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REGRESSION TESTS OF THE RELATIONSHIP BETWEEN
BOOK NET WORTH AND REVISED NET WORTH OF S&L'S

BY

FREDERICK E. BALDERSTON

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Frederick E. Balderston

Working Paper 81-38

October 1981
REGRESSION TESTS OF THE RELATIONSHIP BETWEEN BOOK NET WORTH
AND REVISED NET WORTH OF S&L'S

by

Frederick E. Balderston*

In "The Structural Option for the S&L Industry" (Working Paper
No. 80-19, Center for Real Estate and Urban Economics, University of
California, Berkeley, November, 1980), I discussed the question of future
structural consolidation of the S&L industry and made projections of the
possible numbers of firms that might be absorbed, and the numbers of firms
that might do the absorbing. A critical need, which could not be addressed
in that research report, was to estimate the amount of discount from book
value of mortgage portfolios of different types of savings and loan assoc-
ations, as a means of re-interpreting the accounting data and estimating
future viability. With such information, better estimates could be made
of the numbers of firms that might be regarded as "nucleus" firms, and the
number of firms that we could expect to be absorbed in the consolidation
process.

*Professor of Business Administration, University of California,
Berkeley. This research was supported in part by the Center for Real
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University of California, Berkeley. The author is grateful for the exten-
sive professional help of programming consultant William R. Owens, for the
advice of Kenneth T. Rosen, and for data assistance from the United States
League of Savings Associations, the Federal Home Loan Bank Board, and the
Federal Home Loan Bank of San Francisco. The author is solely responsible
for the analysis and views reported here.
A significant first step was to estimate the percentage amount of portfolio discount, using the different discount rates that would be appropriate for different policy purposes. These estimates were presented in an earlier paper, "S&L Mortgage Portfolios: Estimating the Discount from Book Value" (Berkeley, Center for Real Estate and Urban Economics, October, 1981).

In the work reported here, we proceed to the next step, which is to determine whether there is a reliable predictive relationship between book net worth and revised net worth. In what follows, we shall discuss the relationship between two ratios: the ratio of book net worth to total assets, as an independent variable, and the ratio of revised net worth (after portfolio discount) to total assets. Casting the analysis in terms of these ratios enables treatment of different asset-sizes of firm in the same analytical frame.

Our purpose is to identify and calculate reliable equations for predicting the revised net worth ratio from the book net worth ratio. In what follows, it is shown that a strong general relationship between the two ratios exists, but that it is necessary to subdivide the population of S&L firms into subcategories in order to find reliable predictive equations.

1. The Data Set

The FHLBB data tape for the six-month period ending 12/31/80 had data for 4,002 insured S&L's. The U.S. League of Savings Associations conducted a survey of the portfolios of S&L's throughout the U.S., obtaining information in October 1980 on the amount of loan balance of 2,183 respondent institutions at numerous interest rate ranges. When the two tapes were compared, sample observations were discarded (a) if a U.S. League
respondent institution (by FHLBB docket number) could not be matched with an institution on the FHLBB tape, or (b) if, when matched by docket number, the data showed a gross discrepancy (25% or more) in the number of dollars of loan portfolio. The usable sample consisted of 1,919 respondent S&L's.

2. Revised Net Worth

We chose as the basis of net worth correction a discounting calculation at a discount rate of 14% out to an effective maturity of one-half the number of years to estimated full maturity for each portfolio component. This was an intermediate choice, and the motivation for it was to provide an estimate based on the putative bail-out cost to the U.S. government if an S&L had to be rescued: the 14% discount rate is the risk-free medium-term and long-term borrowing rate of the U.S. government. Using an effective maturity of one-half the full maturity results in a somewhat smaller estimated discount from book value of loan portfolio.

The discount from net worth was calculated for each individual S&L in the respondent group. The amount of discount was then subtracted from book net worth as of 12/31/80 in order to obtain revised net worth.

3. The General Relationship Between the Two Ratios

For each respondent institution, we then plotted Revised Net Worth/Total Assets against Book Net Worth/Total Assets (see Figure 1). As one would expect from other data on the S&L industry, the great bulk of the observations, from the standpoint of the Book Net Worth/Total Assets ratio, lie in the interval from 2.0% to 10.0%. The relationship of the two ratios is strongly positive, but it also shows two interesting features:

(1) nearly all of the Revised Net Worth/Total Assets ratios are less than zero; and
(2) for each value of Book Net Worth/Total Assets in the range from 2.0% to 10.0%, there is a large range of the Revised Net Worth ratio; in most cases, this is on the order of ten percentage points.

The first of these features of the relationship implies that the difficulties of the S&L industry extend to most of the firms in at least the sample, and very probably to the population of the industry as a whole. The second has a direct implication for the policy-maker: it is dangerous to use a low value of book net worth as the main trigger of regulatory concern. Inspection of Figure 1 reveals that a high ratio of book net worth to total assets (in the 8% to 10% range) can be associated with a RNW/TA ratio of anywhere from 0% to -15%. The correction of discounting the loan portfolio is important to provide an indicator worthwhile for policy interventions.

In a regression model, the following equation was estimated:

$$\text{RNWTA} = a_1 + a_2 \text{ NWTA} + a_3 \text{ STOCK}. $$

(The computer program calculated parameter values in a normalized model.)

Here are the values of the parameters and their T-values:

$$a_1 = -170.92$$
$$a_2 = +1.06057; 57.42358$$
$$a_3 = +6.05189; 7.61874$$

The scales of the variables were:

RNWTA and NWTA, in tenths of a percent, so that a value of 100.0 means 10.00%.

STOCK, a value of this dummy variable of +1.0 means that the firm in question is a stock company; a value of -1.0 means that it is a mutual.
The mean values of the variables, over the entire sample, were:

NWTA 58.6609
STOCK  -0.7394
RNWTA -113.1810

The coefficient of determination of the regression is 0.64, implying that approximately two-thirds of the variance of the Revised Net Worth to Total Assets ratio is explained by the equation. As the T-values show, both of the independent variables are significant. The parameter of STOCK is positive, implying that stock companies held their revised net worth ratios a bit better than did mutuals, other things being equal. The parameter of NWTA, at a value of 1.06057, implies that for each rise of 0.1% in book NWTA, there is a rise of 0.106% in RNWTA. We have calculated the intercept from the overall data, though the regression model was run with FHLB districts as individual groups. The negative intercept, of course, implies that if both independent variables were zero, the RNWTA value would be \(-17.092\)\%.

By FHLB district, the numbers of respondent firms and their group means of RNWTA were as follows:

<table>
<thead>
<tr>
<th>FHLB District</th>
<th>No. Firms in Sample</th>
<th>District Mean, RNWTA (in percentage x 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>50.</td>
<td>-108.53979</td>
</tr>
<tr>
<td>D2</td>
<td>117.</td>
<td>-126.95683</td>
</tr>
<tr>
<td>D3</td>
<td>134.</td>
<td>-103.62636</td>
</tr>
<tr>
<td>D4</td>
<td>348.</td>
<td>-122.50453</td>
</tr>
<tr>
<td>D5</td>
<td>262.</td>
<td>-109.48763</td>
</tr>
<tr>
<td>D6</td>
<td>125.</td>
<td>-104.42361</td>
</tr>
<tr>
<td>D7</td>
<td>249.</td>
<td>-116.21594</td>
</tr>
<tr>
<td>D8</td>
<td>158.</td>
<td>-114.80321</td>
</tr>
<tr>
<td>D9</td>
<td>231.</td>
<td>-117.73087</td>
</tr>
<tr>
<td>D10</td>
<td>104.</td>
<td>-114.14883</td>
</tr>
<tr>
<td>D11</td>
<td>81.</td>
<td>-88.24664</td>
</tr>
<tr>
<td>D12</td>
<td>60.</td>
<td>-89.43311</td>
</tr>
</tbody>
</table>
As the above table shows, there are very considerable differences by FHLB district. The regression model reported above was run, however, over the entire sample. (Separate regressions by FHLB district are examined below in order to determine whether the regression coefficients are appreciably different between districts.) These differences in the mean value of RNWTA by FHLB district are great enough to call for concentrated policy attention to those districts having the lowest mean values.

We may conclude this overview with a few summary comments.

(1) The ratio of revised net worth to total assets is successfully predicted by the regression model and the relationship is strong.

(2) For any given book net worth to total assets ratio in the relevant range of NWTA, the range of RNWTA from lowest to highest is approximately ten percentage points, as Figure 1 shows. The strength of the overall relation does not mean that book NWTA always discloses the true situation of the individual firm.

(3) In general, a savings and loan association had to be an heroic exception to have a non-negative ratio of revised net worth to total assets. Very new firms, often stock companies, might have highly positive ratios; but history drags down almost all others.

4. Partition of the Sample into 20 Groups, by Separating Stock Companies from Mutuas in Each District Containing Both

We may explore in this section whether the regression equation is significantly different when stock companies are separated from mutuals in each FHLB district. The following districts had no stock companies in
the U.S. League sample: District 1 (Boston); District 2 (New York); District 3 (Pittsburgh); and District 8 (Des Moines). All districts contained some mutual firms. The twenty groups (eight stock-and-district groups, S4-S12, and twelve mutual-and-district groups, M1-M12) are summarized in Table 1, by number of firms per group and by the group means of book net worth to total assets: (NWTA) and revised net worth to total assets (RNWTA).

Table 1
Net Worth Ratios, 20 Groups of S&L's

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Firms</th>
<th>RNWTA</th>
<th>NWTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4</td>
<td>28.</td>
<td>-100.57135</td>
<td>61.2856</td>
</tr>
<tr>
<td>S5</td>
<td>40.</td>
<td>-101.14984</td>
<td>61.8249</td>
</tr>
<tr>
<td>S6</td>
<td>2.</td>
<td>-118.00000</td>
<td>48.5000</td>
</tr>
<tr>
<td>S7</td>
<td>19.</td>
<td>-126.05257</td>
<td>43.3684</td>
</tr>
<tr>
<td>S9</td>
<td>86.</td>
<td>-109.96481</td>
<td>56.0695</td>
</tr>
<tr>
<td>S10</td>
<td>18.</td>
<td>-109.44438</td>
<td>61.4999</td>
</tr>
<tr>
<td>S11</td>
<td>46.</td>
<td>-71.67374</td>
<td>77.7172</td>
</tr>
<tr>
<td>S12</td>
<td>11.</td>
<td>-24.72726</td>
<td>103.4545</td>
</tr>
<tr>
<td>M1</td>
<td>50.</td>
<td>-108.53979</td>
<td>51.7998</td>
</tr>
<tr>
<td>M2</td>
<td>117.</td>
<td>-126.95683</td>
<td>53.7773</td>
</tr>
<tr>
<td>M3</td>
<td>134.</td>
<td>-103.62636</td>
<td>63.6935</td>
</tr>
<tr>
<td>M4</td>
<td>320.</td>
<td>-124.42386</td>
<td>56.5396</td>
</tr>
<tr>
<td>M5</td>
<td>222.</td>
<td>-110.99023</td>
<td>62.0713</td>
</tr>
<tr>
<td>M6</td>
<td>123.</td>
<td>-104.20288</td>
<td>65.5768</td>
</tr>
<tr>
<td>M7</td>
<td>230.</td>
<td>-115.40350</td>
<td>57.4514</td>
</tr>
<tr>
<td>M8</td>
<td>158.</td>
<td>-114.80321</td>
<td>54.1387</td>
</tr>
<tr>
<td>M9</td>
<td>145.</td>
<td>-122.33745</td>
<td>53.3443</td>
</tr>
<tr>
<td>M10</td>
<td>86.</td>
<td>-115.12761</td>
<td>57.8486</td>
</tr>
<tr>
<td>M11</td>
<td>35.</td>
<td>-110.02846</td>
<td>61.0856</td>
</tr>
<tr>
<td>M12</td>
<td>49.</td>
<td>-103.95898</td>
<td>58.1223</td>
</tr>
</tbody>
</table>

The regression equation for the 20-group model is:

\[ \text{RNWTA} = a_1 + b \times \text{NWTA} \]

or,

\[-113.1811 = -174.8133847 + 1.05065 \times 58.6611.\]
Remembering that the percentage values of the net worth ratios are multiplied by ten, this means that the intercept value is \(-17.48\%\) and that each 0.1% change in book net worth ratio implies a change of 0.105065% in the revised net worth ratio. The coefficient of determination for the equation is 0.6274, which again means that approximately 63% of the variance is accounted for by the equation.

When we test for the equality of slopes between groups, however, the F-ratio test has a value of 16.4377, which means that we can conclusively reject the hypothesis that the slopes are the same.

5. A Pooled Regression Equation for All Stock Companies

Now we compare the eight groups consisting of stock companies. (In the summary just given, these are the eight cases, \(S_4 - S_7, S_9 - S_{12}\).) One group, \(S_6\), has just two cases and should be ignored.

The regression equation, pooling all eight groups, is:

\[-97.9557 = -184.06027 + 1.36657 \times 63.0078.\]

The regression coefficient for the slope has a standard error of 0.03319 and a T-value of 41.17194, so that we can have quite reasonable confidence in it. The coefficient of determination for the equation is 0.875525, indicating that 87% of the total variance is accounted for.

When the slope coefficients are calculated for all eight groups, we test for the hypothesis that there is no significant difference between the slopes. The F-ratio test has a value of 1.1229, so we do not reject the hypothesis that the slopes are insignificantly different from one another. Thus, it would be feasible to simply use the pooled regression equation to predict the revised net worth ratio from the book net worth ratio of stock companies in all FHLB districts.
We should also note, however, that the group means of the Revised Net Worth to Total Assets ratio for the Stock-Company groups are very different for the eight districts, ranging from -2.472726% (in District 12) to -12.605257% (in District 7). (See Table 1.) These group means can be used as a basis for comparing at the various FHLB districts in order to determine where to look for significant problem cases.

6. Regression Equations for Mutuals, District by District

Turning to the twelve groups of mutual S&L's (one group for each district, M^1 through M^{12} in Table 1), we find a different result.

When all twelve groups are pooled, the regression coefficient is 0.80883; it has a standard error of 0.02224 and a T-value of 36.096. The hypothesis that the individual slope coefficients for the twelve groups are the same is decisively rejected, as the F-ratio is 4.4157.

The pooled regression equation is:

\[-115.4617 = -162.38185 + 0.80883 \times x 58.0099.\]

Its coefficient of determination is 0.443944, indicating that only about 44% of the total variance is explained by the pooled regression equation.

The individual regression coefficients are given in Table 2.

By using the specific regression equation for each district that is given by the intercept and slope coefficient indicated above, it is possible to predict the revised net worth ratio of a mutual S&L located in a given district more accurately than could be done by using the pooled regression equation. However, the equations explain less than one-half of the variance in six districts, and two-thirds or more of the total variance in only one.
Table 2

Regression Coefficients, Mutual S&L's, by FHLB District

<table>
<thead>
<tr>
<th>District (mutual firms only)</th>
<th>Intercept (percent X 10)</th>
<th>Slope</th>
<th>Coefficient of Determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-144.1781</td>
<td>0.6880</td>
<td>0.2957</td>
</tr>
<tr>
<td>2</td>
<td>-162.6113</td>
<td>0.6330</td>
<td>0.1405</td>
</tr>
<tr>
<td>3</td>
<td>-144.0906</td>
<td>0.9493</td>
<td>0.6203</td>
</tr>
<tr>
<td>4</td>
<td>-172.1603</td>
<td>0.8443</td>
<td>0.5512</td>
</tr>
<tr>
<td>5</td>
<td>-163.3535</td>
<td>0.8436</td>
<td>0.5020</td>
</tr>
<tr>
<td>6</td>
<td>-173.8389</td>
<td>1.0619</td>
<td>0.7064</td>
</tr>
<tr>
<td>7</td>
<td>-168.2703</td>
<td>0.9202</td>
<td>0.5433</td>
</tr>
<tr>
<td>8</td>
<td>-143.2152</td>
<td>0.5248</td>
<td>0.2097</td>
</tr>
<tr>
<td>9</td>
<td>-153.4746</td>
<td>0.5837</td>
<td>0.2341</td>
</tr>
<tr>
<td>10</td>
<td>-158.6529</td>
<td>0.7524</td>
<td>0.5824</td>
</tr>
<tr>
<td>11</td>
<td>-145.5131</td>
<td>0.5809</td>
<td>0.4044</td>
</tr>
<tr>
<td>12</td>
<td>-147.5631</td>
<td>0.7502</td>
<td>0.4356</td>
</tr>
</tbody>
</table>


In general, as can be seen by inspecting Table 1, the twelve groups of mutuals have lower average book net worth to total asset ratios than did the stock companies. The slope coefficients of the regression equations for the mutuals are smaller—in all but one case, less than unity. Thus, a change of 0.1% in the book net worth ratio implies a less than 0.1% change in the revised net worth ratio for mutual firms in eleven FHLB districts, and only slightly more than 0.1% in the remaining district (District 6). There appear to be several clusters of cases among the twelve districts:

- Districts 3,4,5,6,7: all have slope coefficients well above 0.8;
- Districts 1,2,10,12: have slope coefficients between 0.6 and 0.8;
- Districts 8,9,11: have slope coefficients below 0.6.

Intercept values also vary considerably, as is evident from the "Intercept" column of Table 2; the range is from -14.42% to -17.38%
(remembering that Table 2's intercept values are percentages multiplied by 10).

It is not possible from the data at hand to say whether the differences in these regressions are caused by differences in past lending conditions in the various FHLB districts, or differences in the age of firms (which, in the case of mutuals, has a strong influence on the book net worth they can have accumulated) or other causes. But there it is: a well-defined, statistically-significant set of differences in regression values, but a discouragingly large proportion of unexplained variance in most FHLB districts.

7. Implications of the Results

All of the regression results show a negative intercept and a positive slope: that is, the revised net worth to total assets ratio is strongly negative if the book net worth to total assets ratio is approximately zero, and for each one percent increase of the book net worth ratio, there is an increase of more than one percent of the revised net worth ratio for stock companies, and generally less than one percent for mutuals.

Not only does the industry as a whole display significant difficulties, as shown by the overall regression equation for the industry as a whole, and the pooled regression equation for all twenty groups, but where separate equations are found to be more useful as predictors, their message is different from the overall message only in degree.

The policy maker who wishes to estimate the revised net worth to total assets ratio in any given case has available, from the above equations, a straightforward estimation method. If the firm in question is a
stock company, the single pooled equation for all stock companies can be used and is shown to be quite reliable. If the firm is a mutual, then the district equation pertinent to that firm could be used to predict the revised net worth ratio, in preference to a pooled model for all mutual firms. However, the regression equations are not reliable predictors for mutual firms in any FHLB district. The policy maker should therefore obtain a direct estimate of the amount of portfolio discount for the mutual firm in question in order to obtain the revised net worth to total assets ratio for that firm.

In all cases, it should be recalled, a discount rate of 14% (the Federal government's default-free long-term rate of interest) has been used, and we have assumed that loans will stay on the books to one-half of estimated full maturity. (See Balderston, 1981.) If the analyst challenges these assumptions, or if conditions change, then the predictive equations would of course need to be recalculated accordingly.

References


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<tr>
<td>80-18</td>
<td>Stuart A. Gabriel and Jennifer R. Wolch</td>
<td>&quot;Local Land-use Regulation and Urban Housing Values.&quot;</td>
<td>November 1980.</td>
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<td>80-21</td>
<td>Konrad Stahl</td>
<td>&quot;Oligopolistic Location under Imperfect Consumer Information.&quot;</td>
<td>December 1980.</td>
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<td>David E. Dowall and John Landis</td>
<td>&quot;Land-Use Controls and Housing Costs: An Examination of San Francisco Bay Area Communities.&quot;</td>
<td>March 1981.</td>
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