“Agency Theory in Banking: An Empirical Analysis of Moral Hazard and the Agency Costs of Equity”

AGENCY THEORY IN BANKING: AN EMPIRICAL ANALYSIS OF MORAL HAZARD AND THE AGENCY COSTS OF EQUITY

Darius Palia*, Robert Porter**

Abstract

We present an empirical study of the joint impact of required capital and management incentive compensation on risk-taking in banking. Two separate branches of the extant literature are unified in this paper. The first branch holds that moral hazard associated with government-backed deposit insurance dictates the use of mandatory minimum capital requirements for commercial banks. The second branch argues that incentive compensation aligns the interests of managers and shareholders thus overcoming the inclination of managers to minimize risk at the expense of shareholder value. We employ a simultaneous equation model to mitigate the endogeneity between risk and the independent variables. The 1988 Basle Capital Accord is recognized as an exogenous shock to the capital ratios of commercial banks while CEO age and tenure are used as instruments for management compensation. Preliminary results produce a significant and negative coefficient on capital and a significant positive coefficient on pay-performance sensitivity.

Key words: Moral Hazard, Basel II, Agency Costs, and Incentive Compensation.
JEL Classification: G21, G28, and G32.

1. Introduction

Financial intermediaries have long been identified as unique institutions in free-market economies. The negative externalities deriving from bank failures have prompted a body of government regulation unparalleled among non-financial firms. In the U.S. a large segment of this regulation was enacted in the Depression era of the 1930's. For the next four decades all seemed reasonably well but the 1980's brought a wave of bank failures that produced losses that exceeded in real terms the losses of the 1930's. Quite naturally this led to a questioning of the rationale and efficacy of then current bank and thrift regulation.

One major segment of research focused on the problem of moral hazard and the perverse incentives arising out of a federal safety-net. We know from the theory of financial intermediation that deposit contracts provide better risk sharing than other contractual arrangements. But deposit contracts also inevitably allow the possibility of bank runs thereby mandating government insurance for the depositors. See for example Diamond and Dybvig (1983), Calomiris and Kahn (1991), and Diamond and Rajan (1998). Merton (1977) first quantified the moral hazard issue by identifying the value of deposit insurance as the equivalent of a put option on the FDIC. At that time deposit insurance premiums were charged at a fixed rate, regardless of risk, thereby providing an incentive for banks to increase their risk.

Subsequent empirical studies of the propensity of banks to increase risk in order to maximize the value of their deposit insurance have produced mixed results. Marcus and Shaked (1984) were the first to make Merton's deposit insurance valuation equations operational. Their conclusion was that the deposit insurance premium was substantially higher, not lower, than it should have been given the historic level of bank losses. Duan, Moreau and Sealey (1992) employed a specific test for risk-shifting behavior by banks. They argued that if a bank was able to increase the value of the risk-adjusted deposit insurance then they had appropriated value from the FDIC. Their empirical findings were that only 20% of their sample banks were successful in risk-shifting behavior

* Rutgers University, USA.
** Quinnipiac University, USA.

and therefore it was not a wide-spread problem. Hovakimian and Kane (2000), however, used the same empirical design as Duan, Moreau and Sealey and obtained opposite results. They used a more current period and found that highly-leveraged banks have higher risk-shifting incentives than less-leveraged banks which is consistent with the presence of moral hazard.

Another researcher discussing the problem was Keeley (1990). He raises the question as to why it was not until the 1980's that banks started to exploit the value of deposit insurance since the insurance had been enacted in the 1930's. Keeley notes that while both book-value capital ratios and market-value capital ratios had been declining for quite a while, the market-value of equity had moved from a premium over book-value to a discount under book-value. This, of course, reflects a decline in charter value which in turn is a reflection of the de-regulation of banking that was taking place. During the 1970's and the 1980's banks had received increased powers both as to their geographic expansion and their product offerings. But increased operational flexibility means increased competition and, therefore, a reduction in market power and a related reduction in charter value. Keeley concludes that when charter values are high banks are motivated to minimize risk so as to protect their charter value, but when charter values are low banks are inclined to increase their risk since there is less to lose.

The second major segment of financial research considered here deals with the agency problems between shareholders and managers. In this literature bank managers are viewed as unwilling to increase risk to the level that would maximize shareholder value. Agency problems can be traced to the original work of Jensen and Meckling (1976), Holmstrom (1979) and many others. Amihud and Lev (1981) brought the literature into the specific arena of incentive compensation and risk. Looking for explanations of conglomerate mergers that destroy shareholder value, the authors suggest that managers, in an effort to protect un-diversifiable human capital, are motivated to reduce risk.

Here again, empirical studies have produced conflicting results. In a study focused on banking firms, Saunders, Strock and Travlos (1990) found that management stock ownership induces risk taking. Using capital market measures of risk and the percentage of stock owned by managers as a proxy for ownership structure they provide evidence that stockholder-controlled banks take on higher risk than managerially-controlled banks. In another study Lee (2002) argues that risk-averse managers respond to incentive compensation more aggressively if the risk of bank failure is low.

On the other side of the question, Houston and James (1995) argue that compensation in the banking industry does not promote risk-taking. In their study they find no evidence that equity-based incentives increase the level of risk taking. On the contrary, they find a positive relationship between the use of equity-based compensation and the ratio of market-value to book-value. The use of more equity-based incentives by banks with high charter values is completely inconsistent with a propensity to increase risk. Gorton and Rosen (1995) produce similar results. Their conclusion is that managers with controlling interests tend to make safe loans while entrenched managers make more risky loans.

We contribute to this literature by analyzing the joint impact of moral hazard and owner/manager agency problems on risk in banking. This study is most closely related to the work of Demsetz, Saidenbeg and Strahan (1997). Their study focuses on the same two issues jointly, but their empirical design relates risk to franchise value and ownership structure and they do not address the endogeneity between franchise value and risk. They find a robust negative relationship between risk and franchise value but a statistically significant relationship between risk and ownership structure only for banks with low franchise values.

Another related study is Hughes, Lang, Moon and Pagano (2003). These authors also consider the interaction between safety-net subsidies and managerial incentives and its impact on capital structure. Their empirical findings establish the presence of dichotomous strategies for value maximization, a concept first identified by Marcus (1984). In capsule form, one strategy is to pursue low risk (low leverage) opportunities in order to maximize charter value while the second strategy is to embrace high risk (high leverage) in order to exploit the federal safety net. The authors go on to argue that the choice between strategies is a function of agency problems with low risk and high charter value associated with a higher consumption of agency goods by managers.

In this study we use a simultaneous equation model to mitigate the endogeneity inherent between risk, capital and compensation. Our preliminary results document a significant and negative relationship between risk and capital and a significant and positive relationship between risk and incentive compensation. The remainder of this paper is organized as follows. The next section discusses our data sources and the variables employed. Section 3 identifies our empirical methodology and results while Section 4 concludes.

2. Data and Variables

Sources

We employ the impact of the 1988 Basle Capital Accord on U.S. bank capital ratios to deal with the endogeneity between risk and capital. This is discussed in more detail in the next section but is mentioned here to account for the data employed in our study. To capture the effect of the Basle Accord we study the change in bank capital ratios from 1987, i.e. prior to Basle, to 1991, i.e. subsequent to Basle. In addition to bank balance sheet data we also require risk data and compensation data with the latter being the most problematic.

Standard and Poor's ExecuComp database starts in 1992 and is therefore unavailable for our use. Fortunately, we have been provided the compensation and firm performance data gathered by David Yermack covering the period 1984 – 1991. Following Saunders, Strock and Travlos (1990) we employ market-based measures of bank risk using data from the Center for Research in Security Prices (CRSP).The Federal Reserve Form Y-9C data are used to provide the required bank balance sheet data.

Measures of Risk

We use the standard deviation of the bank's daily total return as our first measure of risk. We are also concerned with firm-specific risk since market-based risk is beyond the control of management. Accordingly, we employ a traditional market model and use the standard deviation of the residuals as our proxy for risk. Our model uses the CRSP equally-weighted index for the market return and is specified as follows:

Our dependent variables are *STDRET* and *RESID_NOINT*.

$$R_{jt} = \beta_{0j} + \beta_{1j} R_{mt} + \varepsilon_{jt}$$

where:

R_{jt} = return to j^{th} stock over period *t*.

R_{mt} = return on egually weighted portfolio of common stock over period *t*.

Measures of capital

The basic measure of capital employed is the ratio of capital to assets, a leverage ratio. We use three permutations of the leverage ratio in our analysis. First, we calculate a standard book-value ratio, second we calculate a market-value ratio and finally we use the Basle Accord's definitions to calculate a risk-based capital ratio.

All data were retrieved from the Federal Reserve Bank web site and a standard bank balance sheet was assembled. Book-value capital ratios were calculated directly from the Fed data. Market-based capital values were calculated by multiplying the number of shares outstanding by the year-end stock price. Market-based asset values were then calculated by taking the bank's total assets, subtracting the book-value of equity and adding the market-value as calculated above. These values were then used to calculate a proxy for Tobin's Q and used to control for charter value.

Risk-based assets as defined by the Basle Accord were only provided in the Fed data for 1991 and not 1987. This, of course, was expected. For consistency, therefore, risk-based assets were calculated by us directly from the Fed data for both years, 1987 and 1991, employing the Basle Accord rules. It should be noted that the 1991 data had differences between the reported figure and the calculated figure but they were not considered to be significant.

Our specific regression variables are *CHGBKCAPRATIO* defined as the change in the book-value capital ratio from 1987 to 1991 and RBAGROWTH defined as the growth in risk-based assets from 1987 to 1991.

Measures of Incentive Compensation

The Yermack dataset enables us to calculate several measures of incentive-compatible compensation. We focus on two measures, first, total managerial compensation sensitivity and second, the sensitivity of options granted and shares owned. Since the sensitivity of the Yermak data items, salary and bonus (SALBON) and other compensation (OTHCOMP), are not observable we estimate them via regression analysis. Following Jensen and Murphy (1990) and Hall and Liebman (1998) we regress the change in CEO salary and bonus on the change in shareholder wealth. The change in shareholder wealth is defined as the market value of the bank's equity at the beginning of the year multiplied by the stock return for that year. A similar regression is run to estimate the sensitivity of the sum of salary and bonus and other compensation, specifically:

$$\Delta(SALBON + OTHCOMP)_t = \alpha + \beta\Delta(ShareholderWeaith)_t + \varepsilon_t$$

The coefficient, beta, is our measure of pay-performance sensitivity.

Following Yermack (1995) and Palia (2001), the sensitivity of options (OPTGRANT) is equal to the number of options granted as a percent of total shares outstanding multiplied by the Black-Scholes hedge ratio adjusted for dividends. The following two assumptions are employed in the calculation: first, all options have a ten year maturity, and second, the risk-free rate is equal to the rate on the ten-year Treasury bond. All other required data are taken from the Yermack dataset. The sensitivity of shares is defined as the shares owned by the CEO as a percent of the total shares outstanding (PCTOWNED).

Total managerial compensation sensitivity (TOTALPPS) is defined as the sum of the sensitivity of salary and bonus and other compensation, plus the sensitivity of options and the sensitivity of shares. Our regression variable is CHGTOTPPS87_91, defined as the change in total pay-performance sensitivity from 1987 to 1991.

Table 1 summarizes our variable definitions, Table 2 presents the calculation of pay-performance sensitivity, and Table 3 provides descriptive statistics.

Table 1

The dependent variable RESID_NOINT is calculated from the following market model:

$R_{jt}= \beta_{0j}+\beta_{1j}R_{mt}+\varepsilon_{jt}$
R_{jt} = return to j^{th} stock over period t
R_{mt}= return on equally weighted portfolio of common stock over period t

Variables	Definitions
Dependent Variables	
STDRET	The standard deviation of the bank's daily total return for 1991 (or the year (YY) if noted).
RESID_NOINT	The standard deviation of the regression residuals from market model for 1991 (or year (YY).
Capital Variables	
BKCAPRATIO(YY)	The bank's book-value ratio of capital to total assets in year (YY).
CHGBKCAPRATIO	The change in the book-value capital ratio from 1987 to 1991.
RBAGROWTH	The growth in risk based assets from 1987 to 1991.
CHGRBAPERTOT	The change in the ratio of risk-based assets to total assets from 1987 to 1991.

Table 1 (continued)

Variables	Definitions
Compensation Variables	
SALBON	The total of the CEO's salary and bonus.
OTHCOMP	Fringe benefits and cash payouts from long-term compensation plans (excluding options).
DSOBETA	The coefficient from regressing the change in SALBON + OTHCOMP on the change in shareholder wealth for the period from 1987 to 1991.
OPTGRANT	The number of new stock options granted during the year.
PPSOPTIONS	The number of options granted as a percent of total shares outstanding multiplied by the Black-Scholes hedge ratio adjusted for dividends.
PCTOWNED	The shares owned by the CEO as a percent of the total shares outstanding.
TOTALPPS(YY)	The sensitivity of all compensation items, salary and bonus, other compensation, options and shares; (DSOBETA + PPSOPTIONS + PCTOWNED)
CHGTOTPPS87_91	The difference between TOTALPPS87 and TOTALPPS91.
YRSASCEO	The number of years the current CEO has served in that capacity as of 1991.
AGE	The age of the CEO in the ending year of the study, 1991.
Control Variables	
LN_TOTASTS	The natural log of the total assets of the bank; to control for size.
TOBINSQ	The ratio of the market value of equity minus the book value of equity plus the book value of assets to the book value of assets; to control for charter value.

Table 2

Pay performance sensitivities

The sensitivities of salary and bonus (SALBON) and other compensation (OTHCOMP) are estimated via regression analysis.

$$\Delta(SALBON+OTHCOMP)t=\alpha+\beta\Delta(ShareholderWealth)_t+\varepsilon_t$$

The sensitivity of options (OPTGRANT) is equal to the number of options granted as a percent of total shares outstanding multiplied by the Black-Scholes hedge ratio adjusted for dividends. The sensitivity of shares is defined as the shares owned by the CEO as a percent of the total shares outstanding (PCTOWNED). The sensitivities reported here are consistent with Jensen and Murphy (1990) and Palia (2001).

1987			
Sensitivity	Mean	Median	Std. Dev.
1SALBON	0.000264	0.000149	0.000690
2SALBON + OTHCOMP	0.000281	0.000109	0.001470
3PPSOPTIONS87	0.000753	0.000238	0.004013
4PCTOWNED87	0.013285	0.001900	0.043509
TOTALPPS87 (Sum of 2+3+4)	0.014319	0.002540	0.043851
PPSOPTSHRS87 (Sum of 3+4)	0.014038	0.00231	0.043681
Change in CEO compensation per $1,000 change in shareholder wealth			
SALBON	$0.26	$0.15	
SALBON + OTHCOMP	$0.28	$0.11	
PPSOPTIONS87	$0.75	$0.24	
PCTOWNED87	$13.28	$1.90	
TOTALPPS87	$14.32	$2.54	
PPSOPTSHRS87	$14.04	$2.31	

Table 2 (continued)

1991			
Sensitivity	Mean	Median	Std. Dev.
1SALBON	0.000264	0.000149	0.000690
2SALBON + OTHCOMP	0.000281	0.000109	0.001470
3PPSOPTIONS87	0.000710	0.000279	0.001109
4PCTOWNED87	0.012056	0.0021	0.040526
TOTALPPS87 (Sum of 2+3+4)	0.013047	0.002476	0.040763
PPSOPTSHRS87 (Sum of 3+4)	0.012766	0.0024	0.04060063
Change in CEO compensation per $1,000 change in shareholder wealth			
SALBON	$0.26	$0.15	
SALBON + OTHCOMP	$0.28	$0.11	
PPSOPTIONS91	$0.71	$0.28	
PCTOWNED91	$12.06	$2.10	
TOTALPPS91	$13.05	$2.48	
PPSOPTSHRS91	$12.77	$2.40`	

Table 3

Descriptive statistics

(All $'s in thousands)

Variable	Mean	Median	Standard Deviation
Dependent Variables			
STDRET	2.4764%	2.1343%	1.1839%
RESID_NOINT	2.3838%	2.0445%	1.2399%
Capital Variables			
BkCapRatio91	6.4838%	6.4029%	1.4442%
BkCapRatio87	6.2856%	6.2585%	1.2705%
CHGBKCAPRATIO	0.2374%	0.3365%	1.3380%
RBAssets91	$17,949,902	$7,140,494	$31,405,125
RBAssets87	$14,883,918	$4,668,384	$28,061,583
RBAGROWTH	40.6750%	28.5965%	50.6548%
CHGRBAPERTOT	0.2019%	0.1767%	10.0476%
Compensation Variables			
SALBON	$653.3	$568.0	$353.5
OTHCOMP	$110.2	$20.0	$351.5
DSObeta	0.000281	0.000108	0.001477
PPSOPTIONS91	0.000710	0.000279	0.001109
PCTOWNED91	1.2056%	0.2100%	4.0526%
TOTALPPS91	0.013047	0.002476	0.040763
PPSOPTIONS87	0.000753	0.000238	0.004013
PCTOWNED87	1.3285%	0.1900%	4.3509%
TOTALPPS87	0.014319	0.002540	0.043851
YRSASCEO	8.06	7.00	6.74
AGE	57	57	6
Control Variables			
LN_TOTASTS	16.178561	16.048447	1.153353
TOBINSQ	0.38483	1.010892	0.18984644

3. Methodology and Results

Our objective is to measure the impact of capital regulation and incentive compensation on risk-taking in the commercial banking industry. Our sample consists of all banks available in the Yermack compensation dataset for which we could find sufficient return data from CRSP to calculate risk proxies and sufficient information from the Federal Reserve's FR Y-9C to calculate the capital ratios. First, banks on the Yermack and CRSP data bases were matched based on the CUSIP number. The name and address of the bank was used as confirmation if the CUSIP number had changed from 1987 to 1991. Second, the matched banks from this procedure were then matched to banks reporting on form FR Y-9C based on the bank's name and address. This produced a total of 112 banks.

The first empirical challenge is to mitigate the obvious endogeneity between the dependent and independent variables. We are regressing risk on capital and CEO incentive compensation. To solve this problem we use a simultaneous equation model and 2SLS. The exogenous variable for risk is simply the relevant measure of risk lagged one period. The exogenous variable for capital represents the growth in the banks' risk-based assets as defined by the Basle Capital Accord. The Accord was announced in 1988 with an implementation date of 1991 and is interpreted as an exogenous shock to the capital structure of banks. Accordingly, we measure the change in capital ratios from 1987 to 1991. The exogenous variables for compensation are CEO's age and tenure.

Our regression model is specified as follows:

$$\sigma_i = \alpha_1 + \beta_1 K_i + \beta_2 PPS_i + \gamma_1 z_1 + e_1 \quad (1A)$$

$$K_i = \alpha_2 + \beta_3 \sigma_i + \beta_4 PPS_i + \gamma_2 z_2 + e_2 \quad (1B)$$

$$PPS_i = \alpha_3 + \beta_5 \sigma_i + \beta_6 K_i + \gamma_3 z_3 + e_3 \quad (1C)$$

where:
σ_i is bank risk;
K_i is change in bank capital ratio;
PPS is *CEO* pay-performance sensitivity
A, *B* and Γ are coefficients to be estimated;
Z is the set of pre-determined variables;
z_1 is risk lagged one period;
z_2 is the change in risk-based assets as a percent of total assets from 1987 to 1991;
z_3 is CEO's age and tenure.

Equations (1A) through (1C) represent a simultaneous equation system for risk, capital and incentive compensation. However, it is difficult to completely identify the system and since we are primarily interested in the determinants of risk we use 2SLS to estimate equation (1A) alone. To create the instruments for capital and incentive compensation we regress the observed values of each on the predetermined variables Z.

More specifically, we estimate the following model to calculate our instrumental variables, CAP_PRED and COMP_PRED:

$$CHGBKCAPRATIO = \alpha + \beta_1 STDRET87 + \beta_2 RBAGROWTH + \beta_3 YRSASCEO + \beta_4 AGE + \varepsilon$$
$$= CAP\_PRED + \varepsilon$$

$$TOTALPPSAVG = \alpha + \beta_1 STDRET87 + \beta_2 RBAGROWTH + \beta_3 YRSASCEO + \beta_4 AGE + \varepsilon$$
$$= COMP\_PRED + \varepsilon$$

$$STDRET = \alpha + \beta_1 CAP\_PRED + \beta_2 COMP\_PRED + \beta_3 STDRET87$$
$$+ \beta_4 LN\_TOTALASTS + \beta_5 TOBINSQ + \varepsilon$$

We control for bank size and charter value, factors that have historically affected the risk, capital and CEO compensation of banks. Our final regression model is then specified as follows:

Our results are shown in Tables 4 and 5. We find the parameter for capital to be highly statistically significant and negative. The parameter for compensation is also significant and carries a positive sign. The negative sign on capital is interesting although not surprising. Risk decreases as capital is increased. This, however, is contrary to the theory that higher capital ratios lead to higher risk through risk arbitrage and off-balance-sheet transactions. As to our second variable of interest, the positive sign on compensation is consistent with agency theory. As pay-performance sensitivity increases theory holds that the interests of managers are more aligned with the interests of shareholders. Accordingly, risk should increase as the manager's financial interests mitigate the conservatism deriving from un-diversifiable human capital.

Table 4

Regression of total risk on fitted values of capital and incentive compensation assuming endogeneity and controlling for size in Panel A and for size and charter value in Panel B

Panel A:

$STDRET=\alpha+\beta_1 CAP\_PRED+\beta_2 COMP\_PRED+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\varepsilon$

Variable	Parameter	t-statistic
Intercept	0,0222	1,33
CAP_PRED	-2,2568***	-2,90
COMP_PRED	0,5314**	2,14
STDRET87	0,6874***	2,70
LN_TOTASTS	-0,0004	-0,36
Adjusted R-Sq	0,1019	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.

Panel B:

$STDRET=\alpha+\beta_1 CAP\_PRED+\beta_2 COMP\_PRED+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\beta_5 TOBINSQ+\varepsilon$

Variable	Parameter	t-statistic
Intercept	0,0424*	1,98
CAP_PRED	-2,0762***	-2,66
COMP_PRED	0,5006**	2,02
STDRET87	0,6865***	2,72
LN_TOTASTS	-0,0010	-0,93
TOBINSQ	-0,0095	-1,49
Adjusted R-Sq	0,1130	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

Table 5

Regression of market adjusted risk on fitted values of capital and incentive compensation assuming endogeneity and controlling for size in Panel A and for size and charter value in Panel B

Panel A:

$RESID\_NOINT=\alpha+\beta_1 CAP\_PRED+\beta_2 COMP\_PRED+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\varepsilon$

Variable	Parameter	t-statistic
Intercept	0,0251	1,54
CAP_PRED	-2,2708***	-2,97
COMP_PRED	0,5518**	2,27
RESID_NOINT87	0,6437**	2,20
LN_TOTASTS	-0,0004	-0,44
Adjusted R-Sq	0,1048	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.

Panel B:

$RESID\_NOINT=\alpha+\beta_1 CAP\_PRED+\beta_2 COMP\_PRED+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\beta_5 TOBINSQ+\varepsilon$

Variable	Parameter	t-statistic
Intercept	0,0466**	2,25
CAP_PRED	-2,0735***	-2,70
COMP_PRED	0,5173**	2,14
RESID_NOINT87	0,6492**	2,24
LN_TOTASTS	-0,0011	-1,07
TOBINSQ	-0,0103*	-1,66
Adjusted R-Sq	0,1208	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

The results concerning capital ratios are consistent with the empirical results of Hovakimian and Kane (2000): low capital levels lead to higher risk while high capital ratios lead to lower risk. The earlier findings of Duan, Moreau and Sealey (1992) are contradicted to the extent that they argued relatively few banks were capable of risk-shifting behavior under the then current capital regime.

Our results concerning incentive compensation support the empirical work of Saunders, Strock and Travlos (1990), namely that stockholder-controlled banks take on higher risk than managerially-controlled banks. We find evidence that higher pay-performance sensitivity increases risk in banks. This is in apparent contradiction to the findings of Houston and James (1995).

In terms of economic significance we find that when the ratio of risk-based assets to total assets moves from the 25^{th} percentile to the 75^{th} percentile risk is decreased by 1.84%. It is important to note that the increase in risk-based assets produces an increase in capital and that is what produces the decline in risk. Calculating the same measurement for total pay-performance sensitivity we find that a move from the 25^{th} to the 75^{th} percentile produces a decline in risk equal to 12.43%. Based on these results it seems clear that incentive compensation dominates the capital ratio in terms of the impact on risk.

One of the other underlying issues in this paper is the question of how to effectively deal with the endogeneity between our variables. We present in Table 6 and 7 the results from our model if we ignore the endogeneity problem. Here we simply regress our measure of risk directly on the change in the book-value capital ratio and the pay-performance sensitivity. We performed Hausman's specification test and found a test statistic exceeding 600 which quite clearly rejects the hypothesis of no error-regressor correlation. The interpretation of results obtained without correcting for endogeneity appears to be very perilous.

Table 6

Regression of total risk on capital and incentive compensation assuming exogeneity and controlling for size in Panel A and for size and charter value in Panel B

Panel A:

$$STDRET=\alpha+\beta_1 CHGBKCAPRATIO+\beta_2 CHGTOTPPS87\_91+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\varepsilon$$

Variable	Parameter	t-statistic
Intercept	0,0162	1,06
CHGBKCAPRATIO	-0,4093***	-5,12
CHGTOTPPS87_91	0,2228***	3,43
STDRET87	0,6050***	3,23
LN_TOTASTS	-0,0002	-0,21
Adjusted R-Sq	0,2766	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.

Panel B:

$$STDRET=\alpha+\beta_1 CHGBKCAPRATIO+\beta_2 CHGTOTPPS87\_91+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\beta_5 TOBINSQ+\varepsilon$$

Variable	Parameter	t-statistic
Intercept	0,0272	1,32
CHGBKCAPRATIO	-0,3890***	-4,63
CHGTOTPPS87_91	0,2244***	3,44
STDRET87	0,6129***	3,26
LN_TOTASTS	0,0006	-0,55
TOBINSQ	-0,0048	-0,80
Adjusted R-Sq	0,2738	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

Table 7

Regression of market adjusted risk on capital and incentive compensation assuming exogeneity and controlling for size in Panel A and for size and charter value in Panel B

Panel A:

$$RESID\_NOINT=\alpha+\beta_1 CHGBKCAPRATIO+\beta_2 CHGTOTPPS87\_91+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\varepsilon$$

Variable	Parameter	t-statistic
Intercept	0,0154	1,03
CHGBKCAPRATIO	-0,4013***	-5,17
CHGTOTPPS87_91	0,2189***	3,41
RESID_NOINT87	0,6351***	3,19
LN_TOTASTS	-0,0001	-0,16
Adjusted R-Sq		

*** statistically significant at the 1% level.
** statistically significant at the 5% level.

Panel B:

$$RESID\_NOINT=\alpha+\beta_1 CHGBKCAPRATIO+\beta_2 CHGTOTPPS87\_91+\beta_3 STDRET87+\beta_4 LN\_TOTASTS+\beta_5 TOBINSQ+\varepsilon$$

Variable	Parameter	t-statistic
Intercept	0,0286	1,42
CHGBKCAPRATIO	-0,3768***	-4,63
CHGTOTPPS87_91	0,2209***	3,44
RESID_NOINT87	0,6450***	3,24
LN_TOTASTS	-0,0006	-0,59
TOBINSQ	-0,0058	-0,99
Adjusted R-Sq	0,2775	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

Table 8

Calculation of fitted value of capital using lagged total risk with (Panel A) and without (Panel B) Tobin's Q

Panel A:

$$CHGBKCAPRATIO=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 ATDRET87+\varepsilon$$

Variable	Parameter	t-statistic
Intercept	-0,0048	-0,34
RBAGROWTH	0,0026	0,95
YRSASCEO	-0,0003	-1,18
AGE	0,0002	0,69
STDRET87	-0,0722	-0,30
Adjusted R-Sq	-0,0195	

Tabel 8 (continued)

Panel B:

$CHGBKCAPRATIO=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 ATDRET87+\beta_4 TOBINSQ+\varepsilon$

Variable	Parameter	t-statistic
Intercept	-0,0168	-1,02
RBAGROWTH	0,0027	0,99
YRSASCEO	-0,0003	-1,11
AGE	0,0002	0,76
STDRET87	-0,0639	-0,26
TOBINSQ	0,0103	1,45
Adjusted R-Sq	-0,0080	

Table 9

Calculation of fitted value of incentive compensation using lagged total risk with (Panel A) and without (Panel B) Tobin's Q

Panel A:

$CHGTOTPPS87\_91=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 STDRET87+\varepsilon$

Variable	Parameter	t-statistic
Intercept	-0,0324**	-2,02
RBAGROWTH	0,0006	0,21
YRSASCEO	-0,0007***	-2,86
AGE	0,0010***	3,47
STDRET87	-0,8921***	-3,28
Adjusted R-Sq	0,1543	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

Panel B:

$CHGTOTPPS87\_91=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 STDRET87+\beta_4 TOBINSQ+\varepsilon$

Variable	Parameter	t-statistic
Intercept	-0,0309*	-1,66
RBAGROWTH	0,0006	0,21
YRSASCEO	-0,0007***	-2,85
AGE	0,0010***	3,44
STDRET87	-0,8932***	-3,27
TOBINSQ	-0,0013	-0,16
Adjusted R-Sq	0,1457	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

Table 10

Calculation of fitted value of capital using lagged market adjusted risk with (Panel A) and without (Panel B) Tobin's Q

Panel A:

$CHGBKCAPRATIO=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 RESID\_NOINT87+\varepsilon$

Variable	Parameter	t-statistic
Intercept	-0,0038	-0,26
RBAGROWTH	0,0025	0,91
YRSASCEO	-0,0003	-1,16
AGE	0,0002	0,71
RESID_NOINT	-0,1592	-0,61
Adjusted R-Sq	-0,0165	

Panel B:

$CHGBKCAPRATIO=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 RESID\_NOINT87+\beta_4 TOBINSQ+\varepsilon$

Variable	Parameter	t-statistic
Intercept	-0,0156	-0,96
RBAGROWTH	0,0026	0,94
YRSASCEO	-0,0002	-1,09
AGE	0,0002	0,79
RESID_NOINT	-0,1674	-0,64
TOBINSQ	0,0104	1,47
Adjusted R-Sq	-0,0045	

Table 11

Calculation of fitted value of incentive compensation using lagged market adjusted risk with (Panel A) and without (Panel B) Tobin's Q

Panel A:

$CHGTOTPP87\_91=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 RESID\_NOINT87+\varepsilon$

Variable	Parameter	t-statistic
Intercept	-0,0301*	-1,93
RBAGROWTH	0,0003	0,09
YRSASCEO	-0,0007***	-2,78
AGE	0,0010***	3,50
RESID_NOINT87	-1,1577***	-4,04
Adjusted R-Sq	0,1958	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

Table 11 (continued)

Panel B:

$$CHGTOTPP87\_91=\alpha+\beta_1 RBAGROWTH+\beta_2 YRSASCEO+\beta_3 AGE+\beta_4 RESID\_NOINT87+\beta_4 TOBINSQ+\varepsilon$$

Variable	Parameter	t-statistic
Intercept	-0,0301*	-1,67
RBAGROWTH	0,0003	0,09
YRSASCEO	-0,0007***	-2,76
AGE	0,0010***	3,48
RESID_NOINT87	-1,1577***	-4,02
TOBINSQ	0,0000	0,00
Adjusted R-Sq	0,1874	

*** statistically significant at the 1% level.
** statistically significant at the 5% level.
* statistically significant at the 10% level.

4. Conclusion

In this paper we have considered the joint impact of capital regulation and owner-manager agency problems on risk in banking. Whilst the efficacy of capital regulation has been debated in the literature, as has the ultimate impact of incentive compensation on risk, the bulk of the research has considered one element or the other, but rarely both elements jointly.

Employing a simultaneous equation model and two-stage least squares regression analysis, we find that capital has a negative and statistically significant relation with risk, whilst compensation has a positive and statistically significant relation with risk.

In terms then of economic significance we find that incentive compensation has a far greater impact on risk than capital levels. The related question of the significance of endogeneity problems is also considered as an important issue for the purposes of this analysis.

References

1. Agrawal, Anup, and Gershon N. Mandelker. 1987. "Managerial Incentives and Corporate Investment and Financing Decisions." *Journal of Finance* 42: 823-837.
2. Amihud, Yakov and Baruch Lev. 1981. "Risk Reduction as a Managerial Motive for Conglomerate Mergers". *Bell Journal of Economics* 12: 605-617.
3. Berger, Philip G., Eli Ofek and David L. Yermack. 1997. "Managerial Entrenchment and Capital Structure Decisions." *Journal of Finance* 52: 1411-1438.
4. Calomiris, Charles w. and Charles M. Kahn. 1991. "The Role of Demandable Debt in Structuring Optimal Banking Arrangements". *American Economic Review* 81 (3): 497-513.
5. Chen, Carl R., Thomas L. Steiner and Ann Marie Whyte. 2001. "Risk-Taking and Executive Compensation Structure in the Banking Industry". Unpublished paper, University of Dayton.
6. Demsetz, Rebecca S., Marc R. Saidenberg and Philip E. Strahan. 1997. "Agency Problems and Risk Taking at Banks." *FRBNY Research Paper* # 9709.
7. Diamond, Douglas W. and P.H. Dybvig. 1983. "Bank Runs, Deposit Insurance, and Liquidity". *Journal of Political Economy* 91: 401-419.
8. Diamond, Douglas W. and Raghuram G. Rajan. 1998. "Liquidity Risk, Liquidity Creation and Financial Fragility: A Theory of Banking". Unpublished Paper, University of Chicago.
9. Duan, Jin-Chuan, Arthur F. Moreau and C.W. Sealey. 1992. "Fixed-rate Deposit Insurance and Risk-shifting Behavior at Commercial Banks". *Journal of Banking and Finance* 16: 715-742.

10. Gorton, Gary and Richard Rosen. 1995. "Corporate Control, Portfolio Choice, and the Decline of Banking." *Journal of Finance* 50: 1377-1420.
11. Hall, Brian J. and Jeffrey B. Liebman. 1998. "Are CEOs Really Paid like Bureaucrats?". *The Quarterly Journal of Economics* 113: 653-691.
12. Holmstrom, Bengt. 1979. "Moral Hazard and Observability". *Bell Journal of Economics* 10: 74-91
13. Houston, Joel F. and Christopher James. 1995. "CEO Compensation and Bank Risk: Is Compensation in Banking Structured to Promote Risk Taking?". *Journal of Monetary Economics* 36: 405-431.
14. Hovakimian, Armen and Edward J. Kane. 2000. "Effectiveness of Capital Regulation at U.S. Commercial Banks, 1985 to 1994". *Journal of Finance* 55: 451-468.
15. Hughes, Joseph P., William W. Lang, Choon-Geol Moon and Michael S. Pagano. 2003. "Managerial Incentives and the Efficiency of Capital Structure in U.S. Commercial Banking". Unpublished paper, FRB Philadelphia.
16. Jensen, Michael C. and William H. Meckling. 1976. "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics* 3: 305-360.
17. Jensen, Michael C. and Kevin J. Murphy. 1990. "Performance Pay and Top-Management Incentives". *Journal of Political Economy* 98: 225-264.
18. John, Kose, Anthony Saunders and Lemma Senbet. 2000. "A Theory of Bank Regulation and Management Compensation". *Review of Financial Studies* 13: 95-125.
19. Keeley, Michael C. 1990. "Deposit Insurance, Risk, and Market Power in Banking". *American Economic Review* 80: 1183-1200.
20. Lee, Seok Weon. 2002. "Insider Ownership and Risk-Taking Behavior at Bank Holding Companies". *Journal of Business Finance & Accounting* 29: 989-1005.
21. Marcus, Alan J. 1984. "Deregulation and Bank Financial Policy". *Journal of Banking and Finance* 8: 557-565.
22. Merton, Robert C. 1977. "An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees". *Journal of Banking and Finance* 1: 3-11.
23. Palia, Darius. 2001. "The Endogeneity of Managerial Compensation in Firm Valuation: A Solution". *The Review of Financial Studies* 14: 735-764.
24. Saunders, Anthony, Elizabeth Strock and Nickolaos G. Travlos. 1990. "Ownership Structure, Deregulation, and Bank Risk Taking". *Journal of Finance* 45: 643-654.
25. Smith, Clifford W. and Ross L. Watts. 1992. "The Investment Opportunity Set and Corporate Financing, Dividend, and Compensation Policies". *Journal of Financial Economics* 32: 263-292.
26. Yermack, David. 1995. "Do Corporations Award CEO Stock Options Effectively?". *Journal of Financial Economics*, 39: 237-269.