

## PIECING TOGETHER PERSONAL WEALTH DISTRIBUTIONS

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The American economy is undergoing enormous stress, brought about by forces that are of a size unprecedented in history. Large trade and budget deficits come readily to mind. Concerns about the Society's long-run international competitiveness exist, as well. Savings rates in the United States have historically been low and appear to be getting lower [1]. What to do about all this is unclear, especially since various industrial sectors seem to be affected to a greater or lesser degree [2].

Various nostrums have been proposed and, in some cases, may even be having a beneficial effect. For instance, the new emphasis on quality in the manufacturing sector is one response that may have started to work, although American goods have a long way to go in many areas [e.g., 3]. There is a widespread belief that the massive tax law changes of the 1980's will also help, particularly the 1986 Tax Reform Act [e.g., 4]. Cuts in marginal rates, for example, should confer at least a short-run advantage on most American businesses.

With all this change in the American economy, how well are we "keeping score?" On a "macro" level, of course, we have the National Income and Product Accounts prepared by the Bureau of Economic Analysis and the "Flow-of-Funds" accounting done by the Federal Reserve Board (FRB). These measures, while subject to weaknesses, have served to monitor economic trends in income and wealth reasonably well. It may be time, however, to heed calls for an integrated approach [5], combining both macro- and microdata [e.g., 6].

A great many of the elements are in place. The Census Bureau's new Survey of Income and Program Participation (SIPP) clearly is a major step [7]. Advances in the measurement of income in the Current Population Survey also are an important factor [8]. Renewed emphasis on improvements in the National Income and Product Accounts is encouraging [9]. In addition, the Federal Reserve Board is undertaking a thorough re-examination of the methodology underlying its "Flow-of-Funds" accounting [10].

Of most interest at this session is the renewal of the Federal Reserve Board's interest in using survey techniques to measure the distribution of wealth [e.g., 11]. The 1962 wealth study by the Board, which was conducted by Dorothy Projector and Gertrude Weiss [12], was a milestone in this area. The 1983 FRB study, as we have heard at this session, offers great promise as a new beginning of what is hoped will be a more regular measurement of wealth by the Board. In both of these FRB efforts the Internal Revenue Service (IRS) offered support. While this cooperation was considerable, in many ways it has been incomplete. (The estate multiplier wealth estimation periodically done at IRS has, until very recently, been carried out as a separate, stand-alone activity.)

This paper is a shortened version of a paper

published by the Internal Revenue Service [13]. The longer paper contains five sections. The first section provides a framework within which the overall wealth distribution problem might be set. That section includes a discussion of information sources on income and wealth appropriate to different groups of nonwealthy, moderately wealthy and very wealthy individuals. That section is not included here. The second part of the complete paper provides a description of the history and limitations of the estate multiplier method. A brief excerpt from that section is included in this paper, as Section 1. Sections 2 and 3 here develop concerns about estate multiplier limitations, specifically in terms of how the 1982 multiplier results relate to the 1983 Federal Reserve Board survey figures. Measurement problems associated with the wealthy (those with at least \$500,000 in assets) are focused on in these sections (which are Sections 3 and 4 of the longer version of this paper). Section 4 here concludes the paper with some observations intended to set the stage for considering what priorities should be given to future work.

### 1. ESTATE MULTIPLIER ESTIMATION

The United States estate tax was instituted in 1916; this legislation required that estate tax returns be filed for individuals who held (at death) gross assets exceeding an annual filing threshold. From 1916 to 1976, the threshold ranged from \$40,000 to \$100,000; for most years it was \$60,000. Since 1976 the filing requirement has been increased annually; in 1982, it was \$225,000 and it reached \$600,000 in 1987. (The threshold is scheduled to be \$600,000 in 1989 also, which is the next year that the FRB plans to conduct a major wealth survey.)

Estimates of U.S. personal wealth from estate tax returns have been made for many years using the so-called "estate multiplier technique." The estate multiplier method assumes that "death draws a random sample of the living population." This assumption allows one to apply statistical sampling theory to the result obtained by weighting estate tax return data by the inverse of the mortality rate characteristic of the demographic group from which the decedent was "selected."

Let  $x_i$  be some measure of wealth, say corporate stock, taken from a sample of  $i = 1, 2, \dots, n$  decedents, where the probability of "death's selection" is denoted by  $\pi_i$ . The estate multiplier estimator of the total

$$\hat{X} = \sum_{i=1}^n \left( \frac{1}{\pi_i} \right) x_i \quad (1.1)$$

is then seen to be simply a conventional Horvitz-Thompson estimator [e.g., 14], where  $\pi_i > 0$  for all  $n$  members of the population.

(Incidentally, if the decedents are themselves a sample from all the returns available, then obviously our estimator should be of the form

$$\hat{\lambda} = \sum_{i=1}^n \left( \frac{1}{\pi_i p_i} \right) x_i \quad (1.2)$$

where the  $p_i > 0$  are known return selection probabilities.) One of the chief difficulties with this method is how to choose the  $\pi_i$ . More research on this problem is needed as pointed out in Section 4.

## 2. CONCEPTUAL COMPARISONS BETWEEN FRB AND IRS WEALTH ESTIMATES

Extensive comparisons have been made by a number of researchers between the 1962 estate tax wealth estimates and the corresponding figures produced by Projector and Weiss from the 1962 FRB work [e.g., 15]. The results of the two approaches seem remarkably close, especially given the initial differences which existed between the 1982 IRS estimates of wealth and those taken from the 1983 FRB effort. The differences between the 1982 IRS and 1983 FRB estimates are still striking and are too large to be entirely attributable to sampling error. The comparability of the 1962 estimates, on the other hand, would be remarkable even if sampling error was the only source of differences. That closeness is probably partially coincidental.

When the original survey figures came out for 1983, they were quite surprising to us, in that they showed an upward movement in the concentration of wealth, which was not reflected in the estate tax data [16, 17]. Frankly, we felt that there had to be an error in the survey results. This, of course, turned out to be the case. Even after correction, however, large discrepancies still remained; clearly, more work was called for.

We had already started, with help from the Census Bureau, to carry out an in-depth analysis of the possible nonresponse bias in the IRS high income sample. (Research in this area will be reported elsewhere in detail. [18]) We then began working with the Federal Reserve Board and the Institute for Social Research's Survey Research Center to see if there were other ways to help. A collaborative effort was undertaken, which still continues. Among other things, that effort has addressed the development of alternative FRB survey weights--a topic touched on elsewhere at this session and, hence, one that will not be covered here.

An intensive examination of the estate tax wealth estimator also seemed in order. Particularly troublesome was the sharp drop in wealth concentration which occurred for 1976 and which was coincidental with major changes in the estate tax law at about that time. We didn't have a good explanation for this and we needed one, especially since the preliminary 1981 and 1982 data showed that only a minor upward shift had been made since then. A paper by McCubbin [19], also given at these meetings was written in part to address these concerns. This discrepancy has yet to be resolved, but we are continuing to study the issue.

At the suggestion of Bob Avery at the FRB, we

looked closely at a number of the many valuation issues that plague the estate multiplier. For example, what is the net effect of using unaudited, rather than audited, tax returns? What about trust assets, transfers in anticipation of death, the tax treatment of jointly owned property and so on? There hasn't been enough time to come to a definite conclusion on each of these issues. (Indeed, there may never be enough time for some of them.) Small samples were studied in a few cases, though, and we consulted with experts on the law and administration of the estate tax to see what, if anything, might have changed in recent years.

### Asset-by-Asset Comparisons

The review undertaken by McCubbin [19], and related work for the present paper, allow us to discuss Avery's conjectures (and others). This is done below on an asset-by-asset basis.

Financial Assets.--Financial assets (cash, corporate stock, bonds and notes and mortgages) appear to be extremely well reported on the estate tax return and in a manner, for the most part, that is conceptually consistent with that in the FRB study. Some net undervaluation of corporate stock may exist, because of the fact that the returns used are unaudited; but, in the sample studied by McCubbin, this impact was quite small--only about 2 percent. Undervaluation of the other financial assets appears to be even less of an issue.

The estate tax law was changed in 1976 to provide special use valuation provisions for farmers and owners of closely-held businesses. This could have led to some further undervaluation of corporate stock; however, because of the stringent nature of the requirements allowing for this provision and the limitation of the reduction to \$500,000, the effects on wealth estimates may be slight and, in any case, would be more significant for smaller estates. (The reduction limit was raised to \$600,000 for those dying in 1981, \$700,000 in 1982 and \$750,000 for decedents in 1983 and thereafter.) Another valuation technique available for corporate stock, the "blockage adjustment," has been available since 1958. If the decedent owned a sizable percentage of a corporation's traded stock, a downward adjustment of the stock's selling price was allowed, if the executor could prove that the disposal of the stock would cause its market price to be depressed.

Nonfinancial Assets.--The various valuation issues are considerably more important for nonfinancial assets (real estate, noncorporate business equity, and other, mainly tangible, assets). Miscellaneous assets, for example, in the McCubbin sample had an adjusted value after audit that was 4 percent greater than its pre-audit amount. Real estate increased by 2 percent during audit. The special use valuation provisions mentioned above also apply to real estate, although again our belief is that these would have only a limited effect. Changes in the treatment of jointly owned property also need to be considered. After 1976, only one-half of the value of certain joint property owned by spouses must be included in the estate.

After 1981, only one-half of any joint property owned by spouses must be included, regardless of which spouse furnished consideration for the property [20]. This could have a sizable effect particularly on time series comparisons of wealth concentration. According to Schwartz [16], for 1982 about \$213 billion was held by wealthy married individuals as their share of jointly owned property.

We have already commented on valuation issues with regard to noncorporate business equity. Unquestionably, the valuation of these assets may be affected by the death of the owner (or part-owner). In addition, the special use valuation provisions described for closely-held corporate stock apply to unincorporated businesses, as well.

In the case of other (nonfinancial) assets, it was conjectured that there might be some problems in locating all of this miscellaneous property for estate tax purposes. In addition to automobiles, furnishings and personal property, the category of other assets includes such things as works of art, copyrights, royalty interests, and gift taxes paid within three years of death. The McCubbin sample found, however, only a few cases where previously unincluded property was added as a result of audit. Virtually all of the 4% increase in the value of other assets was due to revaluations of property.

Insurance and Life Interests.--Insurance, annuities and trust assets in which the decedent possessed only a life interest are particularly troublesome to value properly using estate tax data. The face value of includable life insurance comes into the estate. In the past, an adjustment has been made to lower the face amount to its cash surrender value, but this is a rough adjustment at best. Annuities and life income interests in trust, plus pension and social security wealth, are seriously undervalued or omitted altogether. One solution to this problem is simply to change the scope of the wealth estimates to exclude these assets. This is possible; however, it may result in misleading conclusions about wealthholding patterns in the United States, since pension wealth, for example, has grown enormously in importance in recent years. Linkages between the estate and income tax returns for decedents and beneficiaries are being carried out; these might be a source for a partial correction of such problems (especially if carried back far enough for decedents and forward enough for beneficiaries) [21].

#### Some Other Considerations

Three other overall estate tax valuation issues might be mentioned briefly, even though their effects for 1982 appear likely to be small.

- First, there is some flexibility available in the point at which an asset can be valued for estate tax purposes. While usually the date of death value is used, this need not be the case. As a result of this option, on balance there was a slight decrease in the total assets estimated for 1982 for the wealthy; however, this was far less than 1 percent overall.

- Second, originally all gifts (and related gift taxes) made within three years of death, in contemplation of death, had to be reported on the estate tax return. The 1976 Act required that all transfers made and gift taxes paid within three years of death, regardless of motivation, be included in total gross estate. After 1981, this changed again so that only certain transfers made within three years of death, but all gift taxes paid, had to be included. We are not sure, but it is likely that the estate tax wealth series may have been affected because of these changes, relative to what it was historically. Certainly there is an overstatement relative to what a survey would measure. Such gifts have two chances of being "sampled" (since both donor and donee would have them in their estates if they died); hence, their inclusion in estate tax wealth leads to double counting. Including gift taxes paid is entirely inappropriate since the wealth is no longer in the household sector at all. The extent of this problem does not appear great; however, no current estimates are available.

- Third, in general the wealth of an individual declines during the last few years prior to death, as assets are transferred to heirs or as savings are depleted by expenditures during retirement, including those for the expenses of last illnesses. Thus, the value of many estates might be less at death than at some other (random) time. In addition, some assets in particular are especially likely to decrease in value at death. The undervaluation of annuities was mentioned earlier. The gross estate includes the value of an annuity or pension payment that a beneficiary is due to receive because he or she survives the decedent. The value of payments which terminate at death are not included. Similarly, income interests in trust assets which terminate at death are not included in the estate. In this case, the decedent did not legally own the assets from which the income was derived and so these assets are not included in the estate. (The income stream is not included, as it terminates at death.) Yet even though the decedent did not own the assets for estate tax purposes, he or she benefitted from them and the exclusion of them results in an understatement of economic well-being.

The value of business interests may also decline at death, especially if the decedent was a sole proprietor or important partner in the business. The value of professional (medical, legal) practices certainly could fall around the time of death, since human capital is lost. Survey methods may be more useful in capturing this type of wealth. There are also ways to correct for the decline in wealth which occurs near death. Income tax or other data can be collected and later matched with estate tax records, to provide a picture of economic well-being for more than one point in time [22].

### Summary

While our analysis of valuation concerns in this section is incomplete and preliminary, we conjecture that most of the valuation issues on the estate tax are relatively small, correctible or both. In particular, we believe that, within the conceptual limitations of the estate tax law, the assets shown on estate tax returns are extremely well reported. They draw notable strength from having been taken from administrative records, by highly skilled people and under exacting legal sanctions.

Unlike survey data, such as that collected in SIPP (or in the FRB study), it is thought that estate tax returns do not suffer greatly from response variation. One exception may be for particularly hard-to-value assets, such as an interest in a partnership or closely-held corporation or real estate assets for which there are no ready markets; in such cases, the valuation may be subject to some difference of opinion. Usually there is a financial stimulus for the executor to use the lowest value he thinks can be sustained. It is not uncommon, therefore, that valuations are changed when returns are subjected to audit. In the McCubbin study, such increases occurred nearly half the time. Even so, the percentage changes were fairly small overall and not always in the same direction.

It should be noted, by the way, that sometimes there are good financial reasons for the executor to select the higher rather than lower value of an asset. Because the estate valuation establishes the basis for future taxation of the asset in the hands of the heirs, a higher basis may minimize income taxes, so that while a higher estate tax is paid the net effect is a tax saving. For example, a higher basis for business property subject to depreciation will increase the allowable deductions for depreciation; a higher basis for property which the heirs intend to sell will minimize the income taxes paid on the difference between the estate tax return valuation and the selling price.

While on balance estate assets may be undervalued, the McCubbin data indicates that this bias is small. Even if the outdated study by Harriss is used as a guide, the bias in valuations would still be fairly modest. [23] A larger sample of more recent returns would be needed to conclude this definitively, but it seems unlikely that undervaluation can be a major factor in explaining FRB/IRS differences.

On the other hand, we feel less comfortable about whether or not ownership issues are a factor in the FRB/IRS differences. De facto and de jure differences may exist and there could be some confusion on the survey leading to double counting. Large swings are possible in the estate multiplier estimates depending on how jointly owned property is treated.

Undoubtedly the timing of the estate tax valuations is of some importance. As previously discussed, some assets decrease in value when the owner dies. The value of at least one asset, life insurance, increases at death. (We can correct for this, however.) In addition, the savings of many nonwealthy and moderately wealthy individuals may be depleted after retirement, especially during the last illness.

The FRB estimates, on the other hand, are based on a survey of individuals at various life stages.

Individual assets, as we have seen, may be systematically undervalued on the estate tax return due to particular provisions of the law allowing for special valuations in certain cases for family businesses and farms. While we speculate that this cannot be a major factor, we have no data yet to back that up. It certainly will have some effect on time series comparisons with earlier estate multiplier estimates, as will the change in the treatment of jointly owned property and lifetime transfers. On the survey side, we conjecture that there may be some confusion about where to report certain assets. For example, notes and mortgages could be too low in the FRB study and real estate too high, as a consequence.

The way the "other assets" questions were asked in the survey suggests that a great deal of wealth may simply have been missed altogether. On the estate tax returns, based on a small sample study, we found all kinds of property that were not showing up at all in the survey or, if reported, were being mentioned far less frequently [24]. As noted above, these assets include jewelry, art work, home furnishings, copyright interests and other items.

### 3. NUMERICAL COMPARISONS BETWEEN FRB AND IRS WEALTH ESTIMATES

This section continues the discussion of differences between the 1982 Estate Tax Wealth estimates and those made by the Federal Reserve Board for 1983. To make the numerical comparison shown here, we obtained the help of the Federal Reserve Board in producing special tabulations of individual than wealth from their data on household wealth. Asset by asset price adjustments were made to shift the 1983 FRB figures to 1982 price levels [25]. Attention was confined for each asset type just to individuals or estates with \$500,000 or more of that asset since estate tax returns with gross estate of less than \$500,000 did not have to report asset by asset detail for 1982 decedents. To the extent possible, we have omitted assets that clearly would not be comparable, notably insurance, annuities and pension interests. Comparisons are made in two ways. First there is an overall discussion of differences in average amounts; this is followed by more detailed distributional comparisons.

#### Comparisons Between FRB and IRS Asset Averages

Comparisons between FRB and IRS asset averages are made in Figure A. Substantial differences exist. For example, all but one of the individual asset amounts show the IRS average to be higher than those from the FRB survey (and four of these differ by about 20 percent or more). The one exception--real estate--may arise, in part, due to the difference between the two sources in the treatment of jointly owned property. We estimate that 80 percent of the joint property owned by married individuals is real estate. Adding 80 percent of the un-included joint property held by married IRS top wealthholders to the real estate total yields an average real estate figure of \$1,402,395, or

FIGURE A.--Comparison of Federal Reserve Board and Estate  
Multiplier Wealth Estimates

(Average amounts in thousands of dollars; data confined to  
observations greater than or equal to  
\$500,000 in each category.)

Asset Type	Average Amounts		Difference	
	Federal Reserve Board (1)	Internal Revenue Service (2)	Amount (3)	Percent (4)
Total assets.....	1,504	1,269	235	15.6
Financial assets.....	1,463	1,430	33	2.3
Cash.....	828	878	-50	-6.0
Stock.....	1,350	1,601	-251	-18.6
Bonds.....	1,052	1,305	-253	-24.0
Notes and mortgages..	858	1,105	-247	-28.8
Real Estate.....	1,426	1,020	406	28.5
Noncorporate business..	1,407	1,437	-30	-2.1
Other.....	724	1,316	-592	-81.7

Source: The FRB data are the basic "corrected" data that  
have been made publicly available, deflated from 1983 to  
1982. The IRS data are the final 1982 estimates made  
by Schwartz [16]. See the text for a discussion of the  
differences found.

FIGURE B.--Comparison of Federal Reserve Board and Estate Multiplier  
Frequency Estimates

(Frequency of wealthholders in thousands; data confined to  
observations greater than or equal to  
\$500,000 in each category.)

Asset Type	Frequency		Difference	
	Federal Reserve Board (1)	Internal Revenue Service (2)	Frequency (3)	Percent (4)
Total assets.....	2,581	1,832	749	29.0
Financial assets.....	927	660	267	28.8
Cash.....	53	56	-3	-5.7
Stock.....	661	335	326	49.3
Bonds.....	93	72	21	22.6
Notes and mortgages..	20	32	-12	-0.6
Real Estate.....	718	446	272	37.9
Noncorporate business..	370	71	299	80.8
Other.....	19	71	-52	-273.7

Source: The FRB data are the basic "corrected" data that  
have been made publicly available, deflated from 1983 to  
1982. The IRS data are the final 1982 estimates made  
by Schwartz [16].

\$24,804 less than the FRB average. This adjusted figure may be conceptually closer to the FRB estimate.

The two totals for financial assets and gross assets show FRB average amounts greater than the corresponding IRS figures. This seems a paradox given the fact that nearly all of the individual components that make up these amounts differ in the opposite direction. The reason for this apparent contradiction lies in the large differences in the relative frequencies of the FRB and IRS amounts. In particular, for corporate stock, real estate and noncorporate business assets, the FRB survey reports many, many more individuals holding that asset type than does IRS. (See Figure B.)

As an aside, it might be noted that we are not uncomfortable about the differences at the mean for each asset type. These accord with our expectations about the relative strengths of the estate and survey approaches to wealth estimation. What troubles us greatly are the large differences in the relative frequencies for each asset type. At this point we are unable to account for these. Weaknesses in the estate multiplier being used could be one contributing cause, but it is hard to attribute all of the differences to this one factor. Some uncertainty in how the FRB weighting might be done is another possibility which we are still exploring.

#### Comparisons Between FRB and IRS Asset Distributions

When FRB and IRS asset distributions were compared in our presentation of this paper at the ASA meetings, they were shown graphically, in terms of the cumulative percentage of individuals in each asset size class. (See, for example, Figure C.) The discussant, Edward Budd, noted that the graphs were difficult to interpret, because of the closeness of some of the curves. In response to his comments, we have re-presented the information here, employing quantile-quantile (Q-Q) plots, as described by Wilk and Gnanadesikan in 1968 and reviewed by Hoaglin et al.[26]. By this method,

a plot of the inverses of the two cumulative distribution functions,  $F_{IRS}^{-1}(p_i)$  and  $F_{FRB}^{-1}(p_i)$ ,

can be used to compare the shapes of the distributions as well as look at differences in their means and variances. In particular, the Q-Q chart corresponding to Figure C is shown alongside it as Figure D. Notice first that both plot the data on the "Y" or vertical axis in the same way, i.e., by size of total assets beginning at \$500,000.

For Figure C, the X or horizontal axis is the cumulative percentage of estates or individuals with total assets less than or equal to the amount shown on the Y axis. Thus, we see that for the estate top wealthholder data there are 68 percent with assets of \$500,000 to \$1,000,000; the corresponding percentage for the FRB survey is 60 percent.

For Figure D the Y axis is the same as the X axis, i.e., it plots total assets by size. The difference between the X and Y axes is that on the X axis we plot the FRB data at a fixed set of percentiles, while on the Y axis, we plot the IRS data at the same set of percentiles. Three lines are shown in Figure D:

- a dashed line, which corresponds to the actual plot of the pair of points

$$F_{IRS}^{-1}(p_i) \text{ and } F_{FRB}^{-1}(p_i) \text{ for } p_i$$

at each decile .40, .50, .60, ..., .90 plus at .95, .98, .99, and .995;

- a straight-line smoothing of the basic  $F_{IRS}^{-1}(p_i)$ ,  $F_{FRB}^{-1}(p_i)$  data we obtained by employing ordinary least squares using the equation (3.1) below; and
- a bold-faced 45 degree line that passes through the origin. This last line is included for reference.

We derived Figure D from Figure C by taking the two original simple cumulative distributions for the FRB and IRS data and then interpolating at the  $p_i$  values mentioned above. To do the interpolation, we used new procedures described in a companion paper being given at these

Figure C.--Cumulative Percent of Individuals/Households with \$500,000 or More of Gross Assets

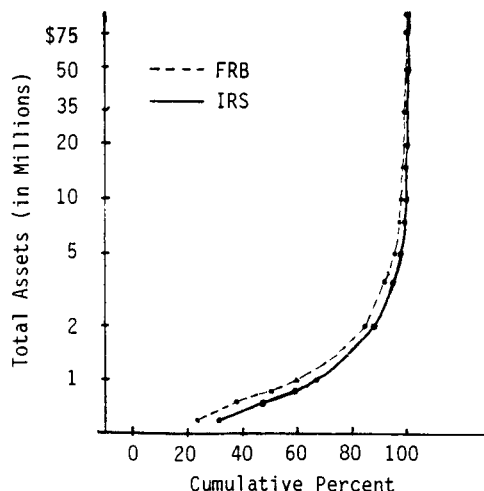
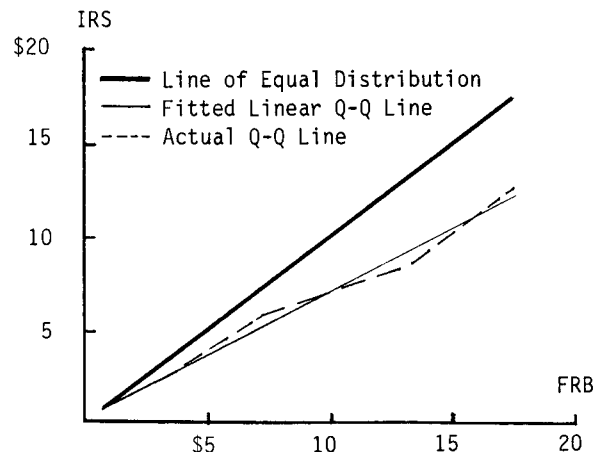


Figure D.--Quantile-Quantile (Q-Q) Plot for Total Assets, FRB and IRS Distributions Compared (\$ in Millions)



meetings [27].

Now, if the distributions are exactly the same, the plot of  $F_{IRS}^{-1}(p_i)$  versus  $F_{FRB}^{-1}(p_i)$ , will form a straight line which passes through the origin and has a slope of 1. If the distributions do not have the same shape, the plot will be nonlinear. In general, if  $F_{IRS}^{-1}(p_i)$  and  $F_{FRB}^{-1}(p_i)$  have the same shape, then the Q-Q plot is of the form

$$F_{IRS}^{-1}(p_i) = \mu + \sigma F_{FRB}^{-1}(p_i) \quad (3.1)$$

where the mean  $\mu$  is a scaled difference between the mean of the IRS data  $\mu_{IRS}$  and the FRB data  $\mu_{FRB}$ , i.e.,

$$\mu = \mu_{IRS} - \left( \frac{\sigma_{IRS}}{\sigma_{FRB}} \right) \mu_{FRB} \quad (3.2)$$

The quantiles  $\sigma_{IRS}$  and  $\sigma_{FRB}$  are the population standard deviations of the IRS and FRB distributions, respectively. (Estimates of  $\mu_{IRS}$  and  $\mu_{FRB}$  have, of course, already been provided in Figure A.)

The slope of the linear relationship between  $F_{IRS}^{-1}$  and  $F_{FRB}^{-1}$  in expression (3.1) is of the form

$$\sigma = \frac{\sigma_{IRS}}{\sigma_{FRB}} \quad (3.3)$$

Hence, if  $\sigma = 1$ , the variances of the IRS and FRB are equal and if, further,  $\mu = 0$  and the shapes are same, then expression (3.1) will be a straight line through the origin.

#### Quantile-Quantile Chart Comparisons

Given the machinery we have just described, what can we conclude from Figure D about the differences between the IRS and FRB measurement of total assets for persons with \$500,000 or more in gross wealth?

- First, as to shape, the dashed line definitely is not straight; it is not badly bowed, however; hence, we might be willing to conclude that the two distributions are not that dissimilar.
- Second, the slope of the Q-Q plot of total assets is less than 1, indicating that the IRS distribution rises faster than that from the FRB survey (in fact,  $\hat{\sigma} = .69$ ).
- Third, as we have already seen in figure A,  $\mu_{IRS}$  and  $\mu_{FRB}$  differ at the mean for total assets and this, along with dispersion differences, i.e.,  $\hat{\sigma} \neq 1$  yield the value  $\hat{\mu} = \$231,240$

All in all, the Q-Q chart for total assets nicely extends the insights of Figure A and indicates that despite large differences at the mean, there are still important similarities, at least as to shape.

Figure E provides a complete set of Q-Q charts for each asset type, beginning with financial assets as a total, then graphing each of its

components: cash, corporate stock, bonds, and notes and mortgages. Three nonfinancial assets also are shown: real estate, noncorporate business assets, and other assets. In what follows, we will comment on each of these briefly:

Cash.--The FRB distribution rises very fast and looks to be quite different in shape from the corresponding IRS data as well. We speculate that reporting of cash in the survey was less complete than on the estate returns, with the consequences that the IRS mean is greater and the IRS distribution is more spread out (with  $\hat{\sigma} = 2.27$  and  $\hat{\mu} = -\$1,001,560$ ).

Corporate Stock.--The shapes of the IRS and FRB stock distributions are fairly similar over at least a portion of their range. The IRS distribution does rise faster than the FRB around the 60th through 90th percentiles, possibly due to some rounding by the survey respondents in their answers. The IRS mean is higher than that for the FRB and, on the whole, the IRS data are somewhat more spread out (with  $\hat{\sigma} = 1.23$  and  $\hat{\mu} = -\$59,500$ ).

Bonds.--The shapes of the IRS and FRB distributions for bonds seem very similar, although there are sizable differences in relative dispersion and in overall means. The IRS data have a much heavier tail than the FRB survey information (with  $\hat{\sigma} = 1.77$  and  $\hat{\mu} = -\$557,040$ ).

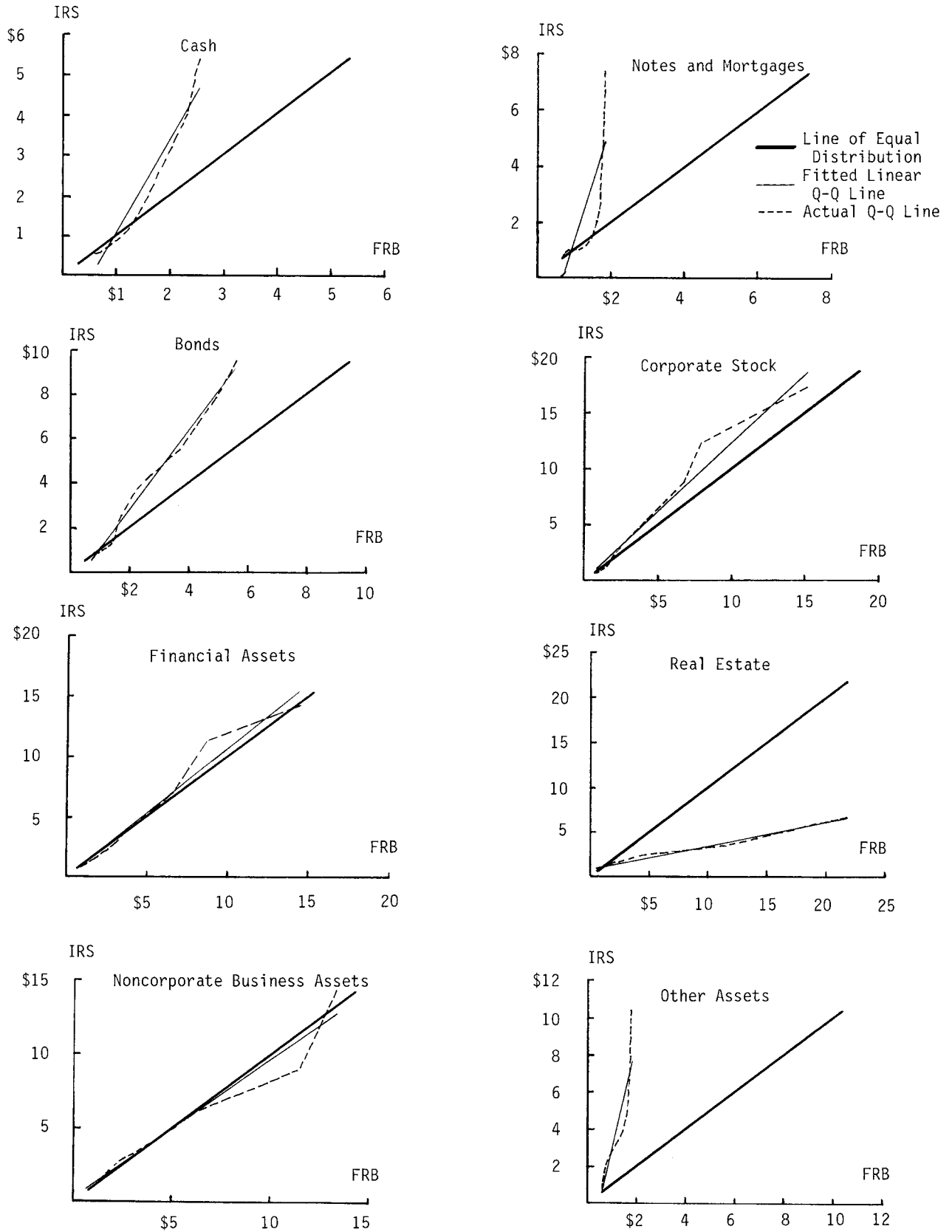
Notes and Mortgages.--Notes and mortgages are very infrequently reported in amounts of \$500,000 or more in the FRB data. The Q-Q plot, perhaps for sampling reasons, shows almost no relationship between the two possible distributions. Nonsampling errors due to misclassification of notes and mortgages as real estate are conjectured to be a factor in the survey as well. (In any event,  $\hat{\sigma} = 4.23$  and  $\hat{\mu} = -\$2,524,340$ .)

Financial Assets.--Financial assets appear quite similar in distribution between the FRB and IRS data sets. There is still a slight bow in the shape (caused by the dominance of corporate stock). Differences in the other components (bonds, cash, and notes and mortgages) tend to cancel out somewhat. The IRS and FRB distributions have nearly the same variances (with  $\hat{\sigma} = 1.01$ ) and differ in their means only slightly as well ( $\hat{\mu} = -\$47,630$ ).

Real Estate.--For all intents and purposes, the IRS and FRB distributions for real estate are identical in shape. On the other hand, they differ greatly in their means and variances (with  $\hat{\sigma} = .26$  and  $\hat{\mu} = \$649,240$ ). The IRS data source is picking up considerably less real estate overall, perhaps partly due to the possible difference in the way jointly owned property is being treated. As we noted earlier in Figure A, if 80 percent of jointly owned property is added to the IRS real estate amount, then the difference between the FRB and IRS mean shrinks from \$406,000 to about \$25,000. We have not replotted the real estate Q-Q chart to see what this change would do to the distribution as a whole, but that effort is underway.

Noncorporate Business Assets.--We were quite surprised, given the valuation issues surrounding this asset, at how close the FRB and IRS distributions came. As with corporate stock, there is a bow in the Q-Q chart (which, again,

Figure E.--Quantile-Quantile (Q-Q) Plots for Each Asset Type, Federal Reserve Board and IRS Distributions Compared (\$ in Millions)





could be due to rounding in the survey). In any event, the IRS distribution rises more quickly between the 60th and 80th percentiles (and less quickly between the 90th and the 98th percentiles). The means and variances of the two distributions are quite close (with  $\hat{\sigma} = .95$  and  $\hat{\mu} = \$100,350$ ).

Other Assets.--As with notes and mortgages, we see little similarity between the FRB and IRS distributions for this component. Ample evidence, as already noted, seems to indicate that the survey may have omitted large amounts of other assets. On the other hand, the IRS data may overstate this component, due to the inclusion of gift taxes paid within three years of death. (In any event,  $\hat{\sigma} = 5.75$  and  $\hat{\mu} = -\$2,847,000$ )

#### Other Considerations

In this section and the last, we have only touched the surface in our comparisons between FRB and IRS data. Most of what has been done can be taken as illustrative of the issues which exist and of how hard it will be to pin down any specific difference to a particular cause or set of causes.

The approach taken has been descriptive and exploratory. Detailed calculations of sampling errors from the FRB and IRS data sets remain to be carried out within the context of the comparisons made here. We originally planned to have some information on these, but time ran out on us. We now expect to report on these later.

#### 4. FUTURE PLANS

The new initiatives by the Federal Reserve Board in measuring wealth deserve complementary, cooperative developments elsewhere in the Federal statistical system. Bob Avery's work and that of his colleagues at FRB, notably Art Kennickell and Greg Elliehausen, have enormously stimulated the IRS' personal wealth estimation program based on estate tax returns. As we have seen in this paper, there are a whole host of issues that need to be studied if these two sources (and others) are to be pieced together. Various levels of integration are possible, depending on the degree to which asset definitions can be made comparable and on our knowledge (or assumptions) about the error properties of each source. We may want to mix the two data sets (and others) in different ways, depending on our analytic objectives. Factors to consider in the blending of data sources include relative response (and nonresponse) biases, response variation and, of course, differences in sample size. The research has simply not been done yet that will allow for a clear choice of approaches. There are some areas (like household and family statistics) that must be based heavily on a survey vehicle. On the other hand, heavy reliance on sources other than a survey may be essential for, say, detailed information on the aggregate wealth of individuals with net worth of \$10,000,000 or more. In between these two extremes there is a great deal of flexibility about how the multiple sources available could be used.

For example, for asset items known to be comparable between the survey and estate data and

for which the survey response variance was not too great, a post-stratification approach using a variant of raking ratio estimation [28] might be possible. For asset items known to be better reported on the estate tax returns, some form of multiple imputation or multiple statistical matching might be tried [29], where the estate tax information is "matched" into the survey. The item "other assets" might be improved on the survey by such an approach. Greenwood's work bears on this point as well [30]. Finally, estate tax return data could be employed to model the upper tail distributions of each asset type as part of an error detection and outlier protection procedure; this would certainly help to avoid the problems that arose last summer [17]. Record check studies of survey reported asset information, like those conducted in the earlier FRB work [12] seem to be needed. When anomalies are detected, correcting response error or down-weighting the cases might be viable options [31].

All of these strategies rely on the notion that what we should do with our outside information is to use it to produce adjusted microdata survey records. This may not always be desirable; for example, in the case of the very wealthy, there are likely to be just a handful of survey schedules available. Less elaborate methods could be adequate or even superior, including just tabulating the survey and estate data. For the extreme upper tail of the wealth distribution, whether of families or individuals, an explicit modelling approach seems unavoidable. Relying on just survey records, however adjusted, won't be enough; even with major improvements here, the sample of the very wealthy will still need supplementation. The important work being done by Forbes [32] in this area might be of great assistance as pointed out by McCubbin [19]. Pareto smoothing of the upper tail also shows promise and needs to be given continued attention [27].

It is possible, given the retrospective nature of the comparisons that we will never be able to completely explain the differences between the 1983 FRB and 1982 IRS wealth estimates. Nevertheless, this exercise has already been a source of several valuable conjectures that have spurred special studies of IRS wealth measurement issues. Many more of these studies are needed and we hope to undertake some of them over the next several years.

More independent work on IRS' (or FRB's) part will not be enough however. For a major advance in our understanding to occur, a tightly coordinated joint IRS-FRB effort seems essential. The proposed 1989 FRB survey of wealth offers one such opportunity, since an estate tax multiplier estimation program is also planned for that year. Within the limitations of these two measurement mediums, there are a fair number of steps that could be taken to improve our ability to align the two data sets. Reducing definitional differences in asset types would be one example. Deeper exploration of types of ownership in both sources would be another, especially for jointly owned and community property but also for partnership holdings. A better method of using an IRS frame for high income individuals seems to be another area where improved cooperation would help greatly,

provided legal restrictions on access can be properly addressed. We look forward to working cooperatively to produce better wealth estimates for 1989 and beyond.

#### AFTERWORD AND ACKNOWLEDGMENTS

All-in-all there are clearly enough challenges in the area of personal wealth estimation to fill the professional lives of the authors of this paper and their colleagues at IRS many times over. We are greatly indebted to all those who helped us in the preparation of what turned out to be an interim report on the implication of FRB-IRS comparisons for future research.

Special thanks are due to Marvin Schwartz at IRS who has labored mightily in this field for many years. The importance of the fresh insights of Bob Avery, Arthur Kennickell and their colleagues at the Federal Reserve Board has already been noted several times. Their help in preparing special tabulations of the 1983 Survey was enormous. The early mentoring of Jim Smith and Dorothy Projector deserves a special note of gratitude. They have set the standard for leadership and excellence in this area and our hope is only to follow in their footsteps. The good sense and support of Wendy Alvey and Beth Kilss must also be mentioned, along with Dan Skelly's persistence in egging us on at certain points. H. Lock Oh, as always, gave invaluable assistance. Typing support was provided by Nancy Dutton, Sheila Gray and Bettye Jamerson.

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