Ownership Structure, Non-Interest Income and Bank Risk in Ghana

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This study investigates the relationship between bank ownership structure, non-interest income and risk in an emerging market setting. Our analysis shows that the relationship between product diversification and bank risk is significantly influenced by asset size and ownership structure. In contrast to large banks, small banks are exposed to higher risk when the income share of non-traditional banking activities rise. We also find strong evidence of differences in risk exposure of banks to non-interest income after controlling for ownership structure. Private domestic and private foreign banks experience lower risk with higher non-interest income while the converse is true for public domestic banks. Furthermore, we show that the speed with which risk adjust to non-income activities is faster for domestic private banks than for foreign banks. These results could provide useful information to investors and regulators of banking institutions as they seek to reconcile the important issues of bank ownership structure, income diversification and size on the one hand with the level of risk exposure on the other hand.

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1. Introduction

This study investigates the effect of ownership structure on the relationship between non-interest income and risk of banks. Theoretically, the diversification from traditional interest income to non-interest income may have beneficial risk implications; however, the empirical literature is inconclusive on the existence of benefits or how differences in banks affect the income diversification-risk benefit relationships (Templeton and Severiens, 1992; Saunders and Walter, 1994; Stiroh, 2004a, 2004b; Lepetit et al., 2008; Delpachitra and Lester, 2013). While many studies have examined the relationship between bank income structure and risk, empirical analysis on how ownership structure affects that relationship in the context of emerging market countries is scanty.

Following the works of Berle and Means (1932) and Coase (1937), a number of studies have shown that ownership structure of firms can explain the activities managers and owners of companies undertake (Fama and Jensen, 1983a, 1983b; Mayers and Smith, 1990, 1992; Smith and Stutzer, 1990; Doherty and Dionne, 1992). Hence, there is a basis for postulating a link between ownership structures, banks diversification activities and risk. Iannotta et *al.* (2007) examine the question of ownership structure while addressing the relationship between profitability, cost

efficiency and risk for a group of European Banks. In their study, ownership structure is analyzed on the basis of mutual banks, public and private sectors banks, and banks with different ownership concentration. They report that significant differences in performance and risk do exist for the different ownership structures, although the signs are not always consistent with expectations. The authors conclude that the reported results concerning ownership structure are quite puzzling and deserve further research. Pennathur et *al.* (2012) also control for ownership structure in analyzing the relationship between non-interest income and risk of Indian banks. Their results show that ownership structure of banks matter in the pursuit of non-interest income. In addition, they find that fee-based income reduces the risk of public sector banks while increasing the risk of both domestic private and foreign private banks. The authors do acknowledge that their study covers one emerging market and a limited period, hence, it beckons the need for future empirical studies in other emerging nations for robustness of the results.

In this study, we address a number of specific research issues. First, we verify the significance and nature of the relationship between product diversification and a set of risk and insolvency measures using accounting data at the individual bank level in Ghana. Second, we investigate how bank size and ownership structure affects the significance and direction of the relationship between banks risk and non-interest income. Since fixed cost associated with non-interest income activities may enable large-sized banks to adopt a more aggressive position on non-interest services than small banks, bank size might influence a banks' behavior towards non-interest income activities (Hidayat et al. 2012). On the subject of ownership, our study classifies banks along the lines of public domestic banks, private domestic banks and private foreign banks. The aim is to investigate whether differences in ownership structure impact risk taking behavior while controlling for size and non-interest income.   Furthermore, we analyze how the speed of adjustment to risk with changes in non-interest income varies with the different ownership classifications. Since the modeling of these relationships involve the dual hypothesis testing about the significance of the relationships between the relevant variables on the one hand, and the specification of appropriate models on the other hand, we question the validity of the models of prior studies that do not examine model specification issues. We specifically address these issues by conducting test to determine the appropriateness of the models used in this study.

The selection of Ghana as a new laboratory to analyze these relationships is motivated by a number of factors. Firstly, Ghana implemented a number of financial liberalization policies in the late 1980s and early 1990s with the goal of improving the operational efficiency of the banking system in the country. These reforms encouraged the entry of several domestic and foreign banks, increased competition and led commercial banks to diversify from their traditional interest income activities

into non-interest income sources[1]. Secondly, in the Ghanaian banking sector, foreign banks dominate the domestic banks in terms of market share. For example, in 2012, 2013 and 2014 the market share of domestic banks was 45.1%, 41.8% and 46.1% versus 54.9%. 58.2% and 53.9% for foreign banks (Bank of Ghana, 2014). Considering the fact that many prior studies focused on countries in which the relative market shares of domestic verses foreign banks is the converse, the prevailing situation in Ghana presents an interesting motivation for further analysis. The Ghanaian experience is also interesting in terms of the country's experience with exceptionally high interest rates culminating in Ghana being listed among the top three high interest rate countries in the world in 2015. These characteristics beg the question of whether findings in the literature from developed countries can be generalized to emerging market countries like Ghana (see Pennathur et al. 2012).

Our paper adds to the relatively scanty literature on emerging markets by not only examining the size dependent relationship between non-interest income and bank risk but also looks at the effects of the individual lines of non-interest activities and ownership structure. Our results show that the relationship between banks income diversification and risk is significantly impacted by asset size and ownership structure. For example, we show that small banks are exposed to higher risk when the income share of non-interest income activities rise. In the case of large banks, however, a higher share of non-interest income in the income structure of banks minimizes risk. We also find strong evidence that ownership structure significantly impacts the relationship between banks non-interest income and risk exposures. For example, private domestic and private foreign banks experience lower risk with higher non-interest income while the converse is true for public domestic banks. This study is also one of the first in the literature to empirically report that the speed with which risk is reduced by non-income activities is faster for domestic private banks than foreign private banks.

The rest of the paper is organized as follows: Section two gives a review of the existing literature on the subject. Section three covers the descriptive statistics and estimation methodology, while Section four presents and discusses the results of our empirical analysis. Lastly, Section five concludes the paper.

2. Literature Review

2.1 Ownership structure and activities of banks

Following the works of Berle and Means (1932) and Coase (1937), a number of studies have shown that ownership structure of firms can explain the activities managers and owners of companies undertake (Fama and Jensen, 1983a, 1983b;

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[1]In contrast to interest income which stems from activities such as granting loans, non-interest income stems from sources such as electronic banking, financial leasing, trading, commission and fees from portfolio management services, money transmission services, underwriting services, and others. With respect to the firms under review in this study non-interest income as a percentage of net operating income was a significant 33% and 37% in 2006 and 2013 respectively. Besides, the amount of non-interest income increased by 635% over the same period with a year-on-year average growth rate of 34%.

Mayers and Smith, 1990, 1992; Smith and Stutzer 1990; Doherty and Dionne 1992). According to Iannotta et al. (2007), ownership structure can be examined in two main dimensions. First, on the basis of degree of ownership concentration, one can classify firms along the lines of whether ownership is more or less dispersed. Alternatively, given that the level of ownership concentration is known, one can further distinguish between firms in terms of the differing stake held by government, or even contrast stock firms with dispersed ownership to mutual firms. It has also been shown that attempts to investigate the risk- taking behavior of banks are receiving increasing attention because banks have important characteristics that make the analysis of risk-taking activities interesting (Esty, 1997; Crespi et al. 2004). Additionally, Garcia-Marco and Robels-Fernadez (2008) argue that the coexistence of moral hazard and owner-manager agency conflicts in banking firms causes a twofold effect on the predictability of the "organizational form-risk taking behavior" relationship. Interestingly, a number of empirical studies on the impact of ownership structure on banks risk and performance have reached different conclusions. Iannotta et al. (2007) after looking at a set of European banks, conclude that their results concerning ownership concentration are quite puzzling and deserve further research. While confirming that significant differences in performance and risk exist for the different bank ownership structures investigated, the authors point out that the signs of the relationships are not always consistent with expectations. Pennathur et al. (2007), report that for Indian banks, ownership structure affects the relationship between non-interest income and risk while highlighting the need for more empirical studies in emerging markets for robustness of results. Other studies on the subject of ownership structure and performance report that government owned banks are considerably less efficient in comparison to private banks (La Porta et al., 2002; Barth et al., 2004; Beck et al., 2004; and Cornet et al., 2010). In contrast, Bonin et al. (2005) while reporting that foreign owned banks are more cost efficient than other banks, do not find that government banks are less efficient than private banks. We hypothesize a positive relationship between non-interest income and bank risk for public domestic banks and a negative relationship for private (both domestic and foreign) banks.

2.2 Income diversification and risk

Along the lines of portfolio theory, many studies have examined the relationship between product diversification and bank risk in the US banking industry. Some of these studies show that product diversification has potential benefits for reducing bank risk. Using market-based data and several risk measures, Templeton and Severiens (1992), find that increase in diversification results in reduction of risk, and that a small amount of diversification can achieve substantial risk reduction benefits. According to Keeton (1991), returns to new financial services neither are correlated highly with returns to banking, nor exceptionally risky by themselves; thus, bank holding companies' (BHCs) expansion into nonbank activities probably should

decrease risk. Other studies that suggest a negative relationship between product diversification and bank risk include Santomero and Chung (1992) and Saunders and Walter (1994). On the subject of maximizing the benefits of diversification based on correlation of returns between industries, Rose (1989) concludes that potential beneficial diversification opportunities would exist for BHCs if only public policy were less restrictive. The author notes that banks and other financial service organisations are more sensitive to economic conditions than other industries.

Interestingly, some studies have found that although diversifying into nonbanking activities can reduce bank risks, these gains tend to be limited in size, scope, or practice. Boyd et al. (1980) measure the correlations between accounting returns at the bank and nonbank affiliates of BHCs during the 1970s, and find that the potential for risk reduction was exhausted at relatively low levels of nonbank activities. Kwast (1989), for example, examine the accounting returns of the securities and non-securities activities of commercial banking companies between 1976 and 1985, and finds a limited potential for risk reduction by diversifying into securities activities. Gallo et al. (1996) find that high levels of mutual fund activity is associated with increased profitability, but only slightly moderate risk levels, at large BHCs between 1987 and 1994.

Other studies suggest that non-interest income activities are positively related with earnings volatility in the US. In other words, non-interest income would not bring obvious diversification benefits. Boyd and Graham (1986) observed a significant positive relationship between diversification and two accounting-based risk measures in the absence of strict regulatory oversight and control. They warn that strict regulation may be needed if the Federal Deposit Insurance Corporation is to avoid paying for aggressive BHC behaviour. Looking at American community banks, that is, small banks that do not belong to any banking group, Stiroh (2004a) examines the link between income diversification and risk–return performance for 1984–2000. The study finds that increase in fee-based revenues caused a worsening in the risk–return trade-off. Stiroh (2004b) also examines U.S. banking data between 1984 and 2001 and report that in aggregate, the correlation between net interest income growth and non-interest income growth increased in the 1990s; moreover, non-interest income was much more volatile than net interest income. In a study by Sinkey and Nash (1993), the authors find that commercial banks that specialize in credit card lending (an often-securitized type of lending that generates substantial fee income) generate higher and more volatile accounting returns, and have higher probabilities of insolvency, than commercial banks with traditional product mixes during the 1980s. Demsetz and Strahan (1997), examine stock returns of BHCs and find that greater diversification across product lines does not translate into reductions in overall risk because the diversification benefits of larger BHCs are offset by their tendency to shift into riskier mixes of activities and hold less equity. A study by Roland (1997) also report that abnormal returns from fee-based activities are less

persistent (more short-lived or volatile) than abnormal returns from lending and deposit-taking at large BHCs.

De Young and Roland (2001) find that increases in product mix increased leverage and revenue volatility. They offered three reasons why non-interest income was more volatile than interest income. First is the relative instability of non-interest income. Due to switching costs and information costs, the lender and/or the borrower is unlikely to terminate the lending relationship. However, for fee-based products, customers find it relatively less costly to shift to using other banks' services resulting in less stable demand. Secondly, there is increased fixed cost associated with non-interest income activities. Thirdly, lack of a regulatory capital requirement for most fee-based activities suggests a higher degree of financial leverage and, thus, higher earnings volatility for fee-based activities.

In addition to the large US based literature recent studies have given attention to other markets outside the U.S. Lepetit et al. (2008) find that European banks expanding into non-interest income activities present higher risk and higher insolvency risk than banks which mainly supply loans. This positive relationship is confirmed by studies in other economies while evidence also shows in some cases that there is no significant relationship between income diversification and bank risk (e.g. Sahoo and Mishra, 2012 – India; Delpachitra and Lester, 2013 - Australia; Zhou, 2014 – China; Tarazi et al., 2010 - Philippine). However, other studies reveal contrary evidence pointing to a negative relationship (Vo et al., 2013 – Vietnam; Chiorazzo et al., 2008 - Italy). Therefore, we expect the relationship between non-interest income and bank risk to be either negative (according to the portfolio theory or empirical studies such as Vo et al., 2013 and Chiorazzo et al., 2008 or positive (as suggested by De Young and Roland, 2004; Stiroh, 2004b and Lepetit et al., 2008).

In many of these studies, bank size, is considered an important intervening variable when modelling the relationship between income diversification and risk. According to De Young and Roland (2001), there is increased fixed cost associated with non-interest income activities. Hidayat et al. (2012) surmise that since this may give large-sized banks the edge to take a more aggressive position on non-interest services than small-sized banks, bank size might influence a banks' behavior in regards to non-interest income activities. Lepetit et al. (2008) show that the positive link they found between non-interest income and risk is mostly accurate for small banks. In contrast, Hidayat et al. (2012) find that a higher reliance on non-interest income activities entails a lower level of bank risk for relatively small-sized banks in Indonesia; but, a higher reliance on non-interest income activities increases risk for relatively large-sized banks. However, for Vo et al. (2013) in the case of Vietnam, the negative relationship mostly holds for large banks while the impact of income diversification is not confirmed clearly for small banks. Similarly, Chiorazzo et al. (2008) in their study on Italian banks contend that diversification benefits are greater at the large banks, even though there are limits to diversification gains as banks get larger. They suggest that small banks get benefits from diversification only when they

have very little non-interest income to start with. We hypothesize a negative relationship between non-interest income activities and bank risk for large –sized banks and a positive relationship for small-sized banks.

Evidently, studies on the effect of product diversification on bank risk have been inconclusive. While portfolio theory predicts that diversification could reduce overall risk if nonbank activities are uncorrelated with traditional banking activities, critics of policies that extend bank powers argue that banks increase their risk through activity diversification (Templeton and Severiens, 1992). In fact, Jessee and Seelig (1977) explain that modern portfolio theory may not apply in the case of BHC diversification. They argue that portfolio theory is developed from the point of view of the passive investor. It makes an implicit assumption that the risks of the individual parts of the portfolio are independent of each other, and that they do not change upon acquisition. However, the BHC may assume management of nonbank activities. In that case, the risk may change and perhaps increase. Consequently, the potential benefits may not be realized.

3. Data and Methodology

In this section of the paper we explore the relationship between product diversification and bank risk in the Ghanaian commercial banking industry using panel quarterly data from financial statements for 2006 to 2013[2]. There were 25 commercial banks in Ghana as at December 2013, all of which are included in the sample.

Using data from the financial statements of each bank published by the Bank of Ghana, we operationalize the variables in our models as follows. The ratio of net non-interest income to net operating income (NON) is used to capture the degree of product diversification of each bank in a given year. Net non-interest income is calculated as the difference between non-interest income and non-interest expenses while net operating income is measured as the sum of net interest income and net non-interest income. Following Stiroh (2004), De Young and Roland (2001), and Lepetit et al. (2008) we disaggregate net non-interest income into two components, namely, the ratio of net fee and commission income to net operating income (COM) and the ratio of net trading income to net operating income (TRAD). This was to allow for deeper insights with respect to the risk implications of different types of non-interest activities. In the Ghanaian banking data, we found that most of the banks categorize their non-interest income into fees and commission, and other operating income. For those that report their income from trading activities we find that net

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[2] The annual data series are interpolated into quarterly frequency using the quadratic match-sum method.in EViews (also see Razzak, 2007; Moldtsova and Papell, 2009; Grossman et. al. 2013 on the use of this method). The quadratic match-sum method fits a local quadratic polynomial for each observation of the original (annual) series, using the fitted polynomial to fill in all observations of the higher frequency (quarterly) series associated with the period. The quadratic polynomial is formed by taking sets of three adjacent points from the original series and fitting a quadratic so that the sum of the interpolated quarterly data points matches the actual annual data points.

trading income accounted for on average 85 percent of "other operating income". Thus, we employ data for other operating income as net trading income. In terms of ownership, we classify private domestic banks as (PrivDom), public domestic banks as (PubDom) and private foreign banks as (PrivFor).

Following studies by Lepetit et al. (2008) and Hidayat et al. (2012) we consider the following standard measures of risk based on accounting data for each bank: the standard deviation of return on equity (SDROE), the standard deviation of return on assets (SDROA), and the ratio of loan loss provisions to net loans (LLP)[3]. Insolvency risk, another form of bank risk, is determined by calculating the Z-score (ADZ) as in Eq. 1. We interpret higher values of Z-score to imply lower probability of bank failure (Boyd and Graham, 1986):

$$ADZ = \frac{1+ROE}{SDROE} \qquad (1)$$

ADZ = Z-score for bank i in year t

where ROE is the return on equity for bank i in year t and SDROE is the standard deviation of ROE.

3.1 Descriptive statistics

Table 1 shows the descriptive statistics for the sample of banks on the basis of bank size and the relevant variables. Large banks are those that have assets greater than GHC567 million while small banks have assets less than GHC567 million[4]. Firstly, large banks tend to be more profitable with high return on equity (ROE) and a high return on assets (ROA) compared to small banks. In particular, there is a huge gap in the ROE of the two groups and this may point to market share concentration in the Ghanaian banking industry. Secondly, in regard to risk measures (SDROE, SDROA, LLP and ADZ), we find that large banks have lower risk levels relative to small banks. Thirdly, it is interesting to note that both the large and small banks have an identical net non-interest income to operating income (NON). This is not surprising given that both groups have similar fees and commission to net operating income (COM) and trading income to net operating income (TRAD). Thus, both groups place similar emphasis on product diversification, suggesting that competition in non-interest income is intense.

Table 2 presents summary statistics on the characteristics of banks with high non-interest income verses those with low non-interest income. The banks classified as having high level of non-interest income activities are those with the value of the relevant variable (NON, COM and TRAD) higher than the third quartile (Q_{75}).

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[3] SDROE and SDROA are calculated as follows: $\sqrt{(x_{it} - \overline{x_i})^2}$ where x is the variable in question and $\overline{x_i}$ is the mean. LLP is computed as loan loss provision/total asset.

[4] First of all, we calculate the average total asset for each bank over the period of 2006 to 2013. Subsequently, following Hidayat et al.'s (2012) treatment of NON, COM and TRAD, we find the median of all average total assets for the 25 banks, which is GHC567 million (about $142 million). This is used as the cut-off size to divide the sample into large and small banks.

In contrast, banks classified as having a low level of non-interest income activities are those with the value of the NON, COM or TRAD lower than the first quartile (Q25). Banks with low levels of non-interest income tend to be larger and more profitable. They are also characterized by lower levels of risk. This finding is consistent with earlier results from univariate mean tests by Lepetit et al. (2008) in that non-interest income is positively associated with bank risk and insolvency risk for European banks.

Table 1: Bank characteristics according to bank size

	ALL banks	Small banks (TA<567m)	Large banks (TA>567m)	
	Mean	Mean	Mean	P-value of the mean test
TA	766.896	360.848	1740.591	0.000
LOAN	0.450	0.407	0.434	0.105
DEPO	0.677	0.606	0.692	0.000
EQUITY	0.146	0.189	0.131	0.000
NON	0.374	0.355	0.347	0.391
COM	0.215	0.201	0.200	0.247
TRAD	0.160	0.137	0.150	0.365
ROE	0.147	0.066	0.253	0.000
ROA	0.022	0.010	0.033	0.000
SDROE	0.016	0.177	0.129	0.004
SDROA	0.153	0.020	0.016	0.055
LLP	0.014	0.011	0.011	0.864
ADZ	31.475	24.074	29.496	0.077
N	698	349	349	

Notes: TA = total assets (million Ghana cedis); LOAN = loans/total assets; DEPO = deposits/total assets; EQUITY = equity/total assets; NON = net non-interest income; COM = net commission income/net operating income; TRAD = net trading income/net operating income; ROE = return on equity; ROA = return on assets; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score. *Source*: Financial reports from Bank of Ghana

3.2 Estimation model

We begin our analysis by looking at the relationship between product diversification and bank risk, after controlling for bank size. We use a modified version of the model used by Hidayat et al. (2012) as follows:

$$RISK_{it} = \beta_0 + \beta_1 CV_{it} + \beta_2 CV_{it} \times \ln(\text{TA}_{it}) + \beta_3 \ln(\text{TA}_{it}) + \sum_{n=1}^{N} \gamma_n X_{nit} + \varepsilon_{it} \quad (2)$$

where $RISK_{it}$ is the value for bank i in year t of each risk measure (SDROE, SDROA, LLP and ADZ), and CV_{it} is the value for bank i in year t of each product diversification variable (NON, COM, and TRAD). It should be noted at this point that in our subsequent examination of ownership models, CV_{it} is the ownership classification

variable (Private sector domestic banks - PrivDom, Public sector domestic banks - PubDom and Private sector foreign banks - PrivFor). ln(TA$_{it}$) is the natural logarithm of total asset for bank i in year t, which accounts for size differences. X_{nit} is the value for bank i in year t for a set of other control variables which account for profitability differences (ROE), business differences (LDR), leverage differences (EQUITY), and annual growth rate of total assets (GTA). As in previous studies, this study examines the role of asset size on the relationship between risk and product diversification by including the interaction term, CV_{it} × ln(TA_{it}) in the model. Differentiating Eq. (1) with respect to CV_{it} results in:

$$\frac{\partial Risk_{it}}{CV_{it}} = \beta_1 + \beta_2 \ln(TA_{it}) \tag{3}$$

Which captures how bank risk is associated with the degree of product diversification/ownership structure in relation to asset size.

4. Empirical results

4.1 Income diversification, size and risk of banks

We first applied the procedure suggested by Tukey (1977)[5]   to check for the presence of outliers in the risk measures and any outlier found is winsorized. Table 3 shows the estimated results. Without the interaction term, *NON* × ln(*TA*), NON has a positive and significant relationship with bank risk (SDROE, SDROA and LLP) as found in Table 2. For the control variables in Table 3, the results show that bank size (lnTA), capital ratio (EQUITY), asset growth (GTA), loan-deposit ratio (LDR) and profitability have a significant and negative association with bank risk. It is noteworthy that even though LDR is negatively related to SDROE, SDROA and ADZ, it is positively linked to LLP. It is quite intuitive that banks with higher LDR may tend to have a higher LLP, especially in Ghana where default rates are quite high.

With the introduction of the interaction term, NON × ln(*TA*), we first undertake a Wald test for the joint significance of β_1 and β_2. This test is necessary to check the possible existence of perfect collinearity between NON and NON × ln(*TA*) which is suggested by a correlation coefficient of 0.83[6] between the two variables. We then find the first derivative of RISK with respect to NON (∂RISK/∂NON) which is given by $\beta_1 + \beta_2$ln(*TA*) to reveal the impact of NON on RISK. The results show that the Wald test reject the null that $\beta_1 = \beta_2 = 0$ across all regression models as reported in Table 3.

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[5] A data point is considered a far outlier if its value is less than the first quartile of distribution minus three times the difference between the first and third quartiles (interquartile range, or IQR) or is greater than the third quartile plus three times the IQR.

[6] Drury (2008) suggests that multicollinearity is a concern where the correlation between any two independent variables exceeds 70 per cent. We do check the Variance Inflation Factor (VIF) and determine that multicollinearity is not an issue.

Table 2: Income structure and bank characteristics

	Low NON NON<Q25	High NON NON>Q75		Low COM COM<Q25	High COM COM>Q75		Low TRAD TRAD<Q25	High TRAD TRAD>Q25	
	Mean	Mean	P-value	Mean	Mean	P-value	Mean	Mean	P-value
TA	845.065	619.762	0.002	759.484	546.828	0.001	706.928	647.848	0.383
LOAN	0.431	0.423	0.631	0.433	0.431	0.887	0.449	0.442	0.697
DEPO	0.587	0.725	0.000	0.580	0.745	0.000	0.608	0.693	0.000
EQUITY	0.173	0.131	0.000	0.194	0.129	0.000	0.164	0.144	0.071
NON	0.233	0.499	0.000	0.283	0.452	0.000	0.267	0.470	0.000
COM	0.153	0.257	0.000	0.119	0.308	0.000	0.204	0.194	0.286
TRAD	0.083	0.242	0.000	0.164	0.144	0.0559	0.064	0.275	0.000
ROE	0.182	0.123	0.047	0.206	0.134	0.000	0.074	0.217	0.008
ROA	0.026	0.017	0.015	0.036	0.010	0.000	0.022	0.025	0.368
SDROE	0.132	0.205	0.000	0.166	0.176	0.613	0.141	0.217	0.000
SDROA	0.018	0.020	0.267	0.017	0.018	0.154	0.016	0.019	0.245
LLP	0.013	0.014	0.503	0.015	0.017	0.125	0.012	0.017	0.008
ADZ	35.280	18.441	0.000	32.897	23.572	0.008	37.013	22.545	0.000
N	174	174		174	174		174	174	

Notes: Variable definitions: TA = total assets (million Ghana cedis); LOAN = loans/total assets; DEPO = deposits/total assets; EQUITY = equity/total assets; NON = net non-interest income; COM = net commission income/net operating income; TRAD = net trading income/net operating income; ROE = return on equity; ROA = return on assets. *Source*: Financial reports from Bank of Ghana.

Table 3: Risk regression for whole sample with NON as an independent variable

	Risk measures						Insolvency measure	
	SDROE	SDROE	SDROA	SDROA	LLP	LLP	ADZ	ADZ
NON	0.203***	1.787**	0.031***	0.427***	0.010**	0.166	0.528	-9.596***
NON*ln(TA)		-0.010**		-0.023***		-0.009**		2.020***
Ln(TA)	-0.062***	-0.021	-0.007***	0.003	-0.002*	0.002**	0.925***	0.087
EQUITY	-0.713***	-0.682***	-0.034***	-0.027**	-0.012	-0.010	8.217***	7.595***
GTA	-0.029	-0.031	-0.017***	-0.017***	-0.011***	-0.011	0.991	1.031*
LDR	-0.077***	-0.069*	-0.004	-0.002	0.016***	0.017***	0.493	0.334
ROE	-0.036***	-0.040***	-0.003	-0.004**	-0.006***	-0.006***	1.001***	1.082***
Cons.	1.666***	0.832**	0.191***	-0.001	0.064**	-0.010	-5.885***	0.925
Adjusted R-squared	0.8080	0.810	0.687	0.697	0.592	0.594	0.726	0.730
F-statistic	47.502***	47.260***	25.226***	26.002	17.008***	16.893***	30.347***	30.353***
$\beta_1 = \beta_2 = 0$ [a]		25.972***		36.230***		7.209**		8.892**
∂RISK/∂NONs [b]		1.787 - 0.010ln(TA)		0.427 - 0.023ln(TA)		0.166 - 0.009ln(TA)		-9.596 - 2.0ln(TA)
Fixed effects test [c]	1031.555***	1038.709	773.363***	791.418***	527.429***	532.139***	779.095	787.197***
No. of obs.	664	664	664	664	664	664	664	664

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Variable definitions: NON = net non-interest income; EQUITY = equity/total assets; GTA = log(current total assets/previous total assets); LDR = loan to deposit; ln(TA) = logarithm of total asset; ROE = return on equity; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score.
[a] Wald test for the joint significance of coefficients. The statistic is distributed as a Chi-square with 2 degrees of freedom.
[b] Derivative of risk (RISK) with respect to the share of non-interest income over net operating income (NON).
[c] Likelihood Ratio test for the joint significance of both cross-section and period fixed effects. The statistic is distributed as χ^2 with 54 degrees of freedom.

Table 4: Risk regression for sub-samples of small banks and large banks with NON as an independent variable

	Risk measures						Insolvency measure	
	SDROE		SDROA		LLP		ADZ	
	Small	Large	Small	Large	Small	Large	Small	Large
NON	1.530*	-0.098	0.020**	-0.034**	0.006*	-0.081***	-3.280**	0.596
ln(TA)	-0.788***	-0.077**	-0.015***	-0.012***	0.001	-0.006*	1.615***	0.610*
EQUITY	-2.454***	-1.387***	0.0040	-0.066**	-0.013	-0.084***	4.884***	9.106***
GTA	0.497	-0.778***	0.007	-0.058***	-0.003*	0.035*	-0.529	8.805***
LDR	-0.820***	-0.022	-0.001	0.001	0.010***	0.018***	1.924***	-0.348
ROE	-0.020	-0.135	-0.028	-0.036***	-0.007***	-0.035***	0.448	0.841
Cons.	12.280***	2.832***	0.298	0.350	-0.012	0.147*	-25.542***	-20.68**
Adjusted R-squared	0.350	0.834	0.345	0.819	0.370	0.729	0.364	0.741
F-statistic	15.257***	18.0571***	40.873***	16.346***	16.553***	10.112***	16.183***	10.711***
Fixed effects test [a]	624.509***	589.918***	501.256***	524.519***	314.335***	362.860***	334.388***	364.400
No. of obs.	349	349	349	349	349	349	349	349

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Variable definitions: NON = net non-interest income; EQUITY = equity/total assets; GTA = log(current total assets/previous total assets); LDR = loan to deposit; ln(TA) = logarithm of total asset; ROE = return on equity; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score.
[a] Likelihood Ratio test for the joint significance of both cross-section and period fixed effects. The statistic is distributed as χ^2 with 51 degrees of freedom.

Table 5: Risk regression for whole sample with COM and TRAD as independent variables

	Risk measures						Insolvency measure	
	SDROE	SDROE	SDROA	SDROA	LLP	LLP	ADZ	ADZ
COM	0.108	0.844	0.026***	0.490***	0.012*	0.195**	-1.551	-6.945***
TRAD	0.240***	2.325**	0.036***	0.353**	-0.008	0.142	1.344	-3.057
COM*ln(TA)		-0.048		-0.026***		-0.010**		2.502***
TRAD*ln(TA)		-0.129**		-0.020**		-0.008		1.065
ln(TA)	-0.063***	-0.031	-0.007***	0.003	-0.002*	0.002	0.951***	0.124
EQUITY	-0.695***	-0.671***	-0.032***	-0.026**	-0.013	-0.011	7.768***	7.280***
GTA	-0.022	-0.027	-0.016***	-0.016***	-0.011***	-0.011***	0.909	0.884
LDR	-0.074	-0.070***	-0.004	-0.002	0.016***	0.017***	0.465	0.271
ROE	-0.030*	-0.036***	-0.003	-0.003**	-0.006***	-0.007***	0.868***	0.913***
Cons.	1.665	1.027***	0.192***	-0.006	0.063**	-0.016	-1.903***	0.752
R^2	0.808	0.809	0.688	0.698	0.591	0.593	0.728	0.731
F-statistic	46.720***	45.680***	24.973***	25.311***	16.712***	16.327***	30.104***	29.568***
$\beta_1 = \beta_3 = 0$ [a]		3.115		21.031***		6.687**		10.745***
$\beta_2 = \beta_4 = 0$ [a]		25.221***		27.555***		3.202		2.516
∂RISK/∂COM [b]		0.844 - 0.048ln(TA)		0.490 - 0.026ln(TA)		0.195 - 0.010ln(TA)		-6.945 +2.5ln(TA)
∂RISK/∂TRAD [c]		2.325 - 0.129ln(TA)		0.353 - 0.020ln(TA)		0.142 - 0.008ln(TA)		-3.057 + 1.0ln(TA)
Fixed effects test [d]	1009.966***	1014.165***	775.328***	759.138***	488.621***	491.009***	775.087***	774.705***
No. of obs.	664	664	664	664	664	664	664	664

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Variable definitions: COM = net commission income/net operating income; TRAD = net trading income/net operating income; EQUITY = equity/total assets; GTA = log(current total assets/previous total assets); LDR = loan to deposit; ln(TA) = logarithm of total asset; ROE = return on equity; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score.
[a] Wald test for the joint significance of coefficients. The statistic is distributed as a Chi-square with 2 degrees of freedom.
[b] Derivative of risk (RISK) with respect to the share of fees and commissions income over net operating income (COM).
[c] Derivative of risk (RISK) with respect to the share of trading income over net operating income (TRAD).
[d] Likelihood Ratio test for the joint significance of both cross-section and period fixed effects. The statistic is distributed as χ^2 with 54 degrees of freedom.

Table 6: Ownership Structure and Bank characteristics

	N	TA	LOAN	DEPO	EQUITY	NON	COM	TRAD	ROE	ROA	SDROE	SDROA	LLP	ADZ
Public sector banks	245	759.82	0.510	0.651	0.120	0.367	0.209	0.158	0.185	0.022	0.109	0.012	0.018	30.08
Private sector domestic banks	104	580.11	0.543	0.700	0.112	0.361	0.208	0.153	0.163	0.014	0.082	0.009	0.024	34.99
P-value		0.000	0.017	0.014	0.170	0.635	0.928	0.589	0.015	0.000	0.016	0.041	0.036	0.197
Public sector banks	245	759.82	0.510	0.651	0.120	0.367	0.209	0.158	0.172	0.021	0.109	0.012	0.018	30.08
Foreign banks	352	825.45	0.382	0.687	0.173	0.403	0.221	0.163	0.124	0.024	0.205	0.021	0.011	25.540
P-value		0.269	0.000	0.000	0.000	0.042	0.053	0.455	0.176	0.263	0.000	0.000	0.000	0.001
Private sector domestic banks	104	580.11	0.543	0.700	0.112	0.361	0.208	0.153	0.167	0.018	0.082	0.009	0.024	34.99
Foreign banks	352	825.45	0.382	0.687	0.173	0.403	0.221	0.163	0.124	0.024	0.205	0.021	0.011	25.540
P-value		0.003	0.000	0.453	0.000	0.061	0.031	0.225	0.425	0.166	0.000	0.000	0.000	0.003

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Variable definitions: TA = total assets (million Ghana cedis); LOAN = loans/total assets; DEPO = deposits/total assets; EQUITY = equity/total assets; NON = net non-interest income; COM = net commission income/net operating income; TRAD = net trading income/net operating income; ROE = return on equity; ROA = return on assets; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score. *Source*: Financial statements from Bank of Ghana.

Table 7:   Risk regression with NON and Ownership as independent variables

	Risk measures						Insolvency measure	
	SDROE	SDROE	SDROA	SDROA	LLP	LLP	ADZ	ADZ
NON	0.203***	0.159	0.031***	0.015***	0.010**	0.064***	0.528	-4.402***
PrivDom		0.088***		0.011***		0.043***		-2.227***
PrivFor		0.200***		0.015***		0.020***		-2.111**
NON*PrivDom		-0.334***		-0.039***		-0.130***		9.270***
NON*PrivFor		-0.329***		-0.027***		-0.062***		3.103
Ln(TA)	-0.062***	-0.011***	-0.007***	0.001*	-0.002*	-0.001	0.925***	0.989***
EQUITY	-0.713***	-0.537***	-0.034***	-0.015**	-0.012	-0.040***	8.217***	14.689***
GTA	(0.370)	-0.043**	-0.017***	-0.007***	-0.011***	-0.010**	0.991	-0.615
LDR	-0.077***	-0.048***	-0.004	-0.004***	0.016***	0.013***	0.493	0.676
ROE		-0.036***	-0.003	-0.007***	-0.006***	-0.007***	1.001***	1.318***
Cons.	1.666***	0.435***	0.191***	0.002	0.064**	0.011	-5.885***	-14.434***
Adjusted R-squared	0.8080	0.396	0.687	0.210	0.592	0.318	0.726	0.284
F-statistic	47.502***	44.518***	25.226***	18.653***	17.008***	8.725***	30.347***	7.589***
$\beta_2 = \beta_4 = 0$ [a]		26.552***		10.370***		112.891***		12.974***
$\beta_3 = \beta_5 = 0$ [a]		27.591***		15.851***		78.747***		9.703***
$\beta_4 = \beta_5 = 0$ [b]		34.182***		17.589***		25.374***		4.880**
∂RISK/∂PrivDom [c]		0.08 - 0.34NON		0.01 - 0.03NON		0.04 - 0.13NON		-2.22 + 9.27NON
∂RISK/∂PrivFor [c]		0.20 - 0.32NON		0.01 - 0.02NON		0.02 - 0.06NON		-2.11+ 3.13NON
Fixed effects test [d]	1031.555***	955.888***	773.363***	754.243***	527.429***	496.852***	779.095	506.508***
No. of obs.	664	664	664	664	664	664	664	664

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Variable definitions: NON = net non-interest income; PrivDom = 1 for private domestic banks, 0 otherwise; PrivFor = 1 for private foreign banks, 0 otherwise; EQUITY = equity/total assets; GTA = log(current total assets/previous total assets); LDR = loan to deposit; ln(TA) = logarithm of total asset; ROE = return on equity; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score.

[a] Wald test for the joint significance of coefficients. The statistic is distributed as a Chi-square with 2 degrees of freedom.

[b] Wald test for significance of difference between coefficients. The statistic is distributed as a Chi-square with 1 degree of freedom.

[c] Derivative of risk (RISK) with respect to PrivDom.

[d] Derivative of risk (RISK) with respect to PrivFor.

[e] Likelihood Ratio test for the joint significance of both cross-section and period fixed effects. The statistic is distributed as χ^2 with 54 degrees of freedom.

Table 8: Risk regression with COM and TRAD and ownership as independent variables

	Risk measures						Insolvency measure	
	SDROE	SDROE	SDROA	SDROA	LLP	LLP	ADZ	ADZ
COM	0.108	0.132	0.026***	0.057	0.012*	0.023**	-1.551	-4.508**
TRAD	0.240***	0.403***	0.036***	0.029***	-0.008	0.076***	1.344	-6.13***
PrivDom		0.090*		0.007		0.034***		-2.375***
PrivFor		0.362***		0.023***		0.014***		-2.197**
COM*PrivDom		-0.328*		-0.026		-0.052***		5.719*
COM*PrivFor		-0.181***		-0.015		-0.024*		5.189*
TRAD*PrivDom		-0.525**		-0.063***		-0.180***		12.278***
TRAD*PrivFor		-0.357**		-0.048***		-0.072***		7.862
ln(TA)	-0.063***	-0.048***	-0.007***	-0.007***	-0.002*	-0.001*	0.951***	0.412***
EQUITY	-0.695***	-1.003***	-0.032***	-0.051***	-0.013	-0.042***	7.768***	9.551***
GTA	-0.022	-0.013	-0.016***	0.002	-0.011***	-0.008**	0.909	-0.150
LDR	-0.074	-0.020	-0.004	-0.007**	0.016***	0.012***	0.465	0.579
ROE	-0.030*	-0.094***	-0.003	0.001	-0.006***	-0.008***	0.868***	1.756***
Cons.	1.665	1.143***	0.192***	0.162***	0.063**	0.028**	-1.903***	-2.255
Bank fixed effects	Included	Included	Included	Included	Included	Included	Included	Included
Time fixed effects	Included	Included	Included	Included	Included	Included	Included	Included
R²	0.808	0.340	0.688	0.240	0.591	0.376	0.728	0.247
F-statistic	46.720***	27.238***	24.973***	4.562***	16.712***	10.301***	30.104***	17.694***

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Variable definitions: COM = net commission income/net operating income; TRAD = net trading income/net operating income; PrivDom = 1 for private domestic banks, 0 otherwise; PrivFor = 1 for private foreign banks, 0 otherwise; EQUITY = equity/total assets; GTA = log(current total assets/previous total assets); LDR = loan to deposit; ln(TA) = logarithm of total asset; ROE = return on equity; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score.

[a] Wald test for the joint significance of coefficients. The statistic is distributed as a Chi-square with 2 degrees of freedom.

[b] Wald test for significance of difference between coefficients. The statistic is distributed as a Chi-square with 1 degree of freedom.

[c] Derivative of risk (RISK) with respect to ownership dummy in relation to the diversification variable in question.

[d] Likelihood Ratio test for the joint significance of both cross-section and period fixed effects. The statistic is distributed as χ^2 with 54 degrees of freedom.

Table 8 (contd): Risk regression with COM and TRAD and ownership as independent variables.

	Risk measures						Insolvency measure	
	SDROE	SDROE	SDROA	SDROA	LLP	LLP	ADZ	ADZ
Hypothesis testing								
$\beta_3 = \beta_5 = 0$ [a]		13.154**		2.347		11.314***		13.001**
$\beta_4 = \beta_6 = 0$ [a]		27.775***		7.803*		9.008**		9.023*
$\beta_3 = \beta_7 = 0$ [a]		23.633***		9.815**		14.949***		15.600***
$\beta_4 = \beta_8 = 0$ [a]		23.582***		16.853***		12.752***		6.145
$\beta_5 = \beta_6 = 0$ [b]		6.257**		11.145***		20.567***		1.120
$\beta_7 = \beta_8 = 0$ [b]		0.568		16.042***		11.429**		21.160***
$\partial RISK/\partial PrivDom$ [c]		0.090 - 0.328COM		0.007 - 0.026COM		0.034 - 0.052COM		-2.375 - 5.719COM
$\partial RISK/\partial PrivFor$ [c]		0.362 - 0.181COM		0.023 - 0.015COM		0.014 - 0.024COM		-2.197 - 5.189COM
$\partial RISK/\partial PrivDom$ [c]		0.090 - 0.525TRAD		0.007 - 0.063TRAD		0.034 - 0.180TRAD		-2.375 + 12.279TRAD
$\partial RISK/\partial PrivFor$ [c]		0.362 - 0.357TRAD		0.023 - 0.048TRAD		0.014 - 0.072TRAD		-2.197 + 7.862TRAD
Fixed effects test [d]	1009.966***	927.888***	775.328***	755.504***	488.621***	446.811***	775.087***	744.741***
No. of obs.	664	664	664	664	664	664	664	664

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Variable definitions: COM = net commission income/net operating income; TRAD = net trading income/net operating income; PrivDom = 1 for private domestic banks, 0 otherwise; PrivFor = 1 for private foreign banks, 0 otherwise; EQUITY = equity/total assets; GTA = log(current total assets/previous total assets); LDR = loan to deposit; ln(TA) = logarithm of total asset; ROE = return on equity; SDROE = standard deviation of return on equity; SDROA = standard deviation of return on assets; LLP = loan loss provision/total asset; ADZ = Z-score.

[a] Wald test for the joint significance of coefficients. The statistic is distributed as a Chi-square with 2 degrees of freedom.

[b] Wald test for significance of difference between coefficients. The statistic is distributed as a Chi-square with 1 degree of freedom.

[c] Derivative of risk (RISK) with respect to ownership dummy in relation to the diversification variable in question.

[d] Likelihood Ratio test for the joint significance of both cross-section and period fixed effects. The statistic is distributed as χ^2 with 54 degrees of freedom.

The first derivative [7] indicates that for small banks, NON is positively associated with risk; however, as asset size increases, the relationship becomes negative. This could be explained by the fact that as banks start to build the requisite infrastructure and capacity to diversify into non-interest activities, non-interest income may initially be low while the related costs lead to volatile net revenues. However, as they consolidate and secure their market share over time, non-interest income increase and become stable, thus improving its associated volatility.

In order to check for robustness, we report the estimation results in Table 4 without the interaction term, *NON* × ln(*TA*), for each group of sub-samples (small-sized and large-sized banks) as defined in Table 1. NON is reported to be positively related to risk measures for the sub-sample of small-sized banks and negatively related to risk measures for the sub-sample of large-sized banks. Thus, these results offer some support for the findings in Table 3 where we show that for small banks, NON is positively associated with risk, but, as asset size increases the relationship becomes negative.

To gain further insight into the relationship between non-interest income and risk, the product diversification measure is disaggregated into two main components, namely, commission and fees (COM) and trading activities (TRAD) as in DeYoung and Roland (2001) and Hidayat et al. (2012). We find partial evidence that COM and TRAD have significant and positive relationships with bank risk as reported in Table 5.

With the introduction of the interaction term, the Wald test reject the null that $\beta_1=\beta_3=0$ for the SDROA, LLP and ADZ equations. The first derivative[8] of risk with respect to COM, $\partial\text{RISK}/\partial\text{COMM}$, shows that the impact of a rise in commission and fee activities on bank risk is positive especially for small banks; however, its impact decreases and becomes negative as asset size increases.

Besides, the Wald test reject the null that $\beta_2=\beta_4=0$ for the SDROA and SDROA equations. Even though the Wald test fails to reject the null that $\beta_2=\beta_4=0$ for the LLP and ADZ equations, the first derivatives in both equations suggests a similar impact as in the case of the SDROE and SDROA equations. Therefore, as with COM, TRAD increases bank risk; however, its effect declines and becomes negative as asset size increases.

Table 5 also reveals that asset growth (GTA), profitability (ROE and ROA) and LISTED have a significant and negative association with bank risk while there is a partial evidence that both asset size and ln(TA) have a positive effect on bank risk. However, the impact of capital leverage (EQUITY) and loan-to-deposit ratio (LDR) is less clear. These results are similar to those in Table 3.

4.2 Ownership structure, income diversification and risk

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[7] 1.787 - 0.010ln(TA), 0.427 - 0.023ln(TA), 0.166 - 0.009ln(TA) and -9.596 - 2.020ln(TA) or SDROE, SDROA, LLP and ADZ equations respectively.

[8] 0.490 - 0.026ln(TA), 0.195 - 0.010ln(TA) and -6.945 + 2.502ln(TA) for SDROA, LLP and ADZ equations respectively.

Further tests are carried out by categorizing banks according to public sector banks, private sector domestic banks and private sector foreign banks. Public sector banks are those where the majority of shares are owned by the State or/and state-owned agencies. Private sector domestic banks are those where the majority of shares are held by Ghanaian shareholders or organizations. Private sector foreign banks have the majority of shares held by foreigners. The uni-variate results for differences in bank ownership are reported in Table 6.

The differences in some of the bank characteristics between the various bank ownership categories are quite striking. Foreign banks are the largest banks while private sector domestic banks are smallest among the three bank ownership categories. Loans (LOAN) constitute more than 50% of total assets for local banks (public sector banks and private sector domestic banks) while comprising 38% of total assets for the average private foreign bank. This could explain why local banks maintain a higher percentage of loan loss provisions (1.8% for public banks and 2.4% for private domestic banks) compared to foreign banks (1.1%). On the liabilities section, private banks (private domestic and foreign) have higher deposit-to-total assets ratio (DEPO) than public banks which is likely due to the formers' aggressive marketing techniques.

With respect to product diversification (NON, COM and TRAD), foreign banks are more aggressive in the market. For instance, they have net non-interest income-to-net operating income ratio (NON) of 40 % compared to about 36% for local banks. This may suggest that the foreign banks have more resources, skills and experience in offering non-traditional banking activities than the local banks taken together.   In addition, the network relations of the foreign banks with their parent banks outside of Ghana may make them more attractive to customers with interest in non-traditional banking activities outside of Ghana, thus making foreign banks more attractive to this group of customers. Taken together, local banks tend to emphasize traditional financial intermediation (granting loans) while the foreign banks are more dominant in non-interest income activities.

With only a few exceptions, we find strong evidence of risk differences for the three bank ownership groups. We note, particularly, that private sector domestic banks have the lowest risk levels (SDROE, SDROA and ADZ) even though they are also characterized by the highest loan loss provision-total asset ratio (LLP)[9]. Moreover, foreign banks are exposed to higher risk levels (highest SDROE, SDROA and ADZ) which may be due to their higher levels of non-interest sources of income. These univariate test results support our finding that non-interest income is positively related to bank risk.

In Table 7, we observe that when the ownership variables are excluded from the models, NON is significant (SDROE, SDROA and LLP). This result is consistent with the result reported in Table 3. Interestingly, the inclusion of bank ownership dummies in the models shows that effect of non-interest income (NON) on public

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[9] This could be linked to the fact that they have the highest loan-to-total assets ratio (LOAN).

banks risk is significant and positive for all regression equations. This implies that after controlling for ownership structure, the pursuit of non-traditional banking activities (NON) has the tendency to increase risk of public banks.

Using the Wald test, we reject the null that $\beta_2 = \beta_4 = 0$ and $\beta_3 = \beta_5 = 0$ for SDROE, SDROA, LLP and ADZ models as reported in Table7. Looking at the ownership structure variables in Table 7, we also observe that being a private domestic bank leads to a significantly lower risk as NON increases. For example, this interpretation is supported by the fact that the first derivate of RISK with respect to PRIVFOR using the SDROA model is 0.011 - 0.039 NON.   This result is not surprising given that the uni-variate results reported in Table 6 show that private domestic banks have the lowest risk levels. In contrast, at higher levels of NON, a bank being public domestic increases risk. Foreign banks are shown to reduce their risk as NON increases as can be inferred from the first derivative of RISK with respect to PRIVFOR, 0.015 - 0.027NON using the SDROA model in Table 7 for example.

Besides, examining the first derivative of RISK with respect to NON yields further insights. The derivative, ∂RISK$/\partial$NON = 0.159 – 0.039PRIVDOM – 0.027 PRIVFOR, shows that while both domestic private and foreign private banks have their risk exposures reduced by an increase in non-interest income (according to ∂RISK$/\partial$PRIVDOM and ∂RISK$/\partial$PRIVFOR), the speed of adjustment is much faster for domestic banks (β_4 = 0.039) than foreign banks (β_5 = 0.027). The Wald test on β_4 - β_5 = 0 is rejected for all the regression models as reported in Table 7. We consider this as an important contribution to the literature.

Moreover, the result is reflected in the uni-variate results reported in Table 6 which show that private domestic banks have the lowest risk levels. In contrast, at higher levels of NON, a bank being public domestic increases risk. Foreign banks are shown to reduce their risk as NON increases as can be inferred from the first derivative of RISK with respect to NON, 0.013 – 0.021NON   using the SDROA model in Table 7 for example.

In Table 8, we consider the individual sources of non-interest income (COM and TRAD). Using the Wald test, we reject the null in most cases that $\beta_3 = \beta_5 = 0$, $\beta_4 = \beta_6 = 0$, $\beta_3 = \beta_7 = 0$ and $\beta_4 = \beta_8 = 0$. The derivatives of risk with respect to PRIVDOM (∂RISK$/\partial$PRIVDOM) and PRIVFOR (∂RISK$/\partial$PRIVFOR) are reported. Similar to the results in Table 7, the derivatives show that increases in COM and TRAD tend to reduce bank risk for both private sector domestic and foreign banks. However, public banks increase their risk exposure as they increase commission and trading income. Again, examining the first derivatives of RISK with respect to the diversification variables (∂RISK$/\partial$COM and ∂RISK$/\partial$TRAD) [10] offers support for our finding in Table 7 that the speed of adjustment in terms of the reduction in risk is significantly higher for private sector domestic banks relative to private sector foreign banks.

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[10] For instance using the SDROE equation the first derivatives are ∂RISK$/\partial$COM = 0.132 - 0.328PRIVDOM - 0.181PRIVFOR and ∂RISK$/\partial$TRAD = 0.403 – 0.525PRIVDOM – 0.357PRIVFOR.

The results of the other control variables besides COM, TRAD and their interaction terms are qualitatively similar to those reported in Tables 5, 6 and 7.

5. Conclusion

Financial sector reforms in the late 1980's to 1990's in Ghana saw the influx of commercial banks into the country. The reforms and the attendant keen competition in the industry have engendered a trend towards strong product diversification. Our paper investigates the implication of ownership structure on product diversification and risk in the banking industry in Ghana. The main conclusions are as follows.

We find that non-interest income (NON, COM and TRAD) is positively associated with risk; however, as asset size increases, the relationship becomes negative. This implies that small banks are exposed to higher risk when the income share of non-traditional banking activities rises. Large banks, on the other hand, could gain from the risk-reducing effect of diversification. These results suggest that analysis of bank risk should consider small banks differently from large banks.

On the question of ownership structure, we conclude that after controlling for ownership structure, the pursuit of non-traditional banking activities (NON) has the tendency to increase risk of public domestic banks. In contrast, the risk of private domestic banks and foreign banks decrease with a rise in non-traditional banking activities. We also show that that while both domestic private and foreign private banks have their risk exposures reduced by an increase in non-interest income, the speed of adjustment in regard to risk reduction is much faster for domestic private banks than foreign private banks. We consider this finding an interesting and major contribution to the existing literature. These results may provide useful information to investors and banking regulators as they attempt to reconcile the important issues of bank ownership structure, income diversification and size on the one hand with the level of risk exposure of banks on the other hand.

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