

DOES BANK DIVERSIFICATION AFFECT FUNDING COST? EVIDENCE FROM THE U.S. BANKS

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ABSTRACT

We investigate how diversification affects the U.S. bank holding companies' funding cost. We document consistent evidence of a lower deposit rates for banks that engage more in non-traditional banking activities. The quantile regressions which dissect the behaviour of banks at the right tail of deposits costs distribution, point out the leveraged effect of diversification is more pronounced with lower-deposits costs banks. The study also suggests diversified banks enjoy lower funding cost during the crisis. Our study is of interest to regulators and policymakers.

Keywords: Diversification, funding cost, deposit rates

INTRODUCTION

The decision to expand into non-traditional banking activities and its impact to bank riskiness is well documented over the two past decades, especially in the aftermath of the global financial crisis where many blame the deregulation that facilitates *casino-style gambling* on Wall Street and allows banks to involve into highly volatile and complex non-bank activities such as trading and market making. However, whether from the theoretical or empirical perspectives, how the decision to diversify can affect bank risk-taking behaviour still receive attention from scholars, and policy makers. Hence, in this study, we revisit this contentious

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debate, and propose a new empirical investigation on the effect of diversification on bank risk under the perspective of its funding cost. This question is important, since the funding cost of banks in some extent can reflect the financial health of banks, and also affect the bank's investment decisions.

There are two potential channels that can explain the association between diversification and bank funding cost. On the one hand, from the perspective of modern portfolio theory, it is expected that an expansion into different activities reduce the risk (e.g., Brewer, 1989), then lower the funding cost of the diversified banks. Furthermore, under assumption of absence of agency conflicts between banks and borrower, prior literature such as Diamond (1984), and Boyd and Prescott (1986), suggests that expansion into other activities can help banks to reduce risk, then lower their funding cost. However, some may argue that the extent to which diversified banks can benefit from moving toward non-traditional banking activities depends on the co-movement of income stream generated from combined activities (Demirgüç-Kunt & Huizinga, 2010). The cost of diversification could outweigh the benefit in case of high correlation between activities, leading a higher risk for banks (Boyd, Graham, & Hewitt, 1993). Additionally, lack of experience in the newly adopted business may negatively affect bank safety (Jiménez & Saurina, 2004). Another concern related to diversification is the intensified agency problems since functional diversification can increase bank's size as well as bank's opaqueness, leading to discretionary decisions to undertake value-decreasing investments (Berger & Ofek, 1995; Goetz, Laeven, & Levine, 2013). These arguments suggest that banks that move toward non-traditional banking activities may experience higher risks, then higher funding cost.

This study sheds light a straightforward question about how diversification influences bank funding cost by employing the data of U.S. bank holding companies. Following Levine, Lin and Xie (2016), we use the (natural logarithm) bank's costs of (domestic) deposits as the proxy of bank funding cost. That is the implicit rates defined as the interest expenses on deposits divided by the quarterly average of the deposits. Following Stiroh and Rumble (2006), Tran, Hassan and Houston (2019a; 2019b), the variable of interest – bank diversification – is the ratio of non-interest incomes over net operating incomes. Controlling for the effects of different bank characteristics and time fixed effects, our empirical analysis provides consistent evidence on a lower cost of deposits for banks that engage more in non-traditional banking activities. Our findings can be viewed as complementary to Levine et al. (2016) who discover that the geographic expansion of banks across U.S. states lowers their funding costs.

We use then the quantile regressions instead of ordinary least squares (OLS) approach to circumvent the assumption of the homogeneity of the effects of diversification on bank funding cost (Tran et al., 2019a; 2019b). The quantile regressions also help us to analyse the banks behaviour at the tail distribution of deposits costs, which is of interest of investors, regulators and policy makers, since high funding cost reflect critical financial health of banks. We document the relationship between diversification and deposits costs is uniform in sign (negative), but decreases in magnitude (less negative) for the upper quantiles. This evidence indicates diversification not only affects the conditional average deposits costs, but also influences the dispersion of deposits costs. Low-deposits costs banks, leveraged by diversification, are more likely to pay lower costs of deposits. In other words, these results taken together support our previous findings that banks pay lower costs of deposits when engaging into non-traditional banking activities, and the impact on the deposits costs appears to be more profound for lower-deposits costs banks.

We provide a battery of sensitivity tests. We perform our investigation: (1) with the inclusion of additional variables to mitigate the problem of omitted variables, (2) with alternative measures of funding cost, diversification, as well as alternative sub-samples, and (3) with alternative econometric approaches. The results of our robustness tests lend support to our previous finding.

We also address the concern of endogeneity since our findings could be derived from the unobservable bank-specific characteristics, which simultaneously affect the funding cost and the decision of diversification of banks, which in turns lead to potential bias in the OLS framework. We use the Heckman selection model and the propensity scores matching approach. In all specifications, our findings remain quantitatively similar to our main evidence.

Having shown the evidence of lower funding cost for banks that engage more in non-traditional banking activities, we provide further investigation by examining the effects of the global financial crisis on the association between diversification and funding cost. More specifically, we perform our baseline model for the periods before, during and after the crisis of 2007. We document there is always evidence of lower funding cost for diversified banks over these periods, and this effect seems to be more pronounced during the crisis. This evidence is interesting since it documents the bright side of diversification during the time when we need the beneficial gain from diversification most. The evidence supports the findings of DeYoung and Torna (2013) which suggest a higher concentration of stakeholder activities (i.e., investment banking, venture capital, etc.) reduces the probability of bank failure during the crisis.

Our study contributes to the literature in several ways. First, our study contributes to the large literature of bank diversification and its effects to bank activities by providing one of the first investigation of the impacts of diversification on bank funding cost. Prior literature mostly concentrates to bank's risk-taking behaviour. We take a different view when assessing the funding cost of banks. Our main results suggest that diversified banks enjoy a lower cost of deposits.

Second, we provide the evidence of the effects of diversification over the entire range of the deposit rates distribution. While the traditional inference approach only reflects the average behaviour of the sample due the assumption of the homogeneity in the association between diversification and funding cost, it may be a poor method to examine the relationship between funding cost and diversification across the entire industry due to the heterogeneity of our sample. Additionally, the quantile regressions help us to investigate the impact of diversification on the right tail of the funding cost, which is of interest of bank stakeholders such as investors, regulators and policy makers, since banks risk is positively to their funding cost. The quantile regressions suggest that diversified banks experience lower deposits costs across the distribution of deposits costs. More interestingly, lower-deposits costs banks, leveraged by higher proportion of non-interest incomes, are more likely to pay lower costs.

We believe that our study is of interests of regulators and policy makers. In the aftermath of the global crisis, various initiatives such as the Volcker Rule in the U.S., Vickers in the U.K., Liikanen in the E.U., and the recent call for the 21st Century Glass–Steagall Act propose *narrow banking* policies that aim to limit some of the permissible activities of banks. Our evidence of lower funding cost of diversified banks, especially during the crisis, emphasises the bright side of diversification, then casts doubt on these initiatives.

LITERATURE REVIEW

There are two potential channels that can explain the association between diversification and bank funding cost. On the one hand, from the perspective of traditional risk-sharing theory, expansion into different activities reduce the risk (e.g., Brewer, 1989), then lower the funding cost of the diversified banks. It is expected that non-traditional banking activities are non-correlated or weakly correlated with traditional activities, inducing diversification gains (DeYoung & Roland, 2001), a mitigated bankruptcy risk (Saunders & Cornett, 2008), then lower bank funding cost. Additionally, under assumption of absence of agency conflicts between banks and borrower, prior literature such as Diamond (1984), Boyd and Prescott (1986) suggests that expansion into other activities can help

banks to reduce risk, then lower their funding cost, since information retrieved from non-interest income generating activities may help loan-making decisions and make diversified banks more efficient, and consequently enhancing the management of credit risk.

On the other hand, some may argue that nonbank activities may be riskier than traditional banking activities when viewed on a stand-alone basis (Saunders & Walter, 1994). The extent to which diversified banks can benefit from moving toward non-traditional banking activities depends on the co-movement of income stream generated from combined activities (Demirgüç-Kunt & Huizinga, 2010). If the sought-after activity is inherently riskier than banking business, and these activities are highly correlated, the cost of diversification could outweigh the benefit, leading a higher risk for banks (Boyd et al., 1993). Additionally, diversified banks do not benefit risks reduction if there is a lack of expertise in the newly adopted business (Jiménez & Saurina, 2004). Literature documents that diversification raises the concern of intensified agency problems since functional diversification can increase bank's size as well as bank's opaqueness, leading to discretionary decisions to undertake value-decreasing investments (Berger & Ofek, 1995; Goetz et al., 2013). Demsetz and Strahan (1997) suggest that diversification does not translate into a reduction of stock volatility. DeYoung and Roland (2001) show a higher volatility of bank earnings for diversified banks. Stiroh (2004) and Stiroh and Rumble (2006) document that banks may benefit from diversification, but these gains are quickly offset by increased exposure to non-interest incomes. De Jonghe (2010) shows the increased tail beta of diversified banks in Europe. Recently, Holod, Kitsul and Torna (2017), Torna (2018) discover the destabilising characteristics of proprietary trading and venture capital for banks. These arguments suggest that banks that move toward non-traditional banking activities may experience higher risks, then higher funding cost.

To the best of our limited knowledge, extant literature on functional diversification does not consider the effect on bank funding cost.¹ Building on this literature, our study looks at the effect of diversification on the bank funding cost.

DATA AND VARIABLES

To shed light our research question, we collect the data of bank holding companies (BHC) with assets over \$150 million from Y-9C reports of Federal Reserve from 2000:Q1 to 2017:Q4. All bank-quarter observations with missing or incomplete financial data on accounting variables are removed from the model. We exclude observations with negative or nonexistent outstanding loans or deposits. Our dataset contains 59,027 observations for 2,558 BHCs. All financial

ratios are winsorised at 1% level on the top and bottom of their distribution to dampen the effects of outliers. Following Levine et al. (2016), we use the natural logarithm of the costs of deposits (LN_COST_DEPO) as the main proxy in our investigation. Following Stiroh and Rumble (2006), Tran et al. (2019a; 2019b), the variable of interest – bank diversification – is the ratio of non-interest incomes over net operating incomes. We control for bank characteristics. The costs of funding may differ according to bank size, or between banks with different leverage, we include banks size (SIZE), capital ratio (CAPITAL). We also control for differences in profitability by including banks performance (EARNINGS), assets growth (GROWTH). Following Cornett et al. (2011), we also control for the proportion of wholesale funding (WHOLESALE) and unused commitments (UNUS_COMMIT). See Table 1 for definitions, and Table 2 for summary descriptive.

Table 1
Variables definitions

Variables	Definitions
LN_COSTDEPO	Natural logarithm of the cost of (domestic) deposits equals natural logarithm of interest expenses on domestic deposits divided by interest-bearing domestic deposits at the beginning of a period.
NII	Non-interest incomes over the net operating incomes.
SIZE	The natural logarithm of gross total assets.
CAPITAL	Book value of equity over gross total assets.
DUMMY LOSS	A dummy variable that equals one if net income is negative, and zero otherwise.
EARNINGS	Income before taxes, provisions recognised in income over gross total assets.
WHOLESALE	Wholesale funds (also known as managed liabilities in the Federal Reserve Bulletin) are the sum of large time deposits, deposits booked in foreign offices, subordinated debt and debentures, gross federal funds purchased, repos, and other borrowed money, following Acharya and Mora (2015).
UNUS_COMMIT	Unused commitments divided by the sum of unused commitments and loans, following Acharya and Mora (2015).
QFE	Time fixed effects, represented by dummies for each quarter of the sample period.

Table 2
Summary statistics

Panel A									
	N	Mean	S.D.	Min	Max				
LN_COST_DEPO	59027	(4.005)	0.635	(6.293)	(2.994)				
COST_DEPO	59027	0.021	0.011	0.002	0.050				
NII	58408	0.227	0.130	0.000	0.814				
SIZE	59027	13.632	1.246	12.089	19.109				
CAPITAL	59027	0.090	0.029	0.019	0.220				
WHOLESALE	58355	0.218	0.096	0.029	0.514				
UNU_COMMIT	58355	0.132	0.075	0.008	0.387				
EARNINGS	59027	0.016	0.009	(0.020)	0.051				
GROWTH	59027	0.020	0.044	(0.085)	0.229				
Panel B									
	LN_COST_DEPO	NII	SIZE	CAPITAL	WHOLESALE	UNU_COMMIT	EARNINGS	GROWTH	LN_COST_DEPO
NII	-0.1505***	1							NII
SIZE	-0.2111***	0.3809***	1						SIZE
CAPITAL	-0.1837***	0.0670***	0.0505***	1					CAPITAL
WHOLESALE	0.2651***	-0.0014**	0.1734***	-0.2359***	1				WHOLESALE
UNU_COMMIT	0.0011**	0.0881***	0.3569***	-0.0972***	0.1062***	1			UNU_COMMIT
EARNINGS	0.0850***	0.1400***	0.0657***	0.2600***	-0.0915***	0.0984***	1		EARNINGS
GROWTH	0.1202***	-0.0054	0.0130***	-0.0581***	0.0806***	0.1170***	0.1058***	1	GROWTH
NII	-0.1505***	1							NII
SIZE	-0.2111***	0.3809***	1						SIZE

Note: This table reports summary statistics for the main sample of U.S. commercial banks used in the analysis. All financial variables are winsorized at 1% and 99% levels.

DOES DIVERSIFICATION IMPACT BANK FUNDING COST?

Main Findings

We perform multivariate analyses to examine how diversification affects bank funding cost after controlling other control variables documented in prior literature. Our main baseline model is as follows:

$$Y_{it} = \alpha + NII_{it-1} + Z_{it-1} + \theta_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is the measure of funding cost of bank i at time t . Following Levine et al. (2016), we use the natural logarithm of the costs of deposits (LN_COST_DEPO) as the main proxy in our investigation. We also use alternative proxies of bank funding cost in our robustness tests. Following Stiroh and Rumble (2006), Tran et al. (2019a; 2019b), the variable of interest – bank diversification – is the ratio of non-interest incomes over net operating incomes. Z_{it} is the vector of control variables described above. All independent variables are lagged of one period to take into account that the information from balance sheet is available to the public with a certain delay. We include time-fixed effects, θ_t , to control for the macroeconomic conditions, common across banks. ε_{it} is the error term. Since COST_DEPO is likely to be correlated within a bank over time, standard errors used to assess significance are corrected for heteroscedasticity and bank-level clustering.

Table 3 reports the results. We first start with a reduced model (Model [1]) where we include only our variable of interests (NII) and time fixed-effects. We present our baseline model in Model (2) where we include our control variables. In both models, the coefficients on our main variable of interest, NII, are negative and statistically significant at the 1% level. For example, in our baseline model (Model [2]), one standard deviation increases of NII, holding all other equal, results to a decrease of the costs of deposits of 2.8 bps (i.e., the coefficient of NII, -0.212 , times the standard deviation of NII, 0.130). The results suggest an economically large, negative relation between bank diversification and its funding cost. This evidence suggests that the funding cost would be lower in banks that engage more in non-traditional banking activities.

In Model (3), we rank NII variable into quartiles and create a variable called NII_QUARTILE, which takes value ranging from 1 (lowest) to 4 (highest). This approach generates greater variation in the distribution of the share of the incomes generated from non-traditional banking activities. We obtain a negative and significant coefficient on NII_QUARTILE.

Table 3
Baseline Multivariate Analysis

	Reduced model (1)	Baseline model (2)	NIL QUARTILE (3)	Additional variables (4)	State-quarter FE (5)	Balanced panel data (6)	Newey-West (7)	Fama-McBeth (8)	Cluster two-way (9)
NII	-0.495*** (0.054)	-0.212*** (0.054)	-0.024*** (0.004)	-0.218*** (0.053)	-0.214*** (0.055)	-0.276* (0.164)	-0.268*** (0.038)	-0.208*** (0.021)	-0.268*** (0.072)
SIZE		-0.055*** (0.007)	-0.054*** (0.007)	-0.057*** (0.007)	-0.061*** (0.006)	-0.072*** (0.014)	-0.136*** (0.005)	-0.055*** (0.007)	-0.136*** (0.024)
CAPITAL		-0.775*** (0.206)	-0.839*** (0.204)	-0.752*** (0.203)	-0.991*** (0.200)	0.409 (0.820)	-1.996*** (0.160)	-0.666*** (0.069)	-1.996*** (0.441)
WHOLESALE		1.178*** (0.064)	1.159*** (0.064)	1.157*** (0.063)	1.242*** (0.066)	1.257*** (0.163)	1.987*** (0.048)	1.200*** (0.127)	1.987*** (0.256)
UNUS_COMMIT		-0.634*** (0.103)	-0.622*** (0.103)	-0.583*** (0.104)	-0.491*** (0.104)	-0.538* (0.293)	0.492*** (0.063)	-0.763*** (0.127)	0.492* (0.276)
EARNINGS		0.105 (0.714)	-0.076 (0.686)	1.440* (0.771)	2.137*** (0.666)	-1.963 (2.076)	9.931*** (0.486)	0.440 (0.830)	9.931*** (2.558)
GROWTH		0.168*** (0.048)	0.146*** (0.048)	0.259*** (0.046)	0.427*** (0.054)	-0.034 (0.123)	0.946*** (0.061)	0.099 (0.116)	0.946*** (0.251)
NPL				1.367*** (0.278)					
DUMMY_LOSS				0.067*** (0.012)					
Constant	-3.043*** (0.012)	-2.542*** (0.087)	-2.512*** (0.091)	-2.563*** (0.087)	-2.767*** (0.079)	-3.786*** (0.167)	-2.585*** (0.055)	-3.404*** (0.083)	-2.585*** (0.248)

(continue on next page)

Table 3 (continued)

	Reduced model (1)	Baseline model (2)	NII_ QUARTILE (3)	Additional variables (4)	State-quarter FE (5)	Balanced panel data (6)	Newey-West (7)	Fama-McBeth (8)	Cluster two-way (9)
Observations	72,048	59,027	59,027	58,989	59,027	10,574	59,027	59,027	59,027
R ²	0.796	0.800	0.801	0.802	0.749	0.836	0.356	0.256	0.174
QFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N_clust	2971	2558	2558	2555	2558	211	Yes	Yes	Yes

Note: This table reports regression estimates of the relation between LN_COSTDEPO and NII. All regressions include time (quarter) fixed effects. All financial variables are winsorised at the 1% and 99% levels. ***, **, * indicate significance at the 1%, 5%, and 10% level respectively. Standard errors are clustered at the bank level. Numbers in parentheses are t-statistics.

We control for omitted and correlated variables in Models (4) by adding the effect of the quality of bank' loan portfolio (NPL), negative net income indicator variable (DUMMY LOSS). Again, we observe that banks that move to non-traditional banking activities experience lower costs of deposits.

Next, in Model (5), instead of including time fixed effects, we include state-quarter fixed effects to take into account the effects of the state where bank locates, and we still reach similar findings.

In Model (6), we use balanced panel data. Excluding banks that are partially exist during the examined period might mitigate the effects of M&A activities and bank defaults on our investigation. Although it comes at the price of over-representing "successful" banks, but attenuates the concern of poor-performing banks (Tran et al., 2019a; 2019b). Our results remain unchanged.

To test whether our results stand the test of different econometric approaches, we carried out the Newey-West to produce consistent estimates in case there exist autocorrelation and possible heteroskedasticity (Model [7]), Fama-MacBeth in Model (8), and finally, two-way cluster procedure to correct for both cross-sectional correlation and serial correlation (Model [9]). The results obtained from these three models are similar in magnitude and significance as in our baseline model.

Regardless of the control variables, the results also document the evidence of the responsiveness of deposit costs to the bank characteristics. Large, well-capitalised banks enjoy lower costs of deposits. The costs of funding are higher for high growth banks. Banks with greater amount of unused commitments outstanding offer lower rates of deposits whereas banks reliant on wholesale funding pay higher deposit rates on average.

In brief, our evidence indicates that banks that engage more in non-interest incomes generating activities offer a lower deposit rate.

Quantile Regressions

This study investigates the association between deposits costs and bank diversification. Investors, regulators, and policy makers seem to be more interested in bank behaviours at the tails of the distribution of (funding) costs, since high (funding) costs reflect a critical situation of bank financial health.

The previous models reflect the conditional mean relationship between banks' deposits costs and their business models. In Table 4, we perform quantile regression to assess whether the association between deposit rates and diversification vary across the distribution of deposit rates. This approach allows us to explore potential forms of conditional heterogeneity and avoids the restrictive assumption that the error terms are identically distributed at different distributions of the bank funding cost (Klomp & de Haan, 2012; Tran et al., 2019a; 2019b).

The coefficients on NII in Models (1)–(9) show the impact of NII on bank's deposit rates is indeed uniform in sign (negative) but increases (less negative) significantly in magnitude with the increase of quantiles, suggesting that NII decrease banks' deposits costs in banks at all levels of deposits costs.

Overall, these results reaffirm our previous findings that NII is associated with lower deposits costs. NII is not only affect the conditional average funding cost, but also affects their distribution. Lower deposits costs banks, leveraged by higher NII, are more likely to pay lower costs.

Alternative Measures of Funding Cost and Diversification

In Table 5, we re-conduct our baseline model with alternative measures of bank funding cost. In Model (1), following Demirgüç-Kunt and Huizinga (2004), we use the total cost of funds equals which is the ratio of total interest expenses over the interest-bearing liabilities. This measure of overall cost of bank debts reflects the implicit interest rate on bank liabilities and is different across bank and time due to the heterogeneity of interest rates and debt maturity. In Model (2), we divide the total interest expenses over the total assets instead of interest-bearing liabilities. In all specifications, our findings remain unchanged, suggesting that diversified banks would encounter lower costs of funding.

We also use alternative measures of bank diversification. In Model (3), following Tran et al. (2019a; 2019b), we use an adjusted Herfindahl-Hirschman index to measure diversification, which accounts for variations in the breakdown of net operating income (NOI) into two main categories: net interest income (NII) and noninterest income (NON). In Model (4), we use the most controversial type of non-interest income: trading income. We sum trading revenues, interest income from trading assets, and the realised gains or losses from held-to-maturity and available-for-sale securities. Using this measure allows us to mitigate the concern that non-interest incomes may include income derived from traditional activities. We still obtain similar findings.

Table 4
Quantile regression

	Q = 0.1	Q = 0.2	Q = 0.3	Q = 0.4	Q = 0.5	Q = 0.6	Q = 0.7	Q = 0.8	Q = 0.9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NII	-0.570*** (0.045)	-0.395*** (0.046)	-0.323*** (0.027)	-0.305*** (0.025)	-0.313*** (0.021)	-0.300*** (0.021)	-0.284*** (0.018)	-0.238*** (0.019)	-0.195*** (0.021)
SIZE	-0.296*** (0.006)	-0.256*** (0.005)	-0.198*** (0.003)	-0.143*** (0.002)	-0.109*** (0.002)	-0.075*** (0.003)	-0.043*** (0.003)	-0.021*** (0.003)	-0.013*** (0.002)
CAPITAL	-3.677*** (0.292)	-3.210*** (0.181)	-2.569*** (0.183)	-1.934*** (0.116)	-1.592*** (0.093)	-1.162*** (0.089)	-0.919*** (0.105)	-0.719*** (0.113)	-0.540*** (0.112)
WHOLESALE	2.816*** (0.050)	2.378*** (0.034)	2.046*** (0.029)	1.773*** (0.026)	1.598*** (0.020)	1.455*** (0.028)	1.298*** (0.029)	1.114*** (0.027)	0.858*** (0.018)
UNUS_COMMIT	0.584*** (0.093)	0.580*** (0.073)	0.525*** (0.059)	0.534*** (0.052)	0.521*** (0.043)	0.574*** (0.044)	0.528*** (0.031)	0.439*** (0.031)	0.320*** (0.037)
EARNINGS	19.409*** (0.824)	15.049*** (0.626)	11.743*** (0.546)	9.088*** (0.513)	7.332*** (0.485)	5.441*** (0.374)	3.881*** (0.374)	3.092*** (0.447)	2.261*** (0.388)
GROWTH	1.097*** (0.131)	1.127*** (0.073)	1.111*** (0.070)	1.031*** (0.059)	1.003*** (0.051)	0.909*** (0.070)	0.866*** (0.075)	0.685*** (0.060)	0.572*** (0.072)
Constant	-1.319*** (0.091)	-1.456*** (0.076)	-1.970*** (0.040)	-2.497*** (0.032)	-2.792*** (0.028)	-3.096*** (0.032)	-3.355*** (0.038)	-3.470*** (0.040)	-3.340*** (0.030)
Observations	59,027	59,027	59,027	59,027	59,027	59,027	59,027	59,027	59,027

Note: This table reports regression estimates of the relation between LN_COSTDEPO and NII using quantile regression. All financial variables are winsorized at the 1% and 99% levels. ***, **, * indicate significance at the 1%, 5%, and 10% level respectively. Numbers in parentheses are *t*-statistics.

Table 5
Alternative measures of funding cost and diversification

	Cost of funds	Interest expenses	Diversification	Trading
	(1)	(2)	(3)	(4)
NII	-0.215*** (0.059)	-0.001*** (0.000)	-0.347*** (0.050)	-0.101* (0.053)
SIZE	-0.033*** (0.008)	-0.000** (0.000)	-0.055*** (0.007)	-0.063*** (0.007)
CAPITAL	-1.131*** (0.216)	-0.008*** (0.001)	-0.862*** (0.203)	-0.770*** (0.205)
WHOLESALE	1.245*** (0.070)	0.005*** (0.000)	1.151*** (0.065)	1.207*** (0.064)
UNUS_COMMIT	-0.514*** (0.103)	-0.003*** (0.000)	-0.609*** (0.103)	-0.623*** (0.104)
EARNINGS	-0.770 (0.689)	-0.010*** (0.002)	-0.118 (0.682)	-0.496 (0.665)
GROWTH	-0.052	0.000 (0.000)	0.137*** (0.049)	0.153*** (0.049)
Constant	(0.047) -4.191***	0.007*** (0.000)	-2.469*** (0.091)	-2.479*** (0.091)
Observations	(0.095)	59,123	58,753	59,791
R ²	59,123	0.758	0.801	0.798
QFE	0.783	Yes	Yes	Yes
N_clust	Yes	2558	Yes	Yes

Note: All financial variables are winsorised at the 1% and 99% levels. ***, **, * indicate significance at the 1%, 5%, and 10% level respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

Endogeneity Concerns

The documented evidence may be biased by the unobservable bank characteristics that simultaneously affect the deposit rates and the decision to diversify, which in turns lead to potential bias in the OLS framework. We address this concern by using Heckman selection model and the propensity score matching (PSM). The results are tabulated in Table 6.

We start by using the Heckman selection model. Following Laeven and Levine (2007) and Tran et al. (2019a; 2019b), we use the average non-interest income of other banks as an instrumental variable. We then estimate the diversification-choice expectation of the model selection error term, given the

Table 6
Endogeneity concerns

Heckman selection	W/o replacement			PSM		
	1st stage (1)	2nd stage (2)	(3)	N = 1 (4)	N = 2 (5)	N = 3 (6)
NII		-0.126** (0.063)	-0.394*** (0.059)	-0.284*** (0.099)	-0.318*** (0.074)	-0.349*** (0.069)
SIZE	0.214*** (0.024)	-0.059*** (0.007)	-0.056*** (0.010)	-0.045*** (0.014)	-0.031*** (0.011)	-0.033*** (0.011)
CAPITAL	-2.505*** (0.935)	-0.804*** (0.210)	-0.927*** (0.263)	-1.266*** (0.383)	-0.904*** (0.346)	-0.834** (0.342)
WHOLESALE	-2.360*** (0.256)	1.205*** (0.066)	1.087*** (0.068)	0.830*** (0.104)	0.917*** (0.095)	0.940*** (0.084)
UNUS_COMMIT	-0.748** (0.355)	-0.634*** (0.105)	-0.639*** (0.118)	-0.446*** (0.135)	-0.569*** (0.130)	-0.635*** (0.126)
EARNINGS	3.938 (2.596)	-0.059 (0.715)	1.501 (1.007)	0.448 (1.034)	0.639 (1.017)	0.657 (1.179)
GROWTH	-0.720*** (0.269)	0.147*** (0.049)	0.281*** (0.074)	0.240* (0.137)	0.157 (0.130)	0.134 (0.124)
AVERAGE DIVERSIFY	7.777*** (0.572)					
IMR		-0.046*** (0.008)				

(continue on next page)

Table 6 (continued)

Heckman selection	W/o replacement			PSM		
	1st stage (1)	2nd stage (2)	(3)	N = 1 (4)	N = 2 (5)	N = 3 (6)
Constant	-7.592*** (0.637)	-2.679*** (0.089)	-2.493*** (0.123)	-2.646*** (0.176)	-2.830*** (0.143)	-2.802*** (0.141)
Observations	59,946	56,145	13,319	1,400	2,469	3,582
R ²	0.688	0.797	0.799	0.800	0.796	0.787
QFE	Yes	Yes	Yes	Yes	Yes	Yes
N_clust	2559	2497	2237	805	1144	1404

Note: The table reports regression estimates of the relation between LN_COSTDEPO and NII. All financial variables are winsorised at the 1% and 99% levels. ***, **, * indicate significance at the 1%, 5%, and 10% level respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

banks' observable characteristics and decision to diversify. In the second stage, we re-estimate our baseline model by including IMR as an additional control variable to correct for potential self-selection biases. Models (1) – (2) report the maximum likelihood estimates of the logit diversification-choice and our baseline model augmented by IMR. Consistent with our core findings, we document a negative and significant coefficient of NII.

We next employ the propensity score matching (PSM) system developed by Rosenbaum and Rubin (1983) and extended by Heckman, Ichimura and Todd (1997). We match each diversified bank with one focused bank sharing similar characteristics as reflected in their propensity scores. We use one-to-one matching without replacement. We find a negative relationship between funding cost and NII. We also use one-to-one matching with replacement. We also match each bank that manipulate the most their earnings with the two and three other banks with the closest propensity scores. We present the results of our PSM analysis in Models (1) – (4). The results are robust to different specifications of PSM.

How Does the Crisis Affect the Association Between Diversification and Funding Cost?

We employ the global financial crisis as a quasi-natural experiment to examine whether diversification affects differently bank funding cost. Following Martinez, Soledad and Schmukler (2001), we examine separately the association between diversification and funding cost before, during and after the crisis, i.e. 2001:Q1–2007:Q2, 2007:Q3–2009:Q2, and 2009:Q3–2017:Q4, respectively. The results are shown in Table 7.

First, we observe that diversified banks enjoy lower funding cost across the sample periods. The coefficient on NII is negative and statistically significant before the crisis (Model [1]). During the crisis, the coefficient on NII still negative and statistically significant at the 1% level, but with greater magnitude (more negative) than the coefficient on NII before the crisis (i.e., -0.159 versus -0.301). This evidence suggests that diversified banks seem to benefit from the diversification gain, then enjoy a lower funding cost during the crisis. The result in Model (3) suggests that diversified banks still benefit from lower funding cost, but with a lesser extent after the crisis to compare with during the crisis time.

Table 7
The effects of the crisis

	Before crisis	During crisis	After crisis
	(1)	(2)	(3)
NII	-0.159*** (0.049)	-0.301*** (0.068)	-0.262** (0.103)
SIZE	-0.044*** (0.006)	-0.026*** (0.008)	-0.085*** (0.015)
CAPITAL	-0.664*** (0.201)	-0.684** (0.290)	-0.670 (0.436)
WHOLESALE	0.996*** (0.055)	0.807*** (0.084)	1.622*** (0.178)
UNUS_COMMIT	-0.458*** (0.091)	-0.593*** (0.111)	-1.221*** (0.242)
EARNINGS	-0.122 (0.693)	-4.253*** (0.706)	2.635* (1.456)
GROWTH	0.381*** (0.052)	0.303*** (0.093)	-0.380*** (0.123)
Constant	-2.692*** (0.071)	-2.801*** (0.104)	-2.978*** (0.216)
Observations	37,698	6,717	14,612
R ²	0.612	0.572	0.633
QFE	Yes	Yes	Yes
N_clust	2418	938	1083

Note: The table reports regression estimates of the relation between LN_COSTDEPO and NII before, during and after the crisis. All financial variables are winsorised at the 1% and 99% levels. ***, **, * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the bank level. Numbers in parentheses are *t*-statistics.

CONCLUSION

In this study, we investigate the impacts of the diversification on bank funding cost using a large sample of U.S. banks during the period of 2000 to 2017. Our models suggest a consistent evidence that banks that move toward non-traditional banking activities enjoy a lower cost of funding. More interesting, we discover that this effect is strengthened during the crisis, and even after the crisis. We obtain similar results even after estimating a battery of robustness tests by using different proxies of diversification and funding cost, using alternative econometric approaches (Newey-West, Fama-MacBeth, Cluster two ways), employing different subsamples, testing a variety of methods to control for endogeneity

(Heckman selection and PSM). We also examine the impacts of diversification across the distribution of bank funding cost, and document that lower funding cost banks, leveraged by higher degree of diversification, are more likely to pay lower costs. We believe that our results are of interest of regulators and policymakers.

NOTES

1. Levine et al. (2016) focus on impact of the geographic expansion of bank assets on the cost of banks' interest bearing liabilities.

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