

Mean (1-a)b/(1-ab) = .013

Log-likelihood = -6487.1

Number of observations = 3441

Table 8. Predicted versus Actual Values, by Income Interval Based on Table 6 Parameter Estimates[a]

Income Interval ($1000's)[b]	Number	% $s_1 > 0$		% $s_1 = L$		% $s_2 > 0$	
		P	A	P	A	P	A
0-10	294	4	2	2	1	47	51
10-20	574	8	8	3	4	49	54
20-30	472	16	16	8	8	51	54
30-40	274	27	30	15	16	55	55
40-50	134	34	30	20	16	58	57
50+	124	43	48	29	31	69	60
TOTAL	1872	16	16	9	9	52	55

Income Interval ($1000's)[b]	Number	% $s_2 > 0$ given $s_1 = L$		Number	% $s_2 > 0$ given $s_1 = 0$	
		P[c]	A[d]		P[e]	A[d]
0-10	5	54	50	283	46	51
10-20	20	53	48	531	48	54
20-30	39	57	59	398	50	53
30-40	40	63	60	199	54	53
40-50	27	64	45	85	56	59
50+	36	74	69	72	65	57
TOTAL	168	63	58	1571	50	54

a. Based on 50 draws per sample observation. P is predicted, and A is actual.

b. Y_T in thousands of dollars.

c. Predicted $s_2 > 0$, given predicted $s_1 = L$.

d. Observed in the sample.

e. Predicted $s_2 > 0$, given predicted $s_1 < 0$.

Table 9. Simulated Responses to Alternative Schemes Based on Table 6 Parameter Estimates

Family Type	Previous Law S_1	Previous Law S_2	Treasury Plan S_1	Treasury Plan S_2	New Law S_1	New Law S_2
All families						
Avg. contribution	351	274	459	270	306	274
% change	--	--	+31	-1	-13	0
Families at IRA Limit*						
Avg. contribution	2754	1647	3953	1611	2438	1659
% change	--	--	+43	-2	-11	0
By Income Interval ($1,000s)						
0-10	50	-213	60	-214	50	-213
10-20	123	- 54	151	- 54	123	- 54
20-30	309	145	402	143	306	145
30-40	633	480	822	474	617	480
40-50	833	874	1151	867	683	875
50+	1090	2326	1486	2311	668	2337

*Families predicted to be at the limit under the previous law.

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Appendix on Estimation

We adopt a stochastic specification that allows additive disturbances e_1 and e_2 associated with S_1 and S_2 respectively. They are assumed to be distributed bivariate normal within standard deviations c_1 and c_2 and correlation r. The joint distribution of S_1 and S_2* is the relevant distribution if IRA contributions are either zero or at the upper limit. The disturbance associated with S_2*, denoted by e_2*, is a linear function of e_1 and e_2 so the joint distribution of S_1 and S_2* is also bivariate normal. Derivation of e_2* and the covariance paramenters (c_2* and $r*$) of the joint S_1, S_2* distribution is straightforward, but tedious.

There are nine possible outcomes. Define $S_1 = \overline{S}_1 + e_1$, $S_2 = \overline{S}_2 + e_2$, and $S_2* = \overline{S}_2* + e_2*$. With f the unit normal density function , F the corresponding distribution function, and F_2 the bivariate distribution function, the probabilities associated with each outcome are given by:

1. $s_1 = 0$ and S_2 observed

$$P_1 = (1/c_2)\ f(s_2-\overline{S}_2*/c_2*)\ \{1-F[\overline{S}_1+r*(c_1/c_2*)(S_2-\overline{S}_2*)/(c_1\sqrt{1-r*^2})]\}$$

2. S_1 observed, S_2 observed

$P_2 = (2pc_1c_2\sqrt{1-r^2})^{-1}$

$\times \exp\{-1/2(1-r^2)[((s_1-\bar{S}_1)/c_1)^2 - 2r(s_1-\bar{S}_1)(s_2-\bar{S}_2))/c_1c_2$

$+ ((s_2-\bar{S}_2)/c_2)2]\}$

3. $s_1 = L$ and S_2 observed

$P_3 = (1/c_2*)f((s_2-\bar{S}_2*)/c_2*)\ F[\{\bar{S}_1-L+r*\ (c_1/c_2*)(S_2-\bar{S}_2*)\}/(c_1\sqrt{1-r*^2})]$

4. $s_1 = 0$ and $S_2 > 0$

$P_4 = F_2\ [-\bar{S}_1/c_1,\ \bar{S}_2*/c_2*;\ -r*]$

5. S_1 observed $S_2 > 0$

$P_5 = (1/c_1)\ f((S_1-\bar{S}_1)/c_1)\ F[\bar{S}_2 + r(c_2/c_1)(S_1-\bar{S}_1)/(c_2\sqrt{1-r^2})]$

6. $s_1 = L$ and $S_2 > 0$

$P_6 = F_2[-(L-\bar{S}_1)/c_1,\ \bar{S}_2*/c_2*;\ r*]$

7. $s_1 = 0$ and $S_2 < 0$

$P_7 = F_2[-\bar{S}_1/c_1,\ -\bar{S}_2*/c_2*;\ r*]$

8. S_1 observed and $S_2 < 0$

$P_8 = (1/c_1)\ f((S_1-\bar{S}_1)/c_1)\ x\{1-F[\bar{S}_2+r(c_2/c_1)(S_1-\bar{S}_1)/(c_2\sqrt{1-r^2})]\}$

9. $s_1 = L$ and $S_2 < 0$

$P_9 = F_2[-(L-\bar{S}_1)/c_1, -\bar{S}_2^*/c_2^*; -r^*]$

The likelihood function is the product of the P_j over the relevant subsets of observations.

Appendix Table 1. Parameter Estimates with k Estimated and $c_1 = c_2$, 1983:2 to 1984:1

Variable	Estimate (Asymptotic Standard Error)	
Covariance terms:		
c_1	3.36 (0.05)	
c_2	3.36 (--)	
r	0.03 (0.02)	
Elasticity parameter, k	-0.15 (0.06)	
Origin parameters:		
a_1	-8.36 (0.51)	
a_2	-0.77 (0.17)	
Determinants of b and a:	b	a
Income	-.0052 (.0007)	-.0116 (.0024)
Age	.0040 (.0011)	.0239 (.0036)
Unmarried	.0583 (.0304)	-.1640 (.0835)
Education	.0091 (.0043)	.0366 (.0107)
Liquid Assets	.0119 (.0005)	-.0141 (.0019)
Nonliquid Assets	-.0002 (.0002)	.0007 (.0006)
No Mortgage	.0585 (.0380)	-.1627 (.0801)
Pension	.0118 (.0226)	.0658 (.0600)
Family Size	-.0247 (.0090)	-.0622 (.0263)
Constant	-1.2153 (.1157)	.1258 (.0483)

Predicted over sample:

Mean b = 0.147
Mean a = 0.820
Mean d_1 = 0.149
Mean d_2 = 0.032

For families predicted to be at the IRA limit:

Mean d_1 = 0.220
Mean d_2 = 0.055
Mean d_2^* = 0.063

Log-likelihood = -4617

Number of observations = 1872

Appendix Table 2. Parameter Estimates with k = 0, and $c_1 = c_2$, 1983:2 to 1984:1

Variable	Estimate (Asymptotic Standard Error)	
Covariance terms:		
c_1	3.40 (0.05)	
c_2	3.40	
r	0.02 (0.02)	
Origin parameters:		
a_1	-8.67 (0.55)	
a_2	-0.52 (0.17)	
Determinants of b and a:	b	a
Income	-.0067 (.0007)	-.0106 (.0021)
Age	.0057 (.0012)	.0190 (.0040)
Unmarried	.0633 (.0312)	-.2093 (.0973)
Education	.0124 (.0047)	.0327 (.0141)
Liquid Assets	.0108 (.0006)	-.0132 (.0016)
Nonliquid Assets	-.0000 (.0002)	.0008 (.0006)
No Mortgage	.0548 (.0376)	-.1792 (.0855)
Pension	.0458 (.0242)	-.0210 (.0688)
Family Size	-.0245 (.0087)	-.0718 (.0318)
Constant	-1.3020 (.1289)	.4456 (.2699)

Predicted over sample:

Mean b = 0.147
Mean a = 0.831
Mean d_1 = 0.157
Mean d_2 = 0.025

For families predicted to be at the IRA limit:

Mean d_1 = 0.223
Mean d_2 = 0.045
Mean d_2^* = 0.056

Log-likelihood = -4621

Number of observations = 1872

Appendix Table 3. Parameter Estimates with k = 0, 1982:1 to 1983:1

Variable	Estimate (Asymptotic Standard Error)	
Covariance terms:		
c_1	3.86 (0.29)	
c_2	2.92 (0.06)	
r	-0.02 (0.02)	
Origin parameters:		
a_1	-9.68 (1.02)	
a_2	-0.27 (0.12)	
Determinants of b and a:	b	a
Income	-.0082 (.0010)	-.0149 (.0033)
Age	.0077 (.0014)	.0137 (.0047)
Unmarried	-.0076 (.0405)	-.0391 (.0980)
Education	.0189 (.0063)	.0113 (.0182)
Liquid Assets	.0086 (.0008)	-.0174 (.0026)
Nonliquid Assets	.0007 (.0003)	.0004 (.0009)
No Mortgage	-.0219 (.0442)	.0716 (.0935)
Pension	.1185 (.0242)	-.4939 (.1055)
Family Size	-.0812 (.0130)	.1643 (.0472)
Constant	-1.4172 (.1670)	.7748 (.3885)

Predicted over sample:

Mean b = 0.120
Mean a = 0.888
Mean d_1 = 0.136
Mean d_2 = 0.015

For families predicted to be at the IRA limit:

Mean d_1 = 0.197
Mean d_2 = 0.035
Mean d_2^* = 0.041

Log-likelihood = -5001

Number of observations = 2141