Reassessment of diversification effects on market values of banks

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Abstract

The effects of income diversification of banks on various risk-adjusted market value measures are reassessed by applying quantile regressions on U.S. bank holding company data from 2000–2010. An indirect effect from a diversified income structure and a direct effect from an increased non-interest income share jointly determine the net effect of income diversification. The first main empirical finding shows a significant discount for the banks in the upper quantiles of the risk-adjusted market value distributions. Second, the net diversification effects change over time. These findings are consistent with the view that the diversification discount reflects an opportunity cost in adjusting a dynamic value-maximizing strategy.

Keywords: Diversification effects, risk-adjusted market values, bank holding companies

JEL Classification: G21

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1 Introduction

Do banks strategically diversify their activities to utilize gains from economies of scope? Does diversification destroy bank valuation and performance? The literature focusing on the cost side of diversification shows several reasons. Most of the diversification studies that show a diversification discount rely on the agency-based argument for which the discount is the result of managerial entrenchment as top management pursues greater control by building empires. Stiroh (2004) and Stiroh and Rumble (2006) show that the benefits of diversified banks are outweighed by the increase in bank risk, and Laeven and Levine (2007) show negative excess values of diversified banks on the basis of the "chop-up" method, both of which support the agency model. Goetz et al. (2013) also support the diversification discount given that geographic diversification intensifies the agency problem. Berger and Humphrey (1991) show that operational and technical inefficiencies dominate scale and scope economies. Ferrier et al. (1993) find diseconomies of diversification attributable to resource overutilization. In contrast, no shortage of research exists that predicts a value premium for diversified banks. One of main functions is to resolve the informational asymmetry and other frictions between capital providers and borrowers (Diamond, 1991; Rajan, 1992). Drucker and Puri (2005) find that both issuers and financial intermediaries benefit from concurrent lending and underwriting. Jayaratne and Strahan (1996), Morgan et al. (2004), and Goldberg (2009) show that cross-economy banking boosts efficiency and growth while reducing economic volatility. Recent empirical work by Elsas et al. (2010) finds that diversification improves bank profitability by a higher margin and a lower cost of non-interest business.

Although rich empirical research exists on diversification that shows both a diversification discount and a premium on the basis of the cost and benefit of diversification, to date these studies have relied on static analyses in that the empirical results are primarily based on cross-sectional or full-sample panel regression analyses. In contrast, the dynamic view of diversification in which firms diversify activities as a dynamic value-maximizing strategy is gaining attention in the literature on non-banking firms. Matsusaka (2001) develops a model that explains diversification as a search and matching process for a new product or industry that is a good match for organizational capabilities. Maksimovic and Phillips (2002) suggest that firms allocate resources efficiently across segments depending on their comparative advantage, and that a diversification discount is consistent with profit maximization in that firms have a higher opportunity cost of diversification in more productive segments. Campa and Kedia (2002) provide evidence that firms self-select to diversify and emphasize the importance of considering the endogeneity of the diversification decision. The dynamic view predicts that a diversification strategy is costly at an early matching stage with a loss of comparative advantage and becomes profitable after the initial stage as a value-maximizing strategy, which is likely to provide a dynamic pattern of net effects from discount to premium.

This paper empirically investigates whether the view of diversification as a dynamic value-maximizing strategy is applied to the context of the banking industry. More specifically, we identify dynamic and heterogeneous patterns of diversification effects on various risk-adjusted accounting- and market-based performance measures by applying the quantile regression approach, as proposed by Koenker and Bassett (1978), to the sample of U.S. bank holding companies (BHCs) across sub-periods within 2000–2010. Our sample period is in line with those of the aforementioned studies that found the diversification discount, which enables us to reevaluate the diversification effects directly in comparison with the prior studies. In addition, because the circumstances under which banks make the optimal decision to diversify their activities differ, depending on business conditions and bank characteristics, the costs and benefits that determine the valuation effects of diversification also likely vary across performance distribution and over time. We take the first step to apply the methodology to bank data to investigate whether the diversification is justified as a dynamic optimal strategy in the banking business.

The Gramm-Leach-Bliley (GLB) Act of 1999 (also known as the Financial Services Modernization Act) effectively repealed the Glass-Steagall Act of 1933 and allowed commercial banking companies to expand their scope of businesses into broad-based securities and insurance segments.[1] Accordingly, the sample BHCs operate on the same playing field and the effects of diversification on valuations are more robustly observed after 1999. Furthermore, the dynamic process of strategic diversification can be analyzed in a simple manner by separating the full sample period into two sub-periods. A dynamic model of diversification suggests that, in an earlier period, diversified banks might show a value discount as they allocate resources to searching and making trial-and-error adjustments for a new business, leading to incurring an opportunity cost through the loss of efficiency in the existing business. Then, after a costly search and adjustment process, the benefits of a strategic diversification decision from a successful matching is likely to come out in a later period.

In addition to the time-varying patterns of diversification effects, identifying the opportunity cost that represents a loss of efficiency during the adjustment period is critical to testing the dynamic process of diversification. As emphasized by Maksimovic and Phillips (2002), the amount of the opportunity cost is likely to be distinct across the sample banks with different comparative advantage status, and the quantile regression is a relevant econometric tool for capturing the opportunity cost by estimating the net effect of diversification not only at the average level but across the full distribution of bank performance. Furthermore, because the distributions of various bank performance measures tend to be positively skewed and are difficult to fully correct by simply transforming relevant variables or data, the standard regression approach may not be able to properly capture the central tendency of the relation between bank activity and performance, whereas quantile regression provides more insights and economic interpretations during the empirical analysis of the diversification effects. Various risk-adjusted performance measures from market information are employed to enable our evaluation of banks' diversification effects.

Our empirical findings are summarized as follows. The net effect of income diversification is determined by an indirect effect through a diversified income structure and a direct effect of increased non-interest income share. An estimation of the direct and indirect effects across the

[1] U.S. bank holding companies were allowed to partially diversify by establishing Section 20 investment banking subsidiaries during the 1990s.

performance quantiles in the earlier sub-period indicates that, first, the negative effects tend to dominate the positive effects, leading to a diversification discount, which is consistent with the result of recent empirical research such as Stiroh and Rumble (2006) and Laeven and Levine (2007). More interestingly, the diversification discount is found to become significant in the upper quantiles of the performance distributions. This result is consistent with the view of Maksimovic and Phillips (2002) in that high-performance banks lose more efficiency by diversifying their revenue structure into non-interest business because they have a comparative advantage in the current interest income business; thus, banks in the upper performance quantiles have to pay higher opportunity costs in the form of efficiency loss for diversification.

We then apply the same analysis to the later sub-period and find that the positive effect dominates the negative effect and that the net diversification effect reverts from discount to premium after 2006. This result clearly supports the view of diversification as a dynamic value-maximizing strategy in that the diversification discount seems to be a product of early-stage searching and the adjustment cost of diversification. Once the costly stage ends, the benefit side is a dominant component in determining the net diversification effect. Prior literature that found a diversification discount focused primarily on the period up to the early 2000s, which corresponds to the early stage of universal banking, and the later 2000s period is found to provide quite a different picture of the diversification effect. If diversification simply brings a discount to bank performance, banks has no reason to decide to diversify. The reason banks diversify their revenue structure toward non-traditional non-interest business despite an observed discount is that they are willing to pay a short-term opportunity cost to achieve long-term benefits. Taking into account the potentially endogenous nature of the diversification decisions of banks as raised by Campa and Keida (2002), we perform the specification test suggested by Hausman (1978) for endogeneity of the share of non-interest income, which proves to support robustness of our results. In summary, our study contributes to the literature by providing empirical evidence on the view of diversification as a dynamic value-maximizing strategy, under which the diversification discount found in the extant studies can be interpreted as an early-stage adjustment cost.

This paper is organized as follows. Section 2 describes in detail the estimation methodology, quantile regression approach, and data source for the sample banks. The main risk-adjusted performance and diversification measures, and the list of control variables selected for our regression analysis, are described in this section. Section 3 presents the empirical results from the quantile regressions for the two sub-periods. The result for the Hausman test is also reported in this section. Section 4 concludes the paper.

2 Estimation and data

2.1 Quantile regression

The most appealing feature of a quantile regression is its ability to estimate quantile-specific effects that describe the impact of covariates not only on the center but also across the full outcome distribution. Because the standard mean regression technique treats the average relationship between a dependent variable and a set of covariates on the basis of the conditional mean function, the central effects obtained through the mean regression provide interesting summary statistics to depict a representative relationship. However, the estimated mean relation fails to describe the full distributional impact unless the conditioning variables affect the central and tail quantiles in the same manner. Furthermore, the mean regression may not properly capture the central tendency, particularly when the distribution is skewed. In contrast, the quantile regression presents the relationships at different quantiles of the outcome distribution. For example, the median quantile regression can provide a better representation of a central tendency and is more robust to outliers than the standard least squares regression under skewed distributions. Given that a small number of large banks have taken a significant portion of the market share in the banking industry and the widespread proliferation of universal banking, particularly since the repeal of the Glass-Steagall Act in 1999, sample banks' performance distributions tend to be positively skewed. Moreover, in many cases, a transformation of the variables or truncation of the sample is not enough to correct the excess skewness; otherwise, a significant number of observations may be lost.

Corresponding to this issue, an analysis that considers the full performance distribution is desirable to gain a richer insight into the valuation impact of the diversification decision of banks under their current performance and efficiency status.

In this paper, the main methodology employed to address the heterogeneous nature of banks' decisions to diversify is the quantile regression method applied to a panel data setup. The quantile analysis that considers the full performance distribution is desirable to gain a richer insight into the valuation impact of the diversification decision of banks under their current performance and efficiency status. Furthermore, the quantile regression applied to sub-periods of the full sample directly addresses the time-varying natures of banks' diversification decisions. Formally, for each bank i and each time t, the conditional τ-th quantile ($0 < \tau < 1$) of a performance measure $Y_{i,t}$, $Q(Y_{i,t} \mid X_{i,t}, Z_i)$, given a set of control variables $X_{i,t}$ taken from financial statements with time fixed effects and a set of individual bank-specific variables Z_i including constants and bank-specific dummy variables, is estimated by solving the following equations:

$$\min_{\alpha,\beta}\left[\sum_{(i,t)\in\{(i,t):Y_{i,t}\geq\alpha Z_i+\beta X_{i,t}\}} \tau\left|Y_{i,t}-\alpha Z_i-\beta X_{i,t}\right| + \sum_{(i,t)\in\{(i,t):Y_{i,t}<\alpha Z_i+\beta X_{i,t}\}} (1-\tau)\left|Y_{i,t}-\alpha Z_i-\beta X_{i,t}\right|\right], \quad (1)$$

yielding

$$Q(Y_{i,t} \mid X_{i,t}, Z_i) = \alpha^{(\tau)} Z_i + \beta^{(\tau)} X_{i,t}. \quad (2)$$

Because we apply the quantile regression to panel data, we need to calculate the clustered standard errors for a linear panel model. We utilize the procedure provided by Machado et al. (2011) in calculating clustered standard errors.

2.2 Data and selection of sample banks

Sample banks for our analysis are chosen from the quarterly Federal Reserve (FR) Y-9C reports that include the consolidated balance sheets and income statements of all U.S. top-tier BHCs, on the basis of the following criteria. Whereas our full sample periods are from the first quarter of 1998 to the fourth quarter of 2010, the initial two years' sample is used as the window periods to reflect the conditional properties of the main risk measures, such as return volatility or beta, to enable the regression sample to start from the first quarter of 2000. We choose the regression period from 2000 to analyze bank activities and performance after the repeal of the Glass-Steagall Act. Then we divide the full period into two sub-periods, from 2000 to 2005 and from 2006 to 2010, to seek evidence of a dynamic change in the pattern of the diversification effect over time. We divide the sample in this manner to maintain similar numbers of observations between the sub-periods, and focus on banks with total assets of more than $500 million to minimize the scale effects from comparing the results between the two sub-periods. This sub-period analysis is also useful to test whether our regression results, particularly from the earlier period observations, are consistent with the results from the prior literature, because the diversification discount in Stiroh and Rumble (2006) and Laeven and Levine (2007) is obtained from a sample period in the early 2000s.

Several additional conditions are imposed for a bank to be included in the sample. First, only BHCs with positive book value of equity as well as with balance sheet reports for the recent consecutive eight quarters are included. Second, because our focus is on the effect of income diversification on banks' risk-adjusted market value performance, the ratio of non-interest income to total operating income must be between zero and one, which is consistent with Stiroh and Rumble (2006). We then map between the bank identifications of the FR Y-9C (RSSD9001) and the Center for Research in Security Prices (PERMCO) obtained from the Federal Reserve Bank of New York to use data on the market values of equity and stock market returns.[2] We further require that a BHC should have historical stock returns for the recent consecutive 24 months for each quarter-end reporting date. This condition is necessary for deriving the time-varying volatility and market beta using two-year rolling windows. These criteria result in the first sub-period (2000–2005) including 7,154 quarter-bank observations and the second sub-period (2006–2010) including 5,970 observations.

[2] See http://www.ny.frb.org/research/banking_research/datasets.html.

2.3 Risk-adjusted market value and diversification measures

Three different variables are considered for the risk-adjusted market performance measures. The first one is the volatility-adjusted Tobin's Q (VTQ), which is the Tobin's Q—the ratio of the market value of common stock plus the book value of preferred stock and surplus plus the book value of total liabilities to the book value of total assets—divided by the 24-month standard deviation. The second measure is the volatility-adjusted stock return (VRET), which is the quarterly compounded stock return from monthly return data divided by the standard deviation of 24 months of returns. The third measure is the beta-adjusted stock return (BRET), which is the excess return over the fair market return—the market beta times the market portfolio return. Because the market beta captures the amount of exposure to market risk, it is also interpreted as a measure of systemic risk. In our analysis, we use the equally weighted average of three industry portfolio returns—banking, insurance and trading—out of the Fama-French 48 industry portfolios as a proxy for the market portfolio to control for the fair return component within the financial industry. The beta of each BHC is derived by regressing 24 months of stock returns on the financial market return.

Following Stiroh and Rumble (2006) and Laeven and Levine (2007), we derive our main diversification measure from the composition of total operating income between net interest income and non-interest income. That is, the income diversification measure DIV_{Income} is defined as

$$DIV_{Income} = 1 - (SH_{int}^2 + SH_{nonint}^2), \tag{3}$$

where the shares of net interest income (SH_{int}) and non-interest income (SH_{nonint}) are derived as

$$SH_{int} = \frac{\text{Net interest income}}{\text{Total operating income}}, \; SH_{nonint} = 1 - SH_{int}. \tag{4}$$

DIV_{Income} takes a maximum value of 0.5, which indicates complete diversification from a 50–50 distribution of total operating income between net interest and non-interest components. In addition to the diversification measure, we explicitly include the share of non-interest income SH_{nonint} as another explanatory variable in our regression analysis.

We also include various control variables that potentially affect the risk-adjusted market values of BHCs in light of the recent literature on bank diversification. To control for a potential size effect, the natural logarithm of total assets in real values transformed by dividing nominal values by the personal consumption expenditure (PCE) price index is included. We also include the real growth rates of total assets and total operating income by subtracting the PCE inflation rate from the nominal growth rates, as well as the squared real asset growth. Capital asset ratio (CAR) is included as another control variable to control for the book value-based financial condition. We additionally add the variables for the balance-sheet composition of bank assets, proxied by the ratio of the non-loan component out of total assets, and liabilities, proxied by the ratio of non-deposits to the total liabilities, to the set of control variables. While bank-level fixed effects may be used to control for individual bank characteristics, inclusion of dummy variables for all individual banks is likely to cause a convergence problem in applying the quantile regression method. Accordingly, we include the state-level fixed effects in line with Stiroh and Rumble (2006) and Goetz et al. (2013). To control for the time variation, the quarter fixed effects are also included in all the regressions.

3 Empirical results

This section presents the regression results using the selected risk-adjusted market value measures of banks on the diversification variables, along with the other control variables. As explained in the previous section, the primary focus of this paper is to evaluate the net effects of income diversification across full distributions of risk-adjusted market values of banks by applying the quantile regression method in (1). Table 1 provides the summary statistics of the sample BHCs for the two sub-periods, where the top panel shows the statistics for the first sub-period and the bottom panel shows the statistics for the second sub-period with the qualification that total assets exceed $500 million. The average size is approximately $20 billion for the first sub-period and $33 billion for the second sub-period, with an average SH_{nonint} in the 0.25–0.27

range. Excess skewness is observed in the last column of Table 1 for the selected market value measures, which gives us good motivation to apply the quantile regression analysis.

Table 1. Summary statistics

Variable	N	Mean	Median	Std. Dev.	Minimum	Maximum	Skewness
				2000:Q1-2005:Q4			
VTQ	7154	66.952	57.524	40.983	1.586	419.372	2.060
VRET	7154	0.667	0.547	1.671	-5.305	10.064	0.402
BRET	7154	0.046	0.033	0.130	-0.543	1.349	1.055
DIV_{Income}	7154	0.346	0.356	0.101	0.020	0.500	-0.563
SH_{nonint}	7154	0.266	0.235	0.149	0.010	0.987	1.695
Asset($bn)	7154	19.602	1.697	98.474	0.500	1,547.789	10.030
CAR	7154	0.094	0.090	0.043	0.018	0.843	10.700
Non-loan	7154	0.352	0.334	0.135	0.056	0.998	1.401
Non-deposit	7154	0.195	0.166	0.144	0.003	1.000	2.018
				2006:Q1-2010:Q4			
VTQ	5970	68.810	53.893	51.582	3.420	489.348	2.239
VRET	5970	-0.252	-0.222	2.047	-6.252	9.756	0.089
BRET	5970	-0.033	-0.030	0.208	-0.889	2.547	1.101
DIV_{Income}	5970	0.335	0.350	0.111	0.000	0.500	-0.567
SH_{nonint}	5970	0.251	0.228	0.143	0.000	0.993	1.582
Asset($bn)	5970	33.026	2.031	195.393	0.500	2,370.594	8.947
CAR	5970	0.095	0.092	0.046	0.001	0.816	10.073
Non-loan	5970	0.308	0.288	0.129	0.041	0.982	1.682
Non-deposit	5970	0.187	0.161	0.132	0.004	0.992	2.537

Table 1 reports the summary statistics of the main variables used for our regression analyses on the market sample, including the number of observations (N), mean, median, standard deviation (Std. Dev.), minimum, maximum and skewness. VTQ is the volatility-adjusted Tobin's Q, and VRET and BRET are the volatility-adjusted and beta-adjusted stock market returns, respectively. DIV_{Income} is the income diversification measure and SH_{nonint} is the share of non-interest income to total operating income. Asset ($bn) is total assets in billions of USD, CAR is the capital asset ratio, non-loan is the ratio of total loans to total assets, and non-deposit is the ratio of total deposits to total liabilities. The top panel shows the results of the statistics from 2000:Q1 to 2005:Q4 and the bottom panel shows the results from 2006:Q1 to 2010:Q4. The sample banks have total assets larger than $500 million.

3.1 Mean and quantile regressions

Table 2 summarizes the results of mean and quantile regressions, where the top panel reports the results of the first sub-period and the bottom panel reports those of the second sub-period. For VTQ regressions, the signs of the coefficients on DIV_{Income} that reflect the indirect effect of diversification are positive, and the signs of the coefficients on SH_{nonint} that reflect the direct effect of diversification are negative. However, the coefficients of VRET and BRET show the opposite signs to those of the VTQ regressions. That is, the indirect effect via diversification on the stock market returns is negative while the direct effect of noninterest income share is positive. How do we interpret the opposite directions of these effects for the market return measures in comparison with those of VTQ? Our interpretation is that, while Tobin's Q reflect market valuation for bank assets, the stock returns reflect the "risk premia," which is compensation for corresponding source of risk. As previously stated, a high degree of diversification indicates a diversified income structure and lower risk via stabilized revenue profile, while a high noninterest income share is likely to generate extra volatility to the interest-based income structure. As a result, both negative coefficient on DIV_{Income} and positive coefficient on SH_{nonint} imply that higher income risk causes higher stock return as a form of additional premium.

Table 2. Mean and quantile regressions

	Mean	10%	30%	50%	70%	90%
			2000:Q1-2005:Q4			
			VTQ			
DIV_{Income}	38.445 (16.176)**	30.449 (9.523)***	26.938 (11.624)**	44.245 (13.126)***	33.444 (25.796)	13.355 (40.779)
SH_{nonint}	-46.659 (14.813)***	-40.936 (9.572)***	-41.703 (8.850)***	-46.792 (10.645)***	-38.276 (22.120)*	-9.623 (40.451)
Log(Asset)	-3.795 (0.985)***	-0.360 (0.727)	-1.213 (0.871)	-2.554 (0.858)***	-3.382 (1.012)***	-5.832 (1.516)***
CAR	-103.882 (32.607)***	-84.462 (46.357)**	-79.509 (73.547)	-54.601 (29.120)*	-68.857 (46.587)	-168.679 (83.896)**
Non-loan	16.779 (12.828)	-1.805 (7.843)	5.541 (9.341)	7.387 (12.336)	12.239 (16.990)	21.101 (22.310)
Non-deposit	31.863 (13.347)**	11.018 (7.326)	18.628 (8.847)**	18.385 (9.455)*	21.680 (14.397)	29.235 (28.386)
Asset gr	-25.085 (9.440)***	-27.623 (6.980)***	-19.388 (14.149)	-15.994 (10.546)	-22.399 (14.560)	-12.667 (16.879)
Asset gr^2	7.682 (9.346)	20.257 (7.011)***	8.530 (12.731)	1.611 (12.379)	4.887 (13.256)	-11.285 (14.229)
Income gr	0.805 (1.901)	0.407 (1.674)	0.720 (1.674)	-0.114 (2.417)	1.994 (2.051)	1.823 (4.473)
Adj. R^2	0.248	0.170	0.219	0.233	0.235	0.217
			VRET			
DIV_{Income}	-0.726 (0.304)**	0.181 (0.498)	-0.198 (0.361)	-0.386 (0.310)	-0.969 (0.560) *	-1.715 (0.504)***
SH_{nonint}	0.392 (0.272)	-0.482 (0.370)	0.053 (0.295)	0.016 (0.246)	0.298 (0.402)	0.992 (0.402)**
Log(Asset)	-0.032 (0.013)**	0.051 (0.024)**	0.014 (0.018)	-0.024 (0.019)	-0.048 (0.023)**	-0.121 (0.024)***
CAR	-0.283 (0.625)	0.744 (0.969)	0.404 (1.092)	0.867 (0.647)	-0.704 (0.786)	-1.566 (0.819)*
Non-loan	-0.424 (0.141)***	-0.441 (0.243)*	-0.574 (0.182)***	-0.510 (0.182)***	-0.175 (0.192)	-0.147 (0.291)
Non-deposit	-0.186 (0.171)	-0.170 (0.272)	-0.063 (0.234)	0.030 (0.209)	0.037 (0.286)	0.018 (0.288)
Asset gr	0.695 (0.378)*	1.576 (0.664)**	0.565 (0.544)	0.413 (0.489)	0.353 (0.367)	0.370 (0.628)
Asset gr^2	-0.731 (0.513)	-1.982 (0.616)***	-0.640 (0.784)	-0.727 (0.422)*	-0.339 (0.384)	-0.371 (0.565)
Income gr	0.303 (0.121)**	0.280 (0.187)	0.342 (0.091)***	0.487 (0.129)***	0.417 (0.252)*	0.324 (0.260)
Adj. R^2	0.251	0.208	0.239	0.247	0.242	0.220

			BRET			
DIV_{Income}	-0.060 (0.032)*	0.067 (0.030)**	-0.002 (0.021)	-0.022 (0.025)	-0.091 (0.033)***	-0.155 (0.071)**
SH_{nonint}	0.062 (0.032)*	-0.083 (0.026)***	0.001 (0.018)	0.003 (0.021)	0.063 (0.027)**	0.139 (0.063)**
Log(Asset)	-0.005 (0.001)***	0.002 (0.001)*	0.000 (0.001)	-0.003 (0.001)**	-0.006 (0.001)***	-0.015 (0.003)***
CAR	-0.077 (0.042)*	0.012 (0.047)	0.032 (0.032)	-0.016 (0.046)	-0.076 (0.032)**	-0.288 (0.093)***
Non-loan	-0.043 (0.013)***	-0.027 (0.019)	-0.053 (0.013)***	-0.043 (0.014)***	-0.019 (0.015)	-0.016 (0.033)
Non-deposit	0.001 (0.016)	0.003 (0.017)	0.005 (0.013)	0.025 (0.015)*	0.008 (0.016)	0.037 (0.042)
Asset gr	0.076 (0.032)**	0.110 (0.055)**	0.049 (0.032)	0.057 (0.035)	0.040 (0.076)	0.068 (0.063)
Asset gr^2	-0.058 (0.046)	-0.142 (0.052)***	-0.044 (0.029)	-0.069 (0.033)**	0.007 (0.183)	-0.022 (0.079)
Income gr	0.023 (0.011)**	0.031 (0.017)*	0.016 (0.009)*	0.025 (0.008)***	0.018 (0.017)	0.016 (0.037)
Adj. R^2	0.196	0.095	0.169	0.189	0.184	0.153
			2006:Q1-2010:Q4			
			VTQ			
DIV_{Income}	47.928 (19.185)**	35.602 (10.407)***	38.692 (10.514)***	39.265 (14.591)***	39.071 (20.462)*	40.852 (34.026)
SH_{nonint}	-27.821 (19.137)	-26.542 (10.565)**	-23.422 (10.610)**	-19.941 (14.560)	-10.035 (17.175)	-7.659 (35.022)
Log(Asset)	-6.071 (1.162)***	-2.058 (0.626)***	-2.366 (0.647)***	-3.191 (0.738)***	-4.865 (1.096)***	-7.988 (1.708)***
CAR	-110.606 (37.703)***	-12.302 (16.228)	-44.817 (17.610)**	-78.136 (25.034)***	-85.977 (25.469)***	-125.728 (45.099)***
Non-loan	27.796 (17.028)	5.578 (8.947)	21.372 (9.086)**	29.602 (11.311)***	35.109 (14.530)**	64.349 (20.011)***
Non-deposit	58.536 (19.409)***	17.277 (8.837)*	15.241 (10.275)	28.494 (12.544)**	38.039 (14.521)***	72.635 (28.909)**
Asset gr	-21.161 (9.967)**	9.046 (7.135)	-3.833 (8.833)	-7.894 (6.769)	-14.903 (8.429)*	-34.740 (20.334)*
Asset gr^2	9.103 (5.905)	-9.408 (14.513)	-0.928 (20.249)	1.440 (3.243)	3.641 (3.804)	34.674 (20.075)*
Income gr	0.397 (1.241)	0.714 (1.027)	0.884 (1.184)	0.195 (1.295)	-1.654 (0.712) **	0.150 (1.794)
Adj. R^2	0.345	0.271	0.310	0.328	0.331	0.324
			VRET			
DIV_{Income}	0.552 (0.352)	1.446 (0.686)**	0.613 (0.410)	0.504 (0.324)	-0.553 (0.400)	-0.595 (0.796)
SH_{nonint}	0.497 (0.312)	0.037 (0.672)	0.708 (0.353)**	0.417 (0.272)	1.172 (0.372)***	1.124 (0.716)
Log(Asset)	0.010 (0.020)	0.021 (0.036)	0.041 (0.025)*	0.024 (0.019)	0.000 (0.019)	-0.072 (0.039)*
CAR	1.413 (0.865)	1.359 (0.981)	1.488 (1.219)	2.328 (1.085)**	1.694 (0.675)**	0.813 (3.067)
Non-loan	0.825 (0.232)***	0.647 (0.361)*	0.216 (0.270)	0.677 (0.237)***	0.853 (0.280)***	1.108 (0.478)**
Non-deposit	-0.587 (0.246)**	-0.285 (0.426)	-0.423 (0.295)	-0.631 (0.249)**	-0.828 (0.238)***	-0.280 (0.463)
Asset gr	1.378 (0.421)***	1.652 (0.876)*	2.665 (0.773)***	1.456 (1.104)	0.565 (0.424)	0.691 (1.278)
Asset gr^2	-0.780 (0.364)**	-1.512 (1.023)	-2.505 (2.231)	-1.068 (2.373)	-0.319 (0.179)*	0.181 (1.517)
Income gr	0.087 (0.053)*	0.079 (0.036)**	-0.014 (0.010)	0.112 (0.147)	0.039 (0.013)***	0.076 (0.016)***
Adj. R^2	0.352	0.275	0.330	0.346	0.324	0.289
			BRET			
DIV_{Income}	0.106 (0.043)**	0.319 (0.082)***	0.158 (0.045)***	0.075 (0.031)**	0.006 (0.039)	-0.174 (0.083)**
SH_{nonint}	-0.016 (0.037)	-0.157 (0.074)**	-0.032 (0.041)	0.013 (0.026)	0.053 (0.029)*	0.151 (0.069)**
Log(Asset)	-0.002 (0.002)	-0.008 (0.004)**	-0.006 (0.002)**	-0.003 (0.002)*	-0.003 (0.002)*	-0.005 (0.003)**
CAR	0.265 (0.115)**	0.438 (0.158)***	0.341 (0.094)***	0.217 (0.064)***	0.119 (0.074)	-0.213 (0.083)***
Non-loan	0.053 (0.024)**	0.059 (0.051)	0.030 (0.023)	0.036 (0.020)*	0.035 (0.022)	0.094 (0.031)***
Non-deposit	-0.002 (0.027)	0.096 (0.049)**	0.062 (0.029)**	0.010 (0.020)	-0.022 (0.022)	-0.074 (0.036)**
Asset gr	0.258 (0.054)***	0.443 (0.154)***	0.306 (0.062)***	0.184 (0.111)*	0.059 (0.031)*	0.024 (0.123)
Asset gr^2	-0.134 (0.045)***	-0.679 (0.617)	-0.312 (0.121)***	-0.120 (0.231)	-0.030 (0.013)**	-0.004 (0.254)
Income gr	0.020 (0.010)*	0.013 (0.029)	0.003 (0.025)	0.012 (0.022)	0.010 (0.001)***	0.015 (0.001)***
Adj. R^2	0.233	0.116	0.186	0.227	0.196	0.139

Table 2 presents the results of standard OLS (Mean) and quantile regressions for the volatility-adjusted Tobin's Q (VTQ) and the volatility-adjusted (VRET) and beta-adjusted (BRET) stock returns. 10%, 30%, 50%, 70% and 90% indicate the result of quantile regression for each corresponding quantile. DIV_{Income} is the income diversification measure and SH_{nonint} is the non-interest income share that is the ratio of non-interest income to total operating income. The control variables include the natural logarithm of real value of total asset (Log(Asset)), the capital asset ratio (CAR), the ratio of non-loan asset to total asset (Non-loan), the ratio of non-deposit liability to total liability (Non-deposit), asset growth (Asset gr) and income growth (Income gr) in real terms deflated by the PCE inflation rate, and the squared asset growth (Asset gr^2). The numbers in parentheses are the standard errors clustered at the bank level. Adj. R^2 is the adjusted (mean) or pseudo (quantile) R-squared value. All the regressions are controlled for the state and quarter fixed effects. ***, **, and * denote significance at the 1%, 5%, and 10% level.

While the signs on the individual coefficients are opposite, there is a common pattern in the relative magnitude on the direct and indirect effects. In the first sub-period, the magnitude of negative (direct in VTQ and indirect in VRET and BRET) effect is relatively bigger than the other positive effect. However, in the second sub-sample, the size of positive coefficient turns to be bigger than that of negative coefficients. The net effect of SH_{nonint} on the risk-adjusted market values is then evaluated by a combination of these two direct and indirect effects. We evaluate and test the net effect of SH_{nonint} across the full distributions of the market performance measures for each sub-period, fixing the value of SH_{nonint} at the average level of full period in the next section.

Two more points are discussed regarding the coefficients on the control variables. Although we focus on the effect of income diversification by capturing variations in the share of (non-)interest income out of the flow of total income, the shares of (non-)loans out of total assets and (non-)deposits out of total liabilities may also reflect degrees of the diversified asset and liability structure. Table 2 shows that an increased share of non-loan assets tends to contribute to enhancing the risk-adjusted market values of banks especially during the later sub-period, which suggests that banks may benefit from a diversified asset structure by holding securities or trading assets other than loans. We can also observe a non-linear effect of the growth in size on banks' risk-adjusted stock returns. While asset growth (as well as income growth) is positively linked with VRET and BRET, the coefficients on squared asset growth tend to be negative. This result indicates that, whereas an increased business scale contributes to enhancing stock return performance, the marginal contribution of the growth in size seems to decrease.

3.2 Net effects of diversification

Given that the net effect of SH_{nonint} on risk-adjusted market values is determined by the interaction of direct and indirect effects, we now perform a formal statistical evaluation of the net effect of diversification. From (3), DIV_{Income} can be restated as a non-linear function of SH_{nonint} such as

$$DIV_{Income} = 2SH_{nonint} - 2SH^2_{nonint}, \tag{5}$$

enabling the derivation of the net effect of SH_{nonint} on VTQ as

$$\frac{\partial \mathrm{VTQ}}{\partial SH_{nonint}} = \beta_{VTQ,DIV}\frac{\partial DIV_{Income}}{\partial SH_{nonint}} + \beta_{VTQ,SH}, \tag{6}$$

where $\beta_{VTQ,DIV}$ and $\beta_{VTQ,SH}$ are the coefficients on DIV_{Income} and SH_{nonint} in the

VTQ regressions, respectively. Equation (6) clearly shows that the net effect of SH_{nonint} on VTQ is composed of the direct effect $\beta_{VTQ,SH}$ and the indirect effect through diversification, which is the product of $\beta_{VTQ,DIV}$ and $\partial DIV_{Income} / \partial SH_{nonint}$. Obviously, calculation of the net effects is applied in the same manner as the other performance regressions. Table 3 summarizes the estimated net effects of SH_{nonint} on the risk-adjusted market values from the 10% to the 90% quantiles for the earlier sub-period in the left panel and later sub-period in the right panel, respectively. Furthermore, we perform the statistical tests for the net diversification effects under the null hypothesis that the estimated net effects are zero, where the results are reported in the last column of Table 3.

Table 3. Net diversification effects across quantiles

	2000:Q1-2005:Q4				2006:Q1-2010:Q4			
	DIV_{Income}	SH_{nonint}	Net effect	F-test (p-value)	DIV_{Income}	SH_{nonint}	Net effect	F-test (p-value)
				VTQ				
Mean	38.445 (16.176)**	-46.659 (14.813)***	-9.626	0.50 (0.48)	47.928 (19.185)**	-27.821 (19.137)	18.346	1.67 (0.20)
10%	30.449 (9.523)***	-40.936 (9.572)***	-11.605	2.48 (0.12)	35.602 (10.407)***	-26.542 (10.565)**	7.752	1.57 (0.21)
20%	34.320 (11.059)***	-44.659 (9.552)***	-11.600	2.10 (0.15)	38.873 (7.976)***	-24.968 (9.265)***	12.478*	3.50 (0.06)
30%	26.938 (11.624)**	-41.703 (8.850)***	-15.755	2.13 (0.14)	38.692 (10.514)***	-23.422 (10.610)**	13.849**	5.34 (0.02)
40%	36.182 (13.250)***	-44.308 (9.739)***	-9.455	0.69 (0.41)	41.781 (10.388)***	-23.149 (12.037)*	17.097**	5.53 (0.02)
50%	44.245 (13.126)***	-46.792 (10.645)***	-4.172	0.12 (0.73)	39.265 (14.591)***	-19.941 (14.560)	17.882**	4.43 (0.04)
60%	45.390 (19.219)**	-45.297 (18.302)**	-1.575	0.01 (0.91)	35.138 (17.032)**	-15.435 (14.119)	18.412**	3.74 (0.05)
70%	33.444 (25.796)	-38.276 (22.120)*	-6.061	0.14 (0.71)	39.071 (20.462)*	-10.035 (17.175)	27.600**	4.75 (0.03)
80%	25.620 (22.559)	-30.596 (18.812)	-5.917	0.10 (0.75)	37.435 (22.227)*	-0.398 (21.211)	35.662**	6.82 (0.01)
90%	13.355 (40.779)	-9.623 (40.451)	3.241	0.02 (0.89)	40.852 (34.026)	-7.659 (35.022)	31.692*	3.52 (0.06)
				VRET				
Mean	-0.726 (0.304)**	0.392 (0.272)	-0.308	2.37 (0.12)	0.552 (0.352)	0.497 (0.312)	1.029***	20.90 (0.00)
10%	0.181 (0.498)	-0.482 (0.370)	-0.309	0.95 (0.33)	1.446 (0.686)**	0.037 (0.672)	1.430***	12.52 (0.00)
20%	-0.013 (0.437)	-0.309 (0.327)	-0.322	1.44 (0.23)	0.948 (0.939)	0.451 (0.876)	1.365***	24.43 (0.00)
30%	-0.198 (0.361)	0.053 (0.295)	-0.138	0.37 (0.54)	0.613 (0.410)	0.708 (0.353)**	1.299***	21.88 (0.00)
40%	-0.179 (0.342)	0.181 (0.278)	0.009	0.00 (0.97)	0.784 (0.391)**	0.310 (0.325)	1.065***	15.12 (0.00)
50%	-0.386 (0.310)	0.016 (0.246)	-0.356	2.12 (0.15)	0.504 (0.324)	0.417 (0.272)	0.902***	15.02 (0.00)
60%	-0.613 (0.368)*	0.102 (0.296)	-0.489*	3.06 (0.08)	0.055 (0.427)	0.713 (0.390)*	0.766***	10.20 (0.00)
70%	-0.969 (0.560)*	0.298 (0.402)	-0.636*	3.67 (0.06)	-0.553 (0.400)	1.172 (0.372)***	0.640**	5.45 (0.02)
80%	-1.850 (0.529)***	1.031 (0.382)***	-0.751**	4.08 (0.04)	-0.391 (0.528)	0.945 (0.414)**	0.568	2.18 (0.14)
90%	-1.715 (0.504)***	0.992 (0.402)**	-0.661*	2.66 (0.10)	-0.595 (0.796)	1.124 (0.716)	0.551	1.21 (0.27)
				BRET				
Mean	-0.060 (0.032)*	0.062 (0.032)*	0.004	0.06 (0.81)	0.106 (0.043)**	-0.016 (0.037)	0.086***	9.65 (0.00)
10%	0.067 (0.030)**	-0.083 (0.026)***	-0.018	0.75 (0.39)	0.319 (0.082)***	-0.157 (0.074)**	0.151***	9.68 (0.00)
20%	0.036 (0.031)	-0.037 (0.026)	-0.002	0.01 (0.91)	0.246 (0.055)***	-0.068 (0.051)	0.169***	19.50 (0.00)
30%	-0.002 (0.021)	0.001 (0.018)	-0.001	0.01 (0.94)	0.158 (0.045)***	-0.032 (0.041)	0.121***	21.16 (0.00)
40%	-0.010 (0.021)	0.009 (0.017)	-0.001	0.01 (0.94)	0.114 (0.030)***	-0.001 (0.025)	0.109***	25.70 (0.00)
50%	-0.022 (0.025)	0.003 (0.021)	-0.018	1.03 (0.31)	0.075 (0.031)**	0.013 (0.026)	0.084***	14.65 (0.00)
60%	-0.056 (0.025)**	0.023 (0.020)	-0.032*	3.33 (0.07)	0.028 (0.029)	0.052 (0.025)**	0.079***	13.82 (0.00)
70%	-0.091 (0.033)***	0.063 (0.027)**	-0.025	1.19 (0.28)	0.006 (0.039)	0.053 (0.029)*	0.059**	5.82 (0.02)
80%	-0.150 (0.030)***	0.092 (0.025)***	-0.053**	6.03 (0.01)	-0.037 (0.041)	0.066 (0.027)**	0.031	0.90 (0.34)
90%	-0.155 (0.071)**	0.139 (0.063)**	-0.010	0.07 (0.79)	-0.174 (0.083)**	0.151 (0.069)**	-0.017	0.16 (0.69)

Table 3 presents the net effects of SH_{nonint} on the volatility-adjusted Tobin's Q (TVQ) and the volatility-adjusted (VRET) and beta-adjusted (BRET) stock returns during 2001:Q1–2005:Q4 in the left panel and during 2006:Q1–2010:Q4 in the right panel. The net effect of SH_{nonint} on each performance is calculated using equation (6). The mean corresponds to the mean (OLS) regressions, and 10%–90% are the results of the quantile regressions for the corresponding quantiles. The numbers in parentheses are the standard errors for the DIV_{Income} and SH_{nonint} columns and the p-values under the null hypothesis of zero net effect for the F-test column. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

As expected from the estimated coefficients on DIV_{Income} and SH_{nonint} in Table 2, the net effects are primarily negative in the earlier sub-period and become primarily positive in the later sub-period. These results show that the discounting effect of diversification is observed in earlier years, and the diversification effect turns from discount to premium in the later period. In the earlier period, whereas the net effects are statistically insignificant in all the VTQ quantiles, those from the VRET and BRET regressions turn out to be significantly negative and relatively large, particularly in the 60%–90% quantiles. Then, most of the observed net effects are significantly positive in the later period except for the 80%–90% VRET and BRET quantiles. These findings demonstrate that, although a diversification discount exists in the earlier period and the discount is larger in the upper performance quantiles, the net effect changes to a premium in the later period, which is larger in the lower performance quantiles. Overall, our results indicate that we can interpret the pattern of net diversification effects from the viewpoint of a dynamic value-maximizing strategy by understanding the diversification discount as an opportunity cost, captured by the discount in the risk-adjusted market values, in the adjustment process of diversification.

3.3 Robustness: Test for endogeneity

As pointed out by Campa and Keida (2002), the endogeneity issue is critical in the evaluation of diversification effects since we may misleadingly conclude that a diversified firm is discounted in case we fail to control for an endogenous nature of the firm's decision to diversify. To explicitly address this endogeneity issue, we test whether the two variables that represent bank diversification, DIV_{Income} and SH_{nonint} , are endogenous using the Hausman specification test. Specifically, for each risk-adjusted market value measure, we perform the Hausman test under the null hypothesis that either DIV_{Income} or SH_{nonint} is exogenous by selecting their own lags as the instruments, and the results are summarized in Table 4.. The results indicate that none of these variables are found to be endogenous at the standard 5% significance level, indicating that the estimated net diversification effects in Table 3 are not likely to be biased because of endogeneity.

Table 4. Test for endogeneity

Dependent	Endogenous	χ^2 -test (p-value)	
		2000:Q1-2005:Q4	2006:Q1-2010:Q4
VTQ	DIV_{Income}	0.49 (0.48)	0.03 (0.86)
	SH_{nonint}	0.26 (0.61)	0.18 (0.67)
VRET	DIV_{Income}	0.16 (0.68)	0.74 (0.39)
	SH_{nonint}	0.90 (0.34)	0.00 (0.95)
BRET	DIV_{Income}	0.05 (0.83)	3.11 (0.08)
	SH_{nonint}	2.75 (0.10)	2.59 (0.11)

Table 4 reports the results of the Hausman specification test for 2000:Q1–2005:Q4 and 2006:Q1–2010:Q4. The dependent column includes the list of risk-adjusted market value measures as the dependent variables, and the endogenous column includes the income diversification measure (DIV_{Income}) and the share of non-interest income (SH_{nonint}) that are tested under the null hypothesis that these variables are exogenous. For each of DIV_{Income} and SH_{nonint} to be tested for endogeneity, the one-period lagged variables are used as instruments. The last two columns present the values of the χ^2 test statistics and p-values.

4 Conclusions

Because the circumstances in which banks diversify their activities differ depending on business conditions and bank characteristics, the costs and benefits of diversification are likely to differ across performance distributions and over time. We examine diversification effects on various risk-adjusted market value measures of U.S. bank holding companies by applying a quantile regression approach across the sub-periods of 2000–2010. In this manner, we intend to understand the diversification of banks from the viewpoint of a dynamic value-maximizing strategy.

The income diversification measure as a non-linear function of the share of non-interest income to total operating income is used to determine the indirect effect through a diversified income structure and the direct effect of an increased share of non-interest income, which jointly determine the net effect of diversification. By separately applying the quantile regression to various market-based risk-adjusted performance measures across the sub-periods, we estimate the direct and indirect effects over the full performance distributions and over time, and observe interesting patterns regarding the diversification discount versus premium that has been actively debated in the literature.

Our empirical findings are summarized as follows. First, the discounting effect is greater in the upper quantiles than in the lower quantiles of the market value distributions. Second, the net effect of diversification changes over time. That is, whereas the negative effect dominates in the earlier period, which is consistent with the diversification discount in the literature, the net effect reverts to a premium in the later period. A dynamic model of diversification implies that, in an earlier period, diversified banks might show a value discount because their resources are reallocated during the searching and adjustment for non-interest income segments, leading to incurring an opportunity cost that reflects a loss of a comparative advantage in the existing interest income business. Higher opportunity costs are captured by the larger diversification discount in the upper quantiles of the risk-adjusted market value distributions. Then, after the costly adjustment period, the benefits from a successful match with a relevant non-interest income segment is likely to come out in a later period and banks begin to benefit from the diversified income structure as a result of a strategic decision, which leads to the diversification premium. Accordingly, our findings explain the diversification discount found in the prior literature as a reflection of an opportunity cost in the adjustment process and provide insights into understanding bank diversification as a dynamic value-maximizing strategy.

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