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Interest rates and the risk-taking incentives of bank CEOs

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Abstract

The risk-taking channel of monetary policy predicts a negative relationship between interest rates and the risk-taking incentives of bank CEOs. Using a sample of U.S. banks over the period 1992-2006, we provide empirical evidence consistent with this prediction. Our finding holds for both short-term and long-term interest rates.

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1. Introduction

A recent line of research argues that there is a significant link between interest rates and bank risk taking. This link is termed the risk-taking channel of monetary policy (Borio and Zhu, 2008). Researchers have offered several explanations why interest rates may affect bank risk taking. For example, low interest rates may reduce banks' incentives to screen out risky borrowers (Dell'Ariccia and Marquez, 2006), motivate banks to invest in risky assets that offer higher yields (Rajan, 2006), increase bank lending capacity (Adrian and Shin, 2000), and encourage banks to take more liquidity risk (Diamond and Rajan, 2009).

Within the context of corporate governance, agency theory argues that shareholders and managers usually have different risk-taking incentives (e.g., Jensen and Meckling, 1976; John, Litov, and Yeung, 2008). Diversified shareholders would like to invest in positive NPV projects regardless of project risk. Managers, however, may pass up some positive NPV but risky projects in order to protect their firm-specific human capital (e.g., Amihud and Lev, 1981) and private benefits of control (e.g., Williams, 1987). One of the most important ways through which shareholders can influence the risk-taking behavior of managers is incentive contract (e.g., Smith and Stulz, 1985; John and John, 1993).

Since the risk-taking channel of monetary policy predicts that shareholders want their banks to take higher risk when interest rates are lower, while the agency theory argues that shareholders can influence bank risk taking through incentive contract, it is reasonable to hypothesize, therefore, that shareholders will provide bank managers with stronger risk-taking incentives when interest rates are lower. Our purpose in this paper is to conduct an empirical test of this hypothesis.

We construct a sample of U.S. banks over the period 1992-2006. Following the recent literature, we measure the risk-taking incentives of bank CEOs using the sensitivity of CEO option portfolio to equity risk (vega). Knopt, Nam, and Thornton (2002) find that vega is a better measure of managerial risk-taking incentives than the proxies used in earlier studies. Mehran and Rosenberg (2008), Belkhir and Chazi (2010), and DeYoung, Peng, and Yan (2010) find that vega is positively related to bank risk taking.

Consistent with our hypothesis, we find a negative and significant relationship between interest rates and vega. This finding holds for both short-term and long-term interest rates, and is robust to controlling for standard vega determinants such as bank size, investment opportunities, and CEO tenure.

Our paper contributes to the literature in two ways. First, we contribute to the literature that examines the risk-taking channel of monetary policy. Previous studies have examined the relationship between interest rates and bank risk taking (e.g., Ioannidou, Ongena, and Peydro, 2009; Jimenez et al., 2010; Delis and Kouretas, 2011; Maddaloni and Peydro, 2011). We complement these studies by examining the effect of interest rates on the risk-taking incentives of bank CEOs. Second, we contribute to the literature that examines the determinants of vega of bank CEOs (e.g., Belkhir and Chazi, 2010; DeYoung, Peng, and Yan, 2010; Niu, 2010). We add to this literature by showing that interest rate is also an important determinant of vega.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 specifies the empirical model. Section 4 describes the data and summary statistics. Section 5 reports the empirical results. Section 6 concludes.

2. Related literature

Recently, researchers have paid increased attention to the risk-taking channel of monetary policy (Borio and Zhu, 2008). According to this channel, a period of low interest rates can induce banks to increase risk taking. Researchers have offered several explanations why this might be the case.

Dell'Ariccia and Marquez (2006) study a model of bank competition in which banks have private information about the creditworthiness of some borrowers but not others. For the unknown borrowers, banks can choose to use collateral requirements to sort safe from risky borrowers, or they can choose to lend with no collateral requirement. Dell'Ariccia and Marquez show that, when interest rates are low, banks will choose to lend to all borrowers with no collateral requirement. This is because banks' incentives to screen out risky borrowers are low when their costs of funds are low.

Rajan (2006) argues that some financial institutions (such as pension funds) have long-term fixed rate liabilities. When interest rates are low, the yields on safe assets are also low, and investing in safe assets would mean that some financial institutions will default on their liabilities. Hence such financial institutions will invest in risky assets that offer high yields. Given the increased demand for risky assets, banks will manufacture more risky assets through securitization. If banks have to keep a piece of every risk originated, their risk taking will be high when interest rates are low.

Adrian and Shin (2010) observe that a reduction of short-term interest rates usually leads to an increase in term spread. Larger term spread means higher profitability and therefore higher forward-looking capital of the banking sector. Such a boost in capital increases bank lending capacity. As a result, some marginal loans that are not made before the boost in bank capital now become feasible. In this way, lower short-term interest rates are associated with higher bank risk taking.

Diamond and Rajan (2009) present a model in which entrepreneurs borrow from banks to invest in long-term projects, and banks take deposits from households. Once projects have been started, households may have an unexpected need to withdraw deposits. Banks will have to call in loans in order to generate the resources to pay deposits. This can lead to costly liquidation of long-term projects. Regulators may want to push down interest rates in the face of such illiquidity. However, anticipation of such intervention can encourage banks to take even more liquidity risk up front.

The risk-taking channel of monetary policy has received strong empirical support. Ioannidou, Ongena, and Peydro (2009) analyze the risk-taking behavior of a sample of banks in Bolivia over the period 1999-2003. They find that a decrease in the federal funds rate in the U.S. leads to

increased risk taking by banks in Bolivia. Jimenez et al. (2010) analyze the records on the granted business loans in Spain over the period 1984-2008. They find that a decrease in short-term interest rates induces lower capitalized banks to increase risk taking. Delis and Kouretas (2011) employ a large sample of European banks over the period 2001-2008 and find that lower interest rates are associated with higher bank risk taking. Maddaloni and Peydro (2011) employ a unique database of the Euro-area and U.S. banks, and find that low interest rates induce banks to soften lending standards for both household and corporate loans.

Notably, previous studies have focused on the risk-taking behavior of banks. To our knowledge, no study has examined the effect of interest rates on the risk-taking incentives of bank CEOs. We attempt to fill this gap in the literature.

3. Empirical model

Belkhir and Chazi (2010) examine the determinants of vega of bank CEOs and the effect of vega on risk taking. They find that larger banks with better investment opportunities and those that operate in a deregulated environment provide their CEOs with higher vega. They also find that vega is positively related to bank risk taking.

Our empirical model is an adaptation of the one used by Belkhir and Chazi (2010). Specifically, we add interest rates to their model:

$$\begin{aligned} Vega_{i,t} = {} & \beta_1 Interest\ rates_t + \beta_2 Size_{i,t-1} + \beta_3 Market - to - book\ ratio_{i,t-1} \\ & + \beta_4 Leverage_{i,t-1} + \beta_5 CEO\ ownership_{i,t-1} + \beta_6 CEO\ tenure_{i,t-1} \\ & + \beta_7 Deregulation_t + \mu_i + \varepsilon_{i,t}, \end{aligned} \quad (1)$$

where *i* denotes the bank, *t* denotes the year, μ_i represents time-invariant, unobserved bank characteristics, and $\varepsilon_{i,t}$ is the error term. Table I presents the definition of variables. Belkhir and Chazi (2010) offer a detailed discussion of each variable (except interest rates) that we briefly summarize below.

Vega is defined as the change in the dollar value of the CEO's option portfolio for a 0.01 change in the annualized standard deviation of the bank's stock returns. We calculate vega using the one-year approximation method developed in Core and Guay (2002). Recent studies such as Belkhir and Chazi (2010), DeYoung, Peng, and Yan (2010), and Niu (2010) use vega to measure the risk-taking incentives of bank CEOs.

Following Maddaloni and Peydro (2011), we use two proxies for interest rates. We use the federal funds rate to proxy for short-term interest rates, and the 10-year yield to proxy for long-term interest rates. The federal funds rate is the primary tool used by the Federal Reserve for implementing monetary policy. It is pivotal in setting short-term interest rates. The 10-year yield influences long-term interest rates such as the interest rates on mortgages.

Size is defined as the book value of assets expressed in billions of dollars. Belkhir and Chazi (2010) argue that it is more difficult for shareholders to monitor the risk-taking decisions of CEOs at larger banks. They also argue that larger banks are better diversified and therefore have a greater capacity to take risk. As a result, shareholders of larger banks should provide their CEOs with higher vega. Consistent with these arguments, Belkhir and Chazi (2010) find a positive relationship between size and vega.

Market-to-book ratio is defined as the ratio of market value of assets to book value of assets. This ratio measures the investment opportunities of the bank. Belkhir and Chazi (2010) argue that the cost of foregoing risk-increasing but positive NPV projects is higher for banks with better investment opportunities. Thus shareholders of such banks should provide their CEOs with higher vega. Consistent with this argument, Belkhir and Chazi (2010) find a positive relationship between the market-to-book ratio and vega.

Leverage is defined as the ratio of book value of liabilities to book value of assets. John and John (1993) argue that CEO compensation contract can serve as a commitment device to reduce the agency costs of debt. Belkhir and Chazi (2010) argue that the agency costs of debt are more severe in the banking industry than in other industries, because banks are highly leveraged and most of bank liabilities are insured deposits. Thus shareholders of banks with higher leverage should provide their CEOs with lower vega. Belkhir and Chazi (2010) find some evidence of a negative relationship between leverage and vega.

CEO ownership is defined as the percentage of outstanding common stock owned by the CEO. CEOs with higher ownership are less diversified, and thus are more likely to forego risk-increasing but positive NPV projects. Accordingly, shareholders should provide such CEOs with higher vega. In their regression analysis, Belkhir and Chazi (2010) find that the coefficient on CEO ownership is not significantly different from zero.

CEO tenure is defined as the number of years that the CEO has spent in office. A priori, the relationship between CEO tenure and vega is not clear. On the one hand, CEOs with longer tenure are more likely to be entrenched, and entrenched CEOs prefer compensation contracts with lower vega. On the other hand, longer tenure might be an indicator of higher quality rather than entrenchment, and high-quality CEOs prefer compensation contracts with higher vega. In their empirical analysis, Belkhir and Chazi (2010) find mixed evidence on the relationship between CEO tenure and vega.

Deregulation is an indicator variable that equals to one for years 2000-2006, and zero for years 1992-1999. The Gramm-Leach-Bliley Act was passed in 1999. It removed historical barriers that prohibited any one institution from acting as any combination of an investment bank, a commercial bank, and an insurance company. Belkhir and Chazi (2010) argue that banks have more investment opportunities after the passage of Gramm-Leach-Bliley Act, and thus shareholders should provide bank CEOs with higher vega in the post-deregulation period. Consistent with their argument, Belkhir and Chazi (2010) find a positive relationship between deregulation and vega. Using a sample of industrial firms as control group, they rule out the possibility that their results are driven by common factors that affect all industries.

4. Data

Our empirical analysis is based on panel data over the period 1992-2006. The sample period starts in 1992 because ExecuComp data starts in that year. The sample period ends in 2006 because we are interested in examining the effect of interest rates on the risk-taking incentives of bank CEOs under normal market conditions (i.e., before the recent financial crisis).

Following DeYoung, Peng, and Yan (2010), we start with a list of commercial banking companies (SIC code 6020) that appear in the ExecuComp database during our sample period. We obtain CEO compensation data from the ExecuComp database, year-end accounting data from the Federal Reserve's FR Y-9C database, stock market data from the CRSP database, and interest rate data from the Federal Reserve Board. Because CEO tenure information is missing for a number of observations in the ExecuComp database, we search for the missing information in the LexisNexis Academic database.

Our final sample consists of 883 observations on 127 banks. To ensure that our results are not driven by outliers, we follow Belkhir and Chazi (2010) and winsorize all the variables (except interest rates and deregulation) at the 1% and 99% levels. The results are qualitatively similar if we do not winsorize.

Table II, Panel A presents summary statistics of the sample. The dependent variable, vega, has a mean value of $181.101 thousand, which is comparable with the mean values reported in DeYoung, Peng, and Yan (2010) and Niu (2010), but substantially larger than the mean value reported in Belkhir and Chazi (2010). This is because the sample of Belkhir and Chazi (2010) is much larger than samples drawn from the ExecuComp database and contains numerous small-sized banks. The mean value of size is $52.889 billion with a standard deviation of $103.048 billion. The average bank has a market-to-book ratio of 1.112 and a leverage of 0.914. The average CEO has a stock ownership of 1.149% and a tenure of 7.541 years.

Panel B presents the federal funds rate and the 10-year yield in each year over the sample period. The federal funds rate ranges from a low of 1.13% in 2003 to a high of 6.24% in 2000. The 10-year yield ranges from a low of 4.01% in 2003 to a high of 7.09% in 1994. The two variables are highly correlated with a correlation of 0.6963. To avoid multicollinearity, in the subsequent regression analysis we do not include both variables in the same regression.

Table III presents the correlation matrix. The highest correlation (0.6794) occurs between vega and size, confirming the importance of controlling for size in vega regressions. Several other correlations are also noteworthy. First, the correlation between size and leverage is positive and significant, suggesting that larger banks have higher leverage. Second, the correlation between size and CEO ownership is negative and significant, suggesting that CEOs of larger banks tend to own a smaller percentage of the common stock of their banks. Finally, the correlation between CEO ownership and CEO tenure is positive and significant, suggesting that CEOs with longer tenure tend to own a larger percentage of the common stock of their banks.

5. Empirical results

Following Belkhir and Chazi (2010), we estimate equation (1) with bank fixed effects. Since observations on the same bank over time are likely to be correlated, standard errors are clustered at the bank level. Table IV reports the regression results.

In column (1), the coefficient on the federal funds rate is negative and significant, suggesting that lower federal funds rate is associated with higher vega. The economic magnitude of the coefficient is also significant: A one percentage point decrease in the federal funds rate is associated with an increase of $20,714 in vega, which is about 11% of the mean value of vega. In column (2), the coefficient on the 10-year yield is also negative and significant. Taken together, these results are consistent with the view that shareholders provide bank CEOs with higher vega when interest rates are lower.

The coefficients on other variables are broadly consistent with those reported in Belkhir and Chazi (2010). In particular, the coefficients on size are positive and significant, suggesting that shareholders of larger banks provide their CEOs with higher vega. The coefficients on market-to-book ratio are positive and significant, suggesting that shareholders of banks with better investment opportunities provide their CEOs with higher vega. The coefficients on deregulation are positive and significant, suggesting that shareholders provide bank CEOs with higher vega after the passage of the Gramm-Leach-Bliley Act in 1999.

We test the robustness of our main regression results in several ways. In the data, vega varies a lot and its distribution is extremely skewed. This variation is paralleled by variation in size. This suggests significant differences between bank CEO contracts of small and large banks. To see whether our results continue to hold for both small and large banks, we split the sample into two subsamples. Each year, small (large) banks are defined as those with size below (above) the median for all banks in our sample in that year. We then run separate regressions for the two subsamples. Columns (1) and (2) of Table V report the regression results for small banks, and columns (3) and (4) report the regression results for large banks. For either subsample, the coefficient on federal funds rate is negative and significant, and the coefficient on the 10-year yield is also negative and significant. Thus, our results hold for both small and large banks.

Over our sample period, banks in the U.S. have gotten larger. This is reflected in our sample as we find significant difference between the size distributions at the beginning and end of the sample period. To address this issue, we include a time trend in the regression. The regression results are reported in columns (1) and (2) of Table VI. The inclusion of time trend does not change our main results.

When interest rates are lower, banks can increase their size by increasing their leverage. Thus, we include an interaction term between interest rates and size to better understand the magnitude of the effect of interest rates on vega. The regression results are reported in columns (3) and (4) of Table VI. The estimated coefficients on federal funds rate and 10-year yield remain negative and significant as those in Table IV, with smaller magnitudes.

6. Conclusion

The risk-taking channel of monetary policy predicts, and recent research documents, that a period of low interest rates can induce banks to increase risk taking. We add to the literature by examining the relationship between interest rates and the risk-taking incentives of bank CEOs. Using a sample of U.S. banks over the period 1992-2006, we find a negative relationship. That is, when interest rates are low, shareholders provide bank CEOs with stronger risk-taking incentives. This finding is consistent with the view that there exists a risk-taking channel of monetary policy, and is important in light of both the recent financial crisis and the current low interest rate regime prevailing in most Western countries.

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Table I
Definition of variables

Variable	Definition
Vega ($ thousands)	The change in the dollar value of the CEO's option portfolio for a 0.01 change in the annualized standard deviation of stock returns
Federal funds rate (%)	The interest rate on overnight unsecured loans among banks
10-year yield (%)	The yield on 10-year Treasury securities
Size ($ billions)	Book value of assets
Market-to-book ratio	The ratio of market value of assets to book value of assets
Leverage	The ratio of book value of liabilities to book value of assets
CEO ownership (%)	The percentage of outstanding common stock owned by the CEO
CEO tenure (years)	The number of years that the CEO has spent in office
Deregulation	An indicator variable that equals to one for years 2000-2006, and zero for years 1992-1999

Table II
Panel A: Summary statistics

	Obs.	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Vega ($ thousands)	883	181.101	294.416	24.961	66.774	197.753
Size ($ billions)	883	52.889	103.048	6.860	18.875	50.440
Market-to-book ratio	883	1.112	0.089	1.052	1.094	1.147
Leverage (%)	883	0.914	0.018	0.904	0.917	0.926
CEO ownership (%)	883	1.149	3.061	0.114	0.278	0.751
CEO tenure (years)	883	7.541	6.296	3.000	6.000	11.000

Panel B: interest rates

	Federal funds rate (%)	10-year yield (%)
1992	3.52	7.01
1993	3.02	5.87
1994	4.21	7.09
1995	5.83	6.57
1996	5.30	6.44
1997	5.46	6.35
1998	5.35	5.26
1999	4.97	5.65
2000	6.24	6.03
2001	3.88	5.02
2002	1.67	4.61
2003	1.13	4.01
2004	1.35	4.27
2005	3.22	4.29
2006	4.97	4.80

Notes: The correlation between federal funds rate and 10-year yield is 0.6963, which is significantly different from zero at the 1% level.

Table III
Correlation matrix

		1	2	3	4	5	6
1	Vega	1.0000					
2	Size	0.6794*	1.0000				
3	Market-to-book ratio	0.1380*	-0.1236*	1.0000			
4	Leverage	-0.1248*	0.1035*	-0.2148*	1.0000		
5	CEO ownership	0.0078	-0.1333*	0.0870*	-0.0480	1.0000	
6	CEO tenure	-0.0269	-0.0930*	0.0840	-0.0335	0.1831*	1.0000

Notes: * indicates significance at the 1% level. Please see Table I for definition of variables.

Table IV
Interest rates and the risk-taking incentives of bank CEOs

	(1)	(2)
Federal funds rate	-20.714*** (5.600)	
10-year yield		-60.567*** (13.447)
Size	2.494*** (0.252)	2.397*** (0.235)
Market-to-book ratio	522.609*** (141.045)	287.150* (158.127)
Leverage	-1,573.698 (1,180.098)	-1,371.957 (1,251.939)
CEO ownership	17.966 (12.691)	18.719 (12.529)
CEO tenure	2.808 (3.479)	2.467 (3.592)
Deregulation	149.726*** (25.308)	120.879*** (26.088)
Bank fixed effects	Yes	Yes
Number of observations	667	667
R-squared	0.689	0.695

Notes: Standard errors are clustered at the bank level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Please see Table I for definition of variables.

Table V
Robustness checks: small versus large banks

	Small banks		Large banks	
	(1)	(2)	(3)	(4)
Federal funds rate	-7.517* (4.170)		-43.175*** (9.591)	
10-year yield		-27.212** (12.475)		-105.278*** (16.964)
Size	5.050** (2.243)	2.879 (2.257)	2.183*** (0.223)	2.005*** (0.198)
Market-to-book ratio	207.097** (86.403)	106.102 (75.004)	511.505** (219.260)	134.371 (213.378)
Leverage	36.243 (1,032.791)	219.767 (1,078.098)	-1,347.424 (1,113.837)	-1,315.531 (1,190.624)
CEO ownership	7.077 (10.114)	7.133 (10.152)	37.919 (38.441)	46.736 (40.810)
CEO tenure	1.792 (1.242)	1.953 (1.232)	3.685 (5.674)	2.923 (6.034)
Deregulation	40.398*** (14.989)	31.090* (17.202)	212.514*** (34.382)	184.699*** (33.567)
Bank fixed effects	Yes	Yes	Yes	Yes
Number of observations	337	337	330	330
R-squared	0.228	0.240	0.762	0.767

Notes: Standard errors are clustered at the bank level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Please see Table I for definition of variables.

Table VI
Robustness checks: including time trend and interaction term

	(1)	(2)	(3)	(4)
Federal funds rate	-18.878***		-12.469***	
	(5.323)		(4.218)	
10-year yield		-53.966***		-52.575***
		(11.693)		(13.328)
Size	2.377***	2.372***	2.821***	3.173***
	(0.249)	(0.244)	(0.397)	(0.810)
Federal funds rate * Size			-0.137*	
			(0.081)	
10-year yield * Size				-0.163
				(0.134)
Market-to-book ratio	365.159**	260.275	554.728***	316.433**
	(157.925)	(165.659)	(140.802)	(156.567)
Leverage	-948.101	-1,282.353	-1,785.484	-1,485.196
	(1,376.963)	(1,315.199)	(1,174.810)	(1,249.460)
CEO ownership	19.015	18.935	16.027	17.765
	(12.742)	(12.600)	(12.220)	(12.456)
CEO tenure	2.409	2.339	3.965	2.978
	(3.685)	(3.701)	(3.227)	(3.490)
Deregulation	86.027**	108.100***	155.760***	123.183***
	(33.158)	(31.214)	(24.853)	(25.567)
Time trend	14.025**	4.189		
	(5.429)	(5.300)		
Bank fixed effects	Yes	Yes	Yes	Yes
Number of observations	667	667	667	667
R-squared	0.696	0.695	0.700	0.700

Notes: Standard errors are clustered at the bank level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Please see Table I for definition of variables.