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Changes in the riskiness of commercial banks: 1975–1989

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CHANGES IN THE RISKINESS OF COMMERCIAL BANKS: 1975-1989

by

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GRADUATE COLLEGE
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CHANGES IN THE RISKINESS OF

COMMERCIAL BANKS: 1975-1989

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This study will identify specific periods during the years 1975-1989 where change in bank risk may have occurred. The work of Kane and Unal (1988) is most similar to this study, although different econometric methodology was utilized.

Four return measures are tested. The returns to equity holders will be used as in many other studies. Certificates of deposit represents insured deposits. Bankers acceptances represents the uninsured debt. Interbank lending will be measured by federal funds.

For all of the debt series, the spread between the specific series and the treasury bill rate will be used as the risk measure. The regression coefficient will represent the risk premium of the debt series.

An econometric technique will be used to find switch point dates rather than to prespecify them as in traditional event study methodology. There are two procedures which have been used to do so. The first is

the Goldfeld-Quandt switching regressions method developed by Goldfeld and Quandt (1972). The other is a combination of the cumulative sum of the squares of recursive residuals method, developed by Brown, Durbin, and Evans (1975), and the log likelihood ratio technique from Quandt (1958).

In this study, the cumulative sum of the squares of recursive residuals method and the log likelihood ratio will be used in the manner suggested by Hays and Upton (1986). The Hays and Upton contribution consists of a ratcheting technique using increasingly more observations.

After all switch points have been found and heteroskedasticity tested for, parameter estimates for the time periods between the dates will be obtained. If no heteroskedasticity was detected then ordinary least squares will be used. White's consistent covariance matrix will be employed when heteroskedasticity is found. In addition, if autoregressive conditional heteroskedasticity is present, then that model will be used.

A binary dummy variable will be included which will take the value zero before and one after the date being considered. Tests will be performed on these coefficients for changes in risk.

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I. INTRODUCTION

A large number of regulatory changes have occurred in commercial banking during the 1970s and 1980s. The riskiness of commercial banks is likely to have changed during that time because of those changes. This study will attempt to identify specific periods during the years 1975-1989 where change in bank risk may have occurred. Events around those specific dates will then be examined for possible cause. The work of Kane and Unal (1988) is most similar to this study, although different econometric methodology was utilized.

Federal regulators have long used banking regulations as a way of protecting the safety and soundness of the banking industry. Minimum capital adequacy standards in commercial banking are an example. An illustration of the relationship behind raising capital standards and bank risk can be seen by modifying the relationship between the beta of a levered firm, β_U, and the beta of an unlevered firm, β_L, as discussed in Hamada (1969). Beta has long been recognized as a measure of systematic risk in the capital asset pricing model. The basic relationship, assuming no bankruptcy costs, is given by

$$\beta_L = (1+ D_L/V_L)\beta_U$$

where D_L is the value of debt and V_L is the value of assets for the levered firm. If the capital adequacy ratio, CA, is defined as equity to assets then the relationship can be rewritten as:

$$\beta_L = (2 - CA)\beta_U.$$

It then follows that risk, measured by β_L, declines as CA increases assuming overall asset risk remains unchanged.

This study will be conducted over the time period 1975-1989. Many events which could affect the banking sector occurred. Several laws concerning banking were enacted in those years. Capital requirements have changed a number of times during that time. Rather than attempt to test for the impact of a specific event, this study attempts to find structural changes to bank equity and debt risk.

The inclusion of both debt and equity in this study of the banking sector, is important due to the nature of deposits. It is also unique to this study. Rather than aggregate all debt instruments into one factor, a division will be made into types of debt. In addition, these debt series will be short term in nature, recognizing that typically banks receive the bulk of their funding from short term debt sources. In this way, differences can be examined in the riskiness of various capital sources for banks.

Four return measures are tested. The returns to equity holders will be used as in many other studies. A simple one factor market model will be utilized. Three additional return series will also be used to test for structural changes in the riskiness of debt. These are the short term debt return series mentioned above. Certificates of deposit represents insured deposits. Bankers acceptances represents the uninsured debt. Interbank lending will be measured by federal funds.

For all of the debt series, the spread between the specific series and the treasury bill rate will be used as the risk measure. This will be regressed on the unit vector. The resulting regression coefficient will represent the risk premium of the debt series.

The data will consist of bank equity return data generated from the Center for Research in Security Prices (CRSP) files and bank debt return data from the National Technical Information Service (NTIS) of the United States Department of Commerce who supplies data from the Federal Reserve.

This study will investigate whether or not any changes in risk occurred during the 1975-1989 period, and what may have been responsible. A change in banking regulations is only one possible cause. This study

recognizes that no causal relationship is established with this methodology.

Event studies in banking are often conducted using a two factor market model consisting of both a market return and an interest rate factor. An event is selected by the researcher as being important. The date the event occurred is established. Although this step sounds simple enough, in practice it can sometimes be very difficult. Market participants anticipate events. As an example, it is quite possible that structural shifts can occur prior to the date when a law goes into effect. After the date is picked, then tests are conducted for changes in regression parameters before and after the event. Considered especially important for these tests are the coefficients on the two indices and the residual variance. Several examples of this type of study would include Binder (1985), Smirlock (1984), Aharony and Swary (1981), Aharony, Saunders, and Swary (1986,1988), Allen and Wilhelm (1988), Lamy and Thompson (1986), Cooper, Kolari, and Wagster (1991), and Slovin, Sushka, and Bendeck (1990).

Another approach is to allow an econometric methodology to find what dates are important rather than to prespecify them as important. There are two methodologies which have been used to do so. The first

is the Goldfeld-Quandt switching regressions method developed by Goldfeld and Quandt (1972). The other is a combination of the cumulative sum of the squares of recursive residuals (CUMSQR) method, developed by Brown, Durbin, and Evans (1975), and the log likelihood ratio (LLR) technique from Quandt (1958).

The Goldfeld-Quandt methodology has been used in banking by Unal (1989) in a contrast to the Smirlock article mentioned above. The technique treats switch point dates and their variances as additional parameters to be estimated by maximum likelihood methods.

More importantly for this study, Kane and Unal (1988) used the technique. Their study covered the time frame 1975-1985. Money center banks, superregional banks, regional banks, and savings and loan equity returns were all tested using the two factor market model. The switch points they identified were generally confirmed by this study.

As a contrast to Kane and Unal, Liang and Mullineaux (1990) utilized the cumulative sum of the squares of recursive residuals and the log likelihood ratio methods rather than the Goldfeld-Quandt switching regressions technique. They found very different switch points.

As a first step, the cumulative sum of the squares of the recursive residuals system is used to find a time

frame where a change in parameters has occurred. Then the log likelihood ratio is employed to isolate the most likely date for the change. Multiple switch points can cause difficulties due to contamination of one event by another.

Liang and Mullineaux applied the cumulative sum of the squares of the recursive residuals to the entire data series and found that a structural change or changes had happened. After focusing to a single most likely point with the log likelihood ratio, the two subperiods were subjected to the cumulative sum of the squares of the recursive residuals to test for further changes. This process was repeated until no further change was evident. Contamination of one event by another is still a strong possibility under that methodology.

In this study, the cumulative sum of the squares of recursive residuals method and the log likelihood ratio will be used in the manner suggested by Hays and Upton (1986). The Hays and Upton contribution consists of a ratcheting technique using increasingly more observations. After a switch point is found, the process is repeated beginning one observation after the switch point. This continues until the end of the data series. The Hays and Upton process goes much further in eliminating the contamination which may occur when

multiple switch points are present by eliminating the observations prior to a switch point and finding all switch points in sequence.

When using the methods described above, a switch may be caused by either a change in risk coefficients, a change in variance, or both. Two tests for heteroskedasticity will be conducted. The first is the Breusch-Pagan-Godfrey test which is a general test for the presence of heteroskedasticity. Second, a test for autoregressive conditional heteroskedasticity, which is a specific type of heteroskedasticity will be calculated.

After all switch points have been found and heteroskedasticity tested for, parameter estimates for the time periods between the dates will be obtained. If no heteroskedasticity was detected then ordinary least squares will be used. White´s consistent covariance matrix will be employed when heteroskedasticity is found. In addition, if autoregressive conditional heteroskedasticity is present, then that model will be used.

A binary dummy variable will be included which will take the value zero before and one after the date being considered. When the coefficient on the dummy variable is statistically significant, then a structural change in risk will have occurred.

II. LITERATURE REVIEW

Risk shifting between the security holders of a firm flows from the work of Franco Modigliani and Merton Miller (1958). In their discussion, they were able to show that the capital structure of a firm does not affect its value. Their point was that the cash flow from the earning assets of the firm, and the associated risk, controls firm value. The capital structure of the firm simply divides the risk and return of the firm among the various security holders of the company.

In essence, the Modigliani-Miller propositions are laws of conservation of risk in finance. Merton Miller gave an example of this conservation in his Nobel Memorial Prize Lecture given on December 7, 1990. He began with a company with five stockholders and five debtholders. The debt was backed in such a way as to be riskless. Two of the stockholders then decide that they are taking too much risk and ask to trade their stock for debt. They are allowed to do so, but only if they trade for debt which is junior to the existing debt. Therefore, the new debt is more risky than the old. When the trade is made, the average risk and return for both the stockholders and the debtholders increase. However the total risk of the firm remains the same. Risk is

transferred from the two new bondholders to the three remaining stockholders.

II. A. EARNING ASSETS AND FIRM VALUE

It has also been shown that when certain market imperfections are allowed in the Modigliani-Miller framework, then the overall value of the firm will increase. The most obvious example is having interest payments from corporations be tax deductible for the corporation. This tax shield of interest has value in its own right.

Another possibility is that companies may alter the risk profile of their earning assets in response to regulatory changes. This has caused a controversy in the banking sector. Several researchers have questioned whether or not capital requirement increases will have an unintended effect which would offset the intended increase in the stability of the banking system and the insurance fund. This effect would be to increase the risk of the bank´s portfolio in an effort to maintain the shareholder´s return with the smaller amount of funds available to them due to the increased capital requirement. Insolvency becomes more likely rather than

less likely as was intended. A very similar argument can be made for the case of the regulators increasing the deposit insurance premium.

Kahane (1977) looks at both capital regulations and regulations constraining portfolio composition as ways that regulators try to ensure the solvency of banks. The author concludes that neither can be considered totally effective individually, but might be if used together. It is also shown that increasing the capital requirement can lead to increased risk in the portfolio held by the bank.

Koehn and Santomero (1980) use two steps to analyze the problem. First the optimal amount of deposits and capital to issue is ascertained. Then choices among various investment opportunities are made. When banks have a risk averse utility function, then increases in the capital requirement of a bank will cause the bank to lose some of its ability to use leverage. The efficient frontier shifts down and to the left meaning that total portfolio variance and return decline. Banks reshuffle their portfolios to more risky ones depending on their level of risk aversion. Using Chebyshev's Inequality, the authors show that there is some level of risk aversion below which the probability of failure actually increases. Risky banks become even more risky, while

safe banks become more safe. If regulators intend increased capital to lower the probability of failure they may have caused just the opposite to occur.

Another article in this area would be Brauer (1984) who focuses on the value of the bank. Deposits are stochastic. The optimal capital structure is arrived at using three assumptions. First, the value of the bank depends on its capital structure. The second assumption is that the capital structure value has a normal distribution since deposits are random in nature. Third, the target of capital regulation is the mean of the capital structure distribution. With these it is shown that increased capital decreases the value of the bank and the uncertainty of the value of the bank.

Lam and Chen (1985) use a shareholder wealth-maximizing model, the cash flow version of the capital asset pricing model. They are able to develop both an internal and external risk measure. Under interest rate ceilings, banks invest in each asset until marginal risk-adjusted returns are the same for each asset held. Banks will shift toward more risky portfolios when increased capital is required. In the absence of interest rate ceilings the direction of shift in portfolio composition cannot be determined, but portfolios could become more risky and the probability of failure higher.

Kim and Santomero (1988) use a mean-variance model that utilizes the new risk-based capital standards to find the efficient frontier and proper portfolio weights which would allow the risk-based system to function. They also analyze how well capital regulation has worked in conjunction with deposit insurance. The authors find that risky banks may increase the risk of their portfolios and their probability of failure in response to an increase in capital standards. They increase business risk to offset a forced decrease in their financial risk.

A recent work by Osterberg and Thomson (1989) use the same framework as Lam and Chen (1985) and studies the effect of risk-based deposit insurance. The same incentive to increase the risk of the bank´s portfolio is shown with flat rate deposit insurance. Risk-based insurance premiums decrease the incentives.

Furlong and Keeley (1987,1989) and Keeley and Furlong (1990) have called into question works such as Kahane (1977) and Koehn and Santomero (1980) which use a mean-variance framework and maximize utility. The authors build upon the state preference models for deposit insurance, such as Kareken and Wallace (1978), and the put option pricing of deposit insurance by Merton (1977). It is their finding that increasing capital

adequacy standards will not cause banks to increase the risk of their portfolios. This is accomplished with the following model. The usual balance sheet equation is assumed to hold so that assets, A_o, equals deposits, D_o, plus equity capital, C_o. Two states of nature may occur and two securities, X and Y, are potential investments with X being the riskier. Deposits are currently priced at

$$P_D = P_1 + P_2$$

and the prices of securities X and Y are

$$P_X = P_1x_1 + P_2x_2 \text{ and}$$

$$P_Y = P_1y_1 + P_2y_2.$$

It is assumed that all of these prices are equal so that

$$P_D = P_X = P_Y = P.$$

S represents the percent of the bank's assets which are invested is X and (1 - S) the percent invested in Y. The current value of the insurance subsidy, which has to be greater than zero if the bank can fail, is

$$I_o = \frac{D_o}{P}P_1 - \frac{C_o+D_o}{P}P_1[Sx_1+(1-S)y_1] > 0.$$

Holding C_o constant and differentiating the above with respect to D_o yields

$$\frac{\delta I_o}{\delta D_o} = \frac{P_1}{P} [1-(Sx_1 +(1-S)y_1)] > 0$$

which is positive and implies that the value of the