

The Usefulness of Financial Ratios as Predictors of Household Insolvency: Two Perspectives

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The purpose of this study was to examine the usefulness of financial ratios as predictors of household insolvency. Financial ratios were developed for 1,934 households using data from the Survey of Consumer Finances. Two statistical methods---logistic regression and a classification tree procedure (CART)---were used for analysis. The 1983 Liquidity ratio was the most important predictor of 1986 insolvency according to the logistic regression while the 1983 Assets/Liabilities ratio was the most important variable in the classification tree. The Gross Annual Debt Payments to Disposable Income ratio was second in importance for each of the two methods. Implications for financial educators, counselors, and planners are offered.

KEY WORDS: *insolvency, financial ratios, classification tree*

Introduction

As families seek to improve the management of their economic resources, a logical first step is to determine their present financial position, e.g., net worth (Prather, 1990). Most text books suggest that preparation of a balance sheet or net worth statement should be accomplished on an annual basis. Although professionals such as Certified Public Accountants, insurance brokers or investment advisors may calculate ratios from a balance sheet, a family is unlikely to do more than calculate net worth. A seminal work by Griffith (1985) suggested that there was much more information to be gleaned from the balance sheet than just the bottom line. Even though there has been limited empirical research using financial ratios for households, a number of family economists believe that financial ratios should be

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used to analyze and interpret personal financial statements (Griffith, 1985; Lytton, Garman & Porter, 1991; Mason & Griffith, 1988; Prather, 1990; Prather & Hanna, 1987). The growth in personal debt and decline in household savings rates during the 1980s makes investigation of methods for analyzing family financial status more important than ever.

Financial Ratios

A study using financial ratios in the 1930s and several later studies were concerned with business failure (Altman, 1971). It was ascertained that failing firms exhibited significantly different ratio measurements than businesses which were successful. Historical accounts specifically cite the use of ratios in predicting bankruptcy. Overall, the ratios which measure profitability, liquidity, and solvency have prevailed as the most useful indicators for business. According to Ketz, Doogar and Jensen (1990), financial ratio analysis is frequently used: (a) to compare a present ratio with past and expected future ratios for the same company or firm, and (b) to compare one firm with those of similar firms or with industry averages at some point in time.

According to several authors (DeVaney, 1993; Fanslow, 1994; Griffith, 1985; Hanna, Chang, Fan & Bae, 1993; Johnson & Widdows, 1985; Langrehr & Langrehr, 1989; Lytton, Garman & Porter, 1991; Mason & Griffith, 1988; Prather, 1990; Prather & Hanna, 1987), household financial ratio analysis could be used: (a) as an objective measure of analysis of family finances, (b) as a measurement of change in financial progress over time, and (c) as a tool for financial educators, counselors, and planners to make recommendations to families. For example, the use of ratios to determine trends such as increasing levels of debt or increased savings may be particularly important to families when the economy is uncertain. Moreover, a family and the family's financial advisor may want to know more than which two items to compare. Some guidelines for comparison would be more informative than the ratio itself, e.g., the Consumer Debt ratio indicates the portion of disposable income committed to the payment of debt and, therefore, not available for savings or other purposes. Financial practitioners caution that families with a 16 to 20% ratio of consumer debt to disposable income are fully extended and that a ratio value less than 15% is preferred (Garman & Fogue, 1991, p. 237). Further, it would be useful to know whether several ratios should be used simultaneously to measure household financial status.

USEFULNESS OF FINANCIAL RATIOS AS PREDICTORS OF HOUSEHOLD INSOLVENCY

Following a study using the 16 ratios suggested by Griffith (1985) with 1983 Survey of Consumer Finance data, Prather and Hanna (1987) suggested household norms for several of the ratios. They concluded that 5 of the 16 ratios were the most useful. According to Prather and Hanna, 4 of the 5 most useful ratios were a comparison of liquid assets to another value on the balance sheet or cash flow statement, i.e., monthly expenses, liabilities, non-mortgage debt, or short-term debt. The fifth ratio was a comparison of equity assets (excluding the home) to net worth.

In a study of perceived household financial security, Iwuagwu (1989) included ratios from the Prather study as independent variables. The results showed that the Liquidity ratio, an Inflationary Hedge ratio, and the Liquid Assets/Consumer Debt ratio were predictors of perceived financial security. However, different numbers of cases were used in Iwuagwu's analysis due to missing data so caution should be used in interpreting the results.

Although Lytton et al. (1991) strongly recommended the use of guidelines with financial ratios, they did not provide empirical evidence of their usefulness. In a descriptive study using Survey of Consumer Finance data, DeVaney (1993) compared the percentage of households which met the financial ratio guidelines in each of the two years, 1983 and 1986. The most noticeable trend was the increase in the ratio for both of the Consumer Debt/Income and Shelter Debt/Income ratios between 1983 and 1986. However, that study did not test the predictive value of financial ratio guidelines.

In a longitudinal study (1982, 1986, and 1991) of 84 household money managers, Fanslow (1994) found that over time a higher proportion of families met a criterion for allocating at least 25% of net worth to investment assets (48.8% in 1982 compared to 72.6% in 1991). However, the proportion of families able to meet the criterion of holding liquid assets comparable to 3 months of expenses declined from 53.6% in 1986 to 40.5% in 1991. Fanslow noted that 14% of the families consistently had no debt during the period. In contrast, families whose debt load increased may find it harder to establish credit and pay off credit card debts, auto loans, or other debts. The level of emergency funds is particularly relevant during recessionary periods. Using the broadest measure of emergency funds and the Survey of Consumer Finance data collected in 1983, Johnson and Widdows (1985) found that only 19% of households had

liquid savings sufficient to cover six months of pretax income. Similar findings were reported by Hanna et al. (1993) using 1990 Survey of Consumer Expenditure data from the Bureau of Labor Statistics. The percent of complete income reporters having sufficient liquid assets to cover six months of pretax income was 19%. However, several authors point out that the criterion of needing a six months reserve can vary according to the individual's financial situation.

Insolvency

The concept of a "going concern" offers a distinction between business and the household relative to financial solvency. Businesses which become insolvent have an indefinite future. The dissolution of an insolvent household is not a viable alternative; the individual or family must continue to function as a social and economic unit.

A generally accepted definition of insolvency is having liabilities in excess of the market value of assets (**Bankruptcy Code, Rules and Forms**, 1993, p. 101). Becker (1992) defined insolvency in the equity sense (not paying debts as they mature) or in the bankruptcy sense (when net assets at fair market value are less than liabilities). Gitman and Joehnk (1991) stated:

If net worth is less than zero, the family is technically insolvent. While this form of insolvency does not mean the family will end up in bankruptcy proceedings, it does reflect the absence of adequate financial planning (p. 49).

The decade of the 1980s has been referred to as a "decade of debt" by many policy observers. Total public debt nearly tripled from 1980 to 1990 while personal debt increased by 79%. In contrast, real personal assets rose by only 36% from \$15.5 to \$21.1 trillion during the decade (**Balance Sheets of the U.S. Economy**, 1991, pp. 19-24). Some observers suggest that consumers simply followed the lead of the public sector. In addition, they implied that the growth in debt reflected a change in basic human nature---that Americans had become engaged in the mindless pursuit of having "more". Media attention appeared to focus on the "debt problem". In 1991, more than 120,000 media reports cited debt, a fourteen-fold increase in citations in 11 years (McKenzie & Klein, pp. 14-15).

Indeed, the filing of consumer bankruptcies has soared in recent years. There were about 410,000 bankruptcies in 1980, more than double the 1970 level of 188,000 (Dunkelberg, 1982, p. 16). In 1992, the number

of bankruptcy filings reached a record high of 977,478. Since then the number of filings has declined slightly (Singletary, 1993). The increased bankruptcy filing rate generated concern among creditors, legislators, and regulators responsible for laws governing the bankruptcy process. Studies by Sullivan, Warren, and Westbrook (1989) and Bhandari and Weiss (1993) have shown that a high level of debt to income is an important factor for many who file for bankruptcy.

Conceptual Framework

The results of previous research suggest that making a comparison of a financial ratio to a guideline could be a useful predictor of household insolvency. However, it is not clear if some ratios are more useful than others or whether the ratios should be used in combination. Although socio-economic factors have also been suggested as predicting insolvency and/or the decision to file for bankruptcy (Shepard, 1984; Sullivan et al., 1989), this study focused only on the financial ratios and guidelines in an attempt to answer the research question of whether financial ratios and guidelines could be utilized to predict insolvency.

In this study, household insolvency was defined as the household having net worth less than one month's income. Although zero or negative net worth may be a more accurate description of the tendency toward insolvency (Becker, 1992; Gitman & Joehnk, 1991), this interpretation assumed that a low level of net worth relative to income was an indicator of insolvency. For example, an individual or family needs to hold a balance in their checking account and cash to handle normal transactions. In this study, two statistical methods were utilized to analyze the usefulness of financial ratios and guidelines and then the results were compared.

Methodology

Data Set

The sample used for analysis was from a public use tape of financial data collected for the 1983 and 1986 Survey of Consumer Finances (SCF) by the Survey Research Center (SRC) of the University of Michigan's Institute for Social Research (Avery & Elliehausen, 1988; Avery & Kennickell, 1988). In 1983, the SCF collected data on the assets and liabilities of a nationally representative sample of U.S.

households through in-person household interviews. The 1986 wave of the SCF re-interviewed 1983 survey respondents by telephone. For this study, respondents who had been part of a non-probability sample of high-income households in 1983 were deleted. Avery, Elliehausen and Kennickell (1987, p. 775) recommended that households headed by a person aged 24 or less should be excluded from most analysis because the 1986 survey under-sampled new households in the under-25 age group. Respondents who had retired from full time employment were excluded. After deleting the high income sample, the retirees, and those households headed by a person aged 24 or less, a sample of 1,934 respondents remained.

Dependent Variable

The dependent variable was insolvency which was defined as the household having net worth less than one month's income. If net worth was less than one month's income in 1986, the variable was coded as 1.0 for insolvency, else the variable was coded as 0.0 for solvency.

Independent Variables

The financial ratios and guidelines used in this study were based on the review by Lytton et al. (1991). These ratios tended to use Total or Disposable Income for comparison because households typically use income as a reference point. Many of the ratios in previous studies have used net worth as the denominator. However, a value of zero in the denominator leads to computational problems. Also, the amount of income is more readily known than the value of net worth. The condition of meeting the guideline for each ratio was coded as 1 if the guideline for the financial ratio was met and 0 otherwise. The financial ratios, the suggested guidelines, and the components of the ratios are described below.

Total Assets/Total Liabilities The Solvency ratio is a broad measure of a household's overall financial position. The guideline was stated that if the ratio yielded a number greater than one, the household was solvent; if otherwise, the household was technically insolvent.

In such situations, current income may be adequate to pay current bills, but liquidating all assets would not yield sufficient funds to pay all outstanding debts (Lytton et al., 1991, p. 18).

Total Assets were defined as real assets plus paper assets. Real assets included the home, other properties, business assets, and vehicles. Paper assets consisted of stocks, mutual funds, bonds,

checking and savings accounts, money market accounts, dollar cash value of life insurance, IRAs and Keogh accounts. Total liabilities consisted of total real estate debt and credit card debt, consumer loans, and non-regular payment outstanding debt.

Liquidity Ratio or Liquid Assets/Disposable Income Liquid assets were defined as cash or cash-equivalent assets that could be converted for immediate use with little or no loss in value. In a standard liquidity ratio, monthly consumption expenses are typically used in the denominator. In this study, disposable income was used as a proxy for monthly expenses. It was anticipated that, in most instances, monthly income would be larger or slightly larger than monthly expenses. This ratio reveals the number of months a family could meet its expenses after a loss of income. Mason and Griffith (1988) and Winger and Frasca (1993) suggest that a reasonable value for this ratio would be between 3 and 6, i.e. liquid assets should be equal to 3 to 6 months of expenses. The guideline used in this research was that if the Liquidity ratio yielded a value greater than 0.25 (1/4 of a year or 3 months), the household was reasonably prepared for emergencies such as a temporary job loss.

All paper assets except IRAs and Keogh accounts were included in liquid assets. Disposable income was calculated by deducting amounts for Social Security and federal income tax from adjusted gross income. Federal income tax was calculated using marital status, age of children, and household size, based on the assumption that all households used the appropriate standard deduction. Thus, disposable income was underestimated for most households using itemized deductions. According to the U.S. Bureau of the Census (1992, p. 326), about 39% of individual income tax returns had itemized deductions in 1985.

Annual Consumer Debt Payments/Disposable Income The consumer debt ratio indicates the portion of disposable income committed to the payment of debt and, therefore, not available for savings or other purposes. Financial practitioners caution that families with a 16 to 20% ratio of consumer debt to disposable income are fully extended (Garman & Fogue, 1991, p. 237). The guideline used for this study was that the relationship of consumer debt to disposable income should be less than 15%. Annual Consumer Debt Payments consisted of credit card debt, outstanding installment loan balances, and line of credit loans. Outstanding loan balances consisted of loans for home

additions and repairs, vehicles, furniture, recreation, education, travel, medical, and investment loans.

Annual Shelter Costs/Total Income The shelter expenses ratio indicates the portion of income going to housing. According to the Federal Home Loan Mortgage Corporation, Shelter Expense should not exceed 28% of gross monthly income (Winger & Frasca, 1993, p. 257). Lytton et al. (1991) compare housing expenditure to disposable income and suggest that a housing expense ratio in the range of 30 to 40% should be manageable. This research used the comparison to total income and a ceiling value of 28% for the guideline. Annual Shelter Costs include rent or mortgage and a maintenance fee for homeowners. The annual maintenance fee was calculated by multiplying the current market value of the home (Avery & Kennickell, 1988, p. 122) by 3% (Lindamood & Hanna, 1979). Although the cost of maintenance of the home can vary from year to year, inclusion of an estimate for maintenance insures that the true cost of home ownership is taken into consideration.

Gross Annual Debt Payments/Disposable Income The Gross Annual Debt ratio (Consumer Debt Payments plus Shelter Costs) examines the portion of disposable income going towards debt payment. To avoid a distortion of the ratio by leaving out renters, rent payment was used for renters and mortgage payment and maintenance cost were used for home-owners. According to Garman and Fogue (1991), the ratio of Gross Annual Debt Payments (Shelter plus Consumer Debt) to Disposable Income should not exceed 40% (p. 95). Lytton et al. (1991) suggest a value between 30 and 35%. Winger and Frasca (1993) suggest a value of 3.0 or better when the ratio is stated as disposable income to debt service, which is equivalent to a Gross Annual Debt Payments to Disposable Income ratio being no more than 33%. Annual Shelter Costs and Annual Consumer Debt Payments were summed to yield Gross Annual Debt Payments. The guideline used was that a household's value for this ratio should be less than 35% to be considered as having a good standing.

Insolvency, the dependent variable, is dichotomous and qualitative in nature. A logistic regression analysis can take into account the binary nature of the dependent variable.¹ The logistic procedure produces parameter results that can be used to produce predicted probabilities for any combination of values of the independent variables.²

A second statistical method, a classification tree, was also used to help determine the usefulness of financial ratios as predictors of insolvency. CART (Classification and Regression Trees) is a specialized statistical software package which has the formation of a classification tree as one of its main purposes. The goal of classification is to sort observations into two or more pre-specified classes with the emphasis on deriving a classification rule which can be used to optimally assign a new observation to one of the pre-specified classes³ (Johnson & Wichern, 1992).

Findings

Descriptive Statistics

Descriptive statistics are presented in the Appendix. The typical household consisted of three persons and was headed by a person who was 44 years old. Two-thirds of the respondents were married. Over three-fourths of the sample were white. More than two-fifths had some college or a college degree but one-fifth had not completed high school. All dollar values were adjusted to 1986 dollars. The mean income in 1983 was \$30,009. By 1986, the average income had increased slightly to \$31,333. The average amount of Total Debt increased from \$19,497 in 1983 to \$22,894 in 1986. In contrast, the average for Net Worth had increased from \$86,964 in 1983 to \$109,352 in 1986. About 7% of the sample were insolvent in 1986, having net worth less than one month's income.

T-Tests

If one know only one piece of information about a household, knowing either whether the household met the Liquidity Guideline or whether the household met the Total Assets/Total Liability Guideline would be the most useful single pieces of information. Table 1 shows the 1986 Insolvency rates by whether or not households met each of the guidelines in 1983, and t-tests for whether the differences in rates were statistically significant. Those who met the Total Assets/Total Liability Guideline in 1983 had a mean Insolvency rate in 1986 of 3.8%, compared to 32.5% for those who did not meet the guideline, so those who did not meet the guideline were almost 9 times as likely to be insolvent as those who did meet the guideline. Those who met the Liquid Assets Guideline in 1983 had a mean Insolvency rate in 1986 of 1.1%, compared to 14.7% for those who did not meet the guideline, so those who did not meet the guideline were 13 times as likely to be

insolvent as those who did meet the guideline. Neither the Gross Debts/Disposable Income Guideline nor the Consumer Debts/Disposable Income Guideline significantly differentiated the 1986 Insolvency rate. The Shelter/Disposable Income Guideline significantly differentiated the 1986 Insolvency rate, but the difference was small, with those meeting the guideline having a mean 1986 Insolvency rate of 4.2%, compared to 6.6% for those who did not meet the guideline.

Table 1
T-tests for Propensity for Insolvency: Net Worth < 1 Month's Income in 1986 by Whether Met Each Guideline in 1983

Variable	Mean Insolvency Rate in 1986		Significance
	Met Guideline	Did Not Meet	
Total Assets/Total Liability	0.038	0.325	0.0001
Liquid Assets/Disposable Income		0.011	0.147
			0.0001
Gross Debts/Disposable Income	0.050	0.067	0.1123
Consumer Debts/Disposable Income		0.060	0.065
			0.2812
Shelter/Total Income	0.042	0.066	0.0001

Logistic Regression

The financial ratios were entered into the logistic regression as dichotomous variables, i.e., the value of the ratio for each household was compared to the suggested guideline for the ratio. Each variable was coded as a one if the household met the guideline and coded as a zero, if otherwise. A negative relationship indicated that there was increased likelihood in the odds of becoming insolvent for households who were unable to meet the guidelines, all else equal. The relationship between the dependent variable and the financial ratio guideline was expected to be negative.

The predictive power of the model as indicated by the concordant pairs was 75% (Table 2 on page 15) which suggests that 1986 insolvency status can be accurately predicted for 75% of the households, just based on information on whether each household met the three guidelines in 1983. The threshold of goodness of fit as measured by the concordant ratio is 50% (Amemiya, 1981). Three of the guidelines were statistically significant predictors of insolvency: Liquidity (Liquid Assets to Disposable Income), Gross Annual Debt Payments to

Disposable Income, and Total Assets to Total Liabilities. When the standardized coefficients were ordered according to magnitude, the coefficient for the Liquidity guideline was by far the largest, suggesting that this was the most important predictor. The second largest coefficient was for the Gross Annual Debts/Disposable Income guideline while the Assets/Liabilities guideline coefficient had the third largest value.

When the logistic regression coefficients were converted to probabilities, it was possible to interpret the effect of a unit change in the coefficient as the predicted probability of a change in the dependent variable (Figure 1 on page 16). All other things equal, not meeting the guideline for the Liquidity ratio was associated with a *five-fold* increase in the probability of being insolvent (16% compared to 3%). For families who met the guideline for Gross Annual Debt Payments compared to Disposable Income, the probability of insolvency was 5% compared to 18% (more than a *three-fold* increase) for those who did not meet the guideline, at the mean of other variables. The effect of the Total Assets/Total Liability guideline was a *three-fold* increase in the risk of becoming insolvent (20% compared to 6%).

Table 2
Logistic Regression Results, Propensity for Insolvency: Net Worth < 1 Month's Income

Variable	Estimate	Standard Error	Standardized Estimate
Total Assets/Total Liability	-1.3407***	0.2182	-0.2154
Liquid Assets/Disposable Income	-1.8251***	0.2774	-0.5025
Gross Debts/Disposable Income	-1.3842***	0.1993	-0.3148
Pseudo R ² = 0.2753		Concordant Pairs 75.2%	

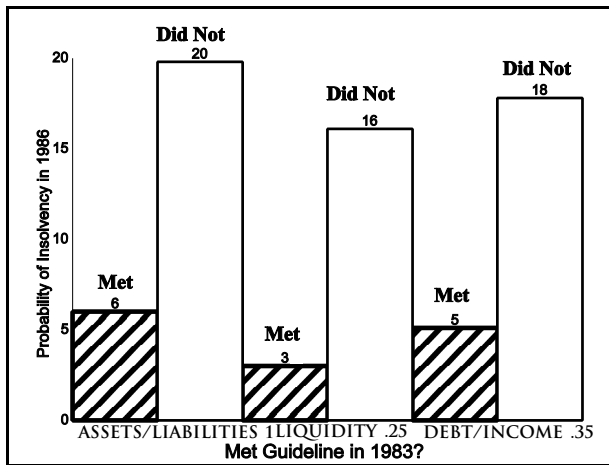
* p < .05 ** p < .01 *** p < .001

In summary, households who would be most likely to be insolvent were those who met one or more of the following conditions: Liquid Assets were less than one-fourth of their Disposable Income, Annual Payments for Housing and Consumer Debt were larger than 35% of their Disposable Income, and Total Assets were less than Total Liabilities. The differences for the Liquidity guideline and the Total Asset/Total Liability guideline were less than those discussed for the t-

tests, because it was assumed that the other guidelines were at the sample means.

Table 3 on page 17 shows the predicted 1986 insolvency rates for various combinations of the three significant guidelines. The most extreme contrast is between those who met none of the three guidelines, with a predicted insolvency rate of 66%, and those who met all three guidelines, with a predicted rate of 2%. Knowing that a household met two guidelines but did not meet one of the other guidelines provided little predictive power for future insolvency. Knowing that a household did not meet any two of the guidelines meant that future insolvency was fairly likely (24-33%.)

Figure 1
 Predicted Probability of Insolvency in 1986, Based on Whether Each Guideline Met in 1983 (n=1,934).



Based on logistic regression in Table 1. For each guideline, the predicted effect was based on the assumption that the other two guidelines were at the mean values for the sample.

Classification Tree

The Classification Tree procedure (CART) was run using a test sample for estimation of the misclassification rate. The test sample was drawn randomly by CART; it consisted of 1/3 of the total cases (Neville, 1988). The class prior probabilities were set at equal percentages which allowed each future case a 50% chance of being classified as having a propensity for insolvency. According to Krzanowski (1977), using the classification tree will be better than a random classification into two groups of insolvent and solvent because the misclassification rate was less than 50%. The analysis yielded a classification tree which had an estimated misclassification rate of 16.8% for the learning sample and 15.5% for the test sample. This value for the misclassification rate suggests that the classification tree will correctly predict the propensity for insolvency of a new observation about 83% of the time.

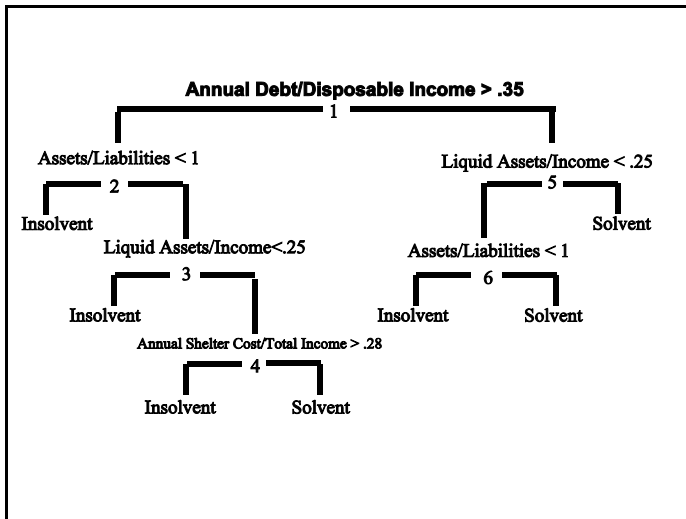
In the classification tree (shown in Figure 2 on page 18), a node represents a split on a specific variable. In the tree, the split criterion is listed above the number of the node. All cases which satisfy the criterion for the node are directed to the left branch. Cases not satisfying this criterion are directed to the right. For example, Node 1 of the classification tree splits on Gross Annual Debts/Disposable Income > .35. This means that households with annual debt payments larger than 35% of disposable income were directed to the left and those with values for the ratio which were less than 35% were directed to the right. Each branch was further divided by another split or was classified as a terminal node. Terminal nodes are labeled by the class assigned to the cases which occupy the node; all cases were eventually classified as solvent or insolvent.

Table 3
 Predicted 1986 Insolvency Rate Based On Combinations of Guidelines
 Being Met or Not Met in 1983

Met Liquid / Disposable Income Guideline?	Met Gross Debt / Disposable Income Guideline?	Met Assets / Liabilities Guideline?	Predicted Probability of Being Insolvent in 1986
yes	yes	yes	2.0%
sample mean	sample mean	sample mean	6.8%
yes	no	yes	7.2%
yes	yes	no	7.5%
no	yes	yes	11.1%
yes	no	no	23.5%
no	yes	no	32.3%
no	no	yes	33.3%
no	no	no	65.6%

In summary, there were 6 splits in the formation of the tree: two splits for each of the Assets/Liabilities and Liquidity ratios and one split for each of the Annual Debt Payments and the Annual Shelter Costs ratios. The classification tree is interpreted as follows: households would first be partitioned according to the comparison of Gross Annual Debt Payments to Disposable Income. Cases with ratios greater than .35 for the Gross Annual Debts ratio would be directed to the left and further partitioned by the Assets/Liabilities ratio, and then by the Liquidity ratio, and finally by the Annual Shelter Costs/Disposable Income ratio. If cases were directed to the right on the first split, they were further partitioned by the Liquidity ratio, and then by the Assets/Liabilities ratio.

Figure 2
 Classification Tree for Insolvency in 1986, Based on Whether Each
 Guideline Met in 1983.



In addition, CART produces a table of the relative importance rating of the variables. The relative importance of each variable is based on the search for the best set of splits in the tree-selection algorithm (Table 4.) The ratings are a mathematical measure based on the entire tree search algorithm and not just the final tree. When drawing conclusions, the relative importance ratings must be considered as well as the criteria which defined the splits in the tree. Because the ratings represent all the attempts to form a tree, the ratings should be given more weight than the variables which defined the nodes in the final tree.

As shown in Table 4, the Assets/Liabilities ratio received the highest relative importance rating but the second highest ranking, assigned to the Annual Debt Payments ratio, was very close in numerical value (96 compared to 100). The Shelter Cost ratio was rated higher than the Liquidity ratio (79 compared to 71). In summary, the analysis of the classification tree indicates that the Assets/Liabilities ratio and the

Gross Annual Debt Payments/Disposable Income ratio were the primary indicators of insolvency.

Table 4
Relative Importance of Variables in Classification Tree
Propensity for 1986 Insolvency: Net Worth < 1 Month's Income

Variable	Rating
1983 Total Assets/Total Liabilities	100
1983 Gross Annual Debt Payments/Disposable Income	96
1983 Annual Shelter Costs/Total Income	79
1983 Liquid Assets/Disposable Income	71
1983 Annual Consumer Debt Payments/Disposable Income	10

Conclusions and Implications

The purpose of this research was to examine the usefulness of financial ratios and guidelines as predictors of future insolvency. Two statistical methods were used for analysis: logistic regression and a classification tree. In each method, the estimation for accuracy of prediction yielded acceptable results as shown by the relatively low misclassification rate for the tree and the high percentage of concordant pairs for the logistic regression. While there was some similarity in the results, there was not agreement about which financial guideline was the most important predictor of insolvency in households. According to the standardized coefficients for the logistic regression, the Liquidity guideline was the most important predictor but in the relative importance ratings for the classification tree, the Liquidity guideline was fourth in importance. In contrast, the Assets/Liabilities guideline was first in importance in the classification tree and third in importance for the logistic regression results. The Gross Annual Debt Payments/Disposable Income guideline was second in importance for each of the two methods. In summary, these three financial guidelines--Liquidity, Asset/Liability, and Gross Annual Debt Payments/Disposable Income---appear to be the most useful predictors of insolvency.

Implications for Financial Educators, Counselors, and Planners

While each statistical method produced useful results in showing the importance of one or more financial ratios, the choice of which ratios to

use for educational, counseling, and planning purposes is up to the practitioner. The financial goals and expertise of the client and the financial information which is available to the practitioner and client may determine the application of the ratios to the client's financial status. In particular, the classification tree lends itself to the development of case studies to illustrate the use of financial ratios. Case studies could be developed with information which was similar to the clients' information. For example, the Gross Annual Debt Payments/Disposable Income ratio consists of items which may be quite readily identified (shelter costs and consumer debt payments). Families who are contemplating the purchase of a home, vehicle or major furnishings may want to evaluate the level of debt which they are able to manage relative to income. Other families may be concerned with having a reserve of cash or cash equivalents for emergencies and want to know what amount is recommended; understanding the Liquidity ratio and guideline may help them make decisions about the allocation of assets. The Assets/Liabilities ratio could be useful as a guideline when families are evaluating short and long term goals about major investments.

In general, the components of these ratios could be readily identified by a family and their financial advisor or educator. Indeed, the application of financial ratios supports several basic skills such as keeping records, thinking analytically, and setting goals. As families begin to understand that meeting one or more of the ratio guidelines could help in avoiding insolvency or the propensity for insolvency, the use of financial ratios and guidelines should be reinforced. As families gain understanding of the use of financial ratios, they will want to make comparisons of ratio values using information from past records and to set goals for the future. Financial ratio guidelines have been referred to by practitioners as "rules of thumb" which suggests that the guidelines should be easy to remember and apply. These results support that recommendation.

If a counselor has time to obtain only one piece of information, the Liquidity Guideline or the Asset/Liability guidelines would each be useful. The Asset/Liability guideline has the advantage of not requiring information about income, whereas the Liquidity Guideline requires both balance sheet and income information. Ideally, information for all three guidelines listed in Table 3 (page 17) should be obtained, as there was a *33-fold* difference in predicted insolvency between those who met all three guidelines and those who met none of the guidelines.

Limitations and Implications for Future Research

Data collected specifically for the purpose of analyzing financial ratios would be helpful. For example, studies tend to collect expenditure data or balance sheet data but they seldom include both sets of information. Also, measures for income tend to be gross or before tax income instead of disposable income. Finally, this research ignored the effect of variables such as income, age, education, race, and marital status in an attempt to determine which ratio(s) would emerge as indicators of insolvency. Future research could involve ratios, socio-economic factors, and interaction variables. Also, it seems likely that different levels of the ratios would be appropriate to families at various stages of the life cycle. This suggests an interesting approach for further study.

Endnotes

1. *The logit procedure is a non-linear technique designed for use with dependent variables that are dichotomous variables and other multinomial variables (Hosmer & Lemeshow, 1989). When estimated, the logit equation predicts the natural logarithm of the odds ratio of the probability an event occurs given the levels at which the independent variables were set.*

The equation is stated as follows (Maddala, 1983):

$$\log (P/(1-P)) = \beta_0 + \beta_1 X_1 + \dots + \beta_k X_k$$

where P = probability that the dependent variable = 1, 1-P = probability that the dependent variable = 0, k = the number of independent variables in the model.

The regression coefficients are interpreted as the change in the odds ratio. The percentage of concordant pairs is reported in each logistic regression model as another measure of goodness-of-fit (SAS Institute Inc., 1989, p. 1090). This number is the percentage of cases in which the independent variables have correctly predicted the dependent variable. This is interpreted as follows: an observation is counted as concordant if the predicted probability is greater than 0.5 and the actual value is 1, or discordant if the predicted probability is less than 0.5 and the actual value is 0.

2. *The logistic procedure produces parameter results that can be used to produce predicted probabilities for any combination of values of the independent variables (Maddala, 1983) as shown: $Y = \sum \beta_i X_i$ $p = 1/(1 + e^Y)$*

3. Classification rules are usually developed from a training sample consisting of p random variables of interest. The training sample is a set of data collected from what is believed to be a representative sample of the population of objects which are to be classified in the future. A classification tree is built by grouping and re-grouping the training sample cases based on the various values of the predictor variables. Accuracy is estimated by applying this tree to each test sample case and comparing the predicted category of the response variable to its actual category. The misclassification rate is the percentage of cases in the test sample whose response variable was incorrectly predicted by the tree (Brieman, Friedman, Olshen & Stone, 1984; Neville, 1988).

Appendix

Descriptive Statistics			
Characteristic		1983	1986
Race/Ethnic Background	White		87.8%
	87.8%		
	Black	10.2	10.2
	Other	2.8	2.8
Years of Education	Less than High School		20.1
	20.1		
	High School Diploma		35.3
	35.3		
	Some College or Degree		44.7
	44.7		
Marital Status	Married	68.3	67.8
	Other	31.7	32.2
Gender of Head	Male	79.9	77.7
	Female	20.1	22.3
Home Ownership	Own	73.4	77.9
	Other	26.6	22.1
Total Income (Median)		\$28,304	28,000
Paper Assets (Median)		6,167	11,188
Real Assets (Median)		55,967	66,764
Real Estate Debt (Median)			1,224
	7,739		
Total Other Debt (Median)			1,445
	1,000		
Total Debt (Median)		9,054	11,022
Net Worth (Median)		44,950	59,767
1983 dollar amounts were adjusted to 1986 dollars			

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