Income diversification and bank efficiency in an emerging market

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Abstract

Purpose – The purpose of this paper is to explore the non-linear relationship between income diversification and efficiency of Ghanaian banks within the universal banking era.

Design/methodology/approach – The stochastic frontier analysis (SFA) technique is employed on annual data of 26 Ghanaian banks from 2003 to 2011 to estimate cost and profit efficiency scores. In the second stage analysis, a tobit regression model is estimated to examine the empirical effect of diversification into non-interest generating activities on estimated cost and profit efficiency scores while controlling for other bank specific characteristics.

Findings – The findings of the SFA reveal high levels of efficiency in cost compared with profit to reflect high inefficiencies on the revenue side. An analysis of efficiency scores by two categories of bank size suggests that large banks have high cost and profit efficiency compared to small banks. A non-linear relationship is found between income diversification and efficiency while size was also found to be important in enabling banks exploit the potential benefits of income diversification.

Research limitations/implications – This study focuses on one banking market in Africa. A comparative analysis in a cross-section of banking markets in Africa will be useful to bring robustness to the findings of this study.

Practical implications – The findings of this study provides useful insights for management on the best corporate model in ensuring that diversification activities are efficiency-enhancing.

Originality/value – This study presents the first empirical evidence on the non-linear relationship between efficiency and income diversification in emerging banking markets in Africa.

Keywords Africa, Efficiency, Ghana, Banks, Emerging markets, Income diversification, Stochastic frontier analysis

Paper type Research paper

1. Introduction

The financial reforms in many African countries in the early 1990s have shifted the focus to the generation of non-traditional income in the form of fee incomes, service charges, trading revenue among several others. However, the empirical evidence on the effect of bank income diversification on the economic performance of banking markets in Africa appears scant. This relationship is explained by two competing theories. The first, referred to as the "strategic-focus" hypothesis, argues that diversified firms are more likely to have difficulties with the monitoring of multiple business units, high agency costs and high earning variations (see Winton, 1999; Klein and Saidenberg, 2010; De Young and Roland, 2001; Stiroh, 2004; De Jonghe, 2010; Amihud and Lev, 1981; Laeven and Levine, 2007; Deng and Elyasiani, 2008). However, the proponents of conglomeration hypothesis argue that diversification of banking activities ensures the maximization of managerial efforts across different aspects banking operations (Iskandar-Datta and McLaughlin, 2007; Gambacorta *et al.*, 2014). This result in economies

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of scope benefit through the cost-sharing of fixed cost over multiple products and minimize the variations in banks earnings (Saunders and Walter, 1994; Lown *et al.*, 2000; Gambacorta *et al.*, 2014). These divergent theories suggest a non-linear relationship between income diversification and bank performance. For instance, excessive diversification may result in increased cost[1] over and above any perceived benefits (Riordan and Williamson, 1985; Grant *et al.*, 1988; Berger and Ofek, 1995; Jensen, 1996).

With this background in mind, this paper undertakes to explore the non-linear relationship between bank income diversification and efficiency in the Ghanaian banking market. Specifically, this study extends the literature on bank efficiency in Ghana and other emerging economies in three ways. First, we assess bank performance by using parametric measures in the stochastic frontier analysis (SFA) to estimate cost and profit efficiency. Majority of efficiency studies in developing economies employ technical efficiency and financial ratios as proxies for bank performance. The second contribution is the analysis of the relationship between estimated cost and profit efficiency scores and bank income diversification. Through a linear and quadratic regression modelling framework, this study explores the possible non-linear relationship between bank income diversification and efficiency. To best of the author's knowledge, these relationships have not been explored in the context of banking markets in Africa. The shift towards non-interest generating activities following the implementation of financial liberalization policies makes it relevant for this study to explore the diversification-performance relationship in a banking market in Africa. Finally, the paper also examines the role of bank-level characteristics in moderating the efficiency-diversification relationship.

The Ghanaian banking industry provides an interesting background for such analysis for the following reasons. Since 2003, commercial and development banks have diversified into other portfolios such as financing of international, commerce and corporate lending, treasury services, loan syndication (Amidu and Hinson, 2006) among several others. This development was mainly driven by the introduction of the Universal Banking license in 2003 and has to the growth in the non-interest generating activities of banks. The Act also required the increase of the minimum capital requirement to GH¢7 million for both existing and newly licensed banks. This has been subsequently reviewed upwards to GH¢60 million since December 2012. From 2013, new entrants are required to meet capital requirements of GH¢120 million.

Over the past decade, the industry has also witnessed a surge in the computerization with the introduction of automated teller machines (ATMs). As at 2011, there were 618 operational ATMs across the country. The total branch network increased to 833 in 2012 from 360 branches in 2004 (Ecobank Research, 2013). Currently, the industry consists of 27 banks, 15 foreign and 12 domestic owned banks. About 51 per cent of total industry assets are held by foreign owned banks (International Monetary Fund, 2011). As at December 2010, the largest state owned bank[2] accounted for 12.6, 15 and 13.1 per cent of the total industry assets, loans and advances and deposits respectively (PwC, 2011).

Presented in Table I is revenue[3] and profitability indicator in the banking industry. We observe the industry to be highly reliant on revenue from traditional banking activities in lending. Over the period, about two-thirds of banks revenue is generated from interest income from loans and advances compared with the revenue from non-traditional activities in fees and commission. From the profitability indicators, return on shareholder equity averaged 18.83 per cent while return on total assets was 2.35 per cent between 2004 and 2011. The average bank expenditure was 65.61 per cent of total bank income. The market structure of the banking industry proxied by the five

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Return on assets	0.002	0.002	0.027	0.019	0.029	0.041	0.011	0.034	0.021
Return on equity	0.019	0.023	0.21	0.151	0.296	0.307	0.133	0.187	0.197
Cost to income ratio	0.520	0.511	0.809	0.834	0.653	0.641	0.69	0.595	0.559
Interest income	0.771	0.796	0.808	0.806	0.775	0.804	0.842	0.837	0.806
Non-interest income	0.229	0.204	0.192	0.194	0.225	0.196	0.158	0.163	0.194
Herfindahl index									
Loans	0.1228	0.1144	0.1039	0.0913	0.0941	0.0863	0.0830	0.0597	0.0538
Assets	0.1141	0.1066	0.0962	0.0871	0.0838	0.0744	0.0693	0.0600	0.0600
Deposits	0.1260	0.1210	0.1097	0.0990	0.0862	0.0770	0.0680	0.0655	0.0632
CR5									
Loans	0.7146	0.6594	0.6250	0.5797	0.5740	0.5412	0.4900	0.4109	0.3815
Assets	0.6950	0.6559	0.6115	0.5743	0.5560	0.5186	0.4946	0.4499	0.4427
CR3									
Loans	0.5324	0.5141	0.4684	0.4165	0.4279	0.4046	0.3651	0.2908	0.2505
Assets	0.4926	0.4746	0.4343	0.4129	0.4129	0.3754	0.3485	0.3038	0.3035

Notes: CR5 = five bank concentration ratio; CR3 = three bank concentration ratio
Source: Authors estimation from research data

Table I.
Structure of the banking industry

and three firm concentration ratios and the Herfindahl index of the banks major balance sheet items in assets and loans are also shown in Table I. We observe that the five largest banks account for about half of the industry's assets and loans whilst the three largest banks account for one-third of the industry's assets and loans between 2004 and 2011. This reflects a highly concentrated banking market. Overall, the banking industry can be characterized as an evolving and competitive financial services industry.

The remainder of the paper is organised as follows: Section 2 reviews empirical studies on income diversification and efficiency in banking markets; Section 3 describes the data and methodology employed in the analysis; Section 4 discusses the empirical results and Section 5 covers the conclusion and policy recommendations from the findings of the study.

2. Literature review

The empirical relationship between income diversification and bank performance has been the subject of considerable academic debate in developed markets with mixed findings. For instance, using the SFA on sample of European banks between 1995 and 1996, Vennet (2002) found specialised banks to have high efficiency in cost and profit compared to diversified banks. Acharya *et al.* (2006) employed data on 105 banks from 1993 to 1999 and concluded that diversification activities of Italian banks did not improve performance. Stiroh and Rumble (2006) report that increased reliance on non-interest income activities is associated with increased risk and lower return. This conflicting effect casts a shadow of doubt on the benefits of diversification. Deng *et al.* (2007) also provided evidence on the negative effect of income diversification on firm performance by finding an inverse relationship between cost of debt and diversification activities of bank holding companies. Mercieca *et al.* (2007) examined the effect of non-interest income on profitability of 755 banks between 1997 and 2003 in Europe. The authors find evidence to suggest that bank benefits from bank income diversification is less than the high uncertainty of non-interest income revenue. Lepetit *et al.* (2008) also find increased non-intermediation

activities resulted in high risk taking by banks in 14 European countries from 1996 to 2002. Elyasiani and Wang (2012) examined the effect of income diversification on production efficiency of bank holding companies from 1997 to 2007. Using both technical efficiency and productivity changes as the dependent variables, the authors find statistically significant negative relationship with income diversification.

Other studies have also found evidence of a positive effect of diversification on bank performance. For example, Baele *et al.* (2007) provided an empirical evidence of a positive relationship between diversification and franchise value using a sample of 17 European countries. Chronopoulos *et al.* (2011) also examined the diversification-efficiency relationship for new member states[4] admitted into the European Union between 2001 and 2007. The authors employed the DEA technique to estimate both cost and profit efficiency of banks in the first stage analysis. Their results revealed high levels of efficiencies on both cost and revenue side of bank activities. Most importantly, the authors find a strong evidence to support the hypothesis that bank income diversification is efficiency-enhancing. Recently, Lee *et al.* (2014) analysed the effect of bank income diversification on performance on a panel data of banks in 29 Asia-Pacific countries from 1995 to 2009. The authors provided evidence of a positive impact of income diversification in respect of countries with bank dominated financial systems.

Following the inconclusive evidence in the empirical literature discussed above, Gambacorta *et al.* (2014) analysed the non-linear relationship between income diversification and bank profitability using an international sample of 98 banks from 27 countries over the period 1994 to 2012. The authors find evidence of an inverted *U*-shaped relationship. Specifically, the authors found that beyond 30 per cent of diversification ratio, diversification become less profitable.

Coming from the backdrop of reforms in the financial services industry that has led to a shift in focus to non-interest generating activities in banking markets in many African countries, it is only appropriate that attention is paid to effect of growing non-traditional banking activities on efficiency. To best of the authors knowledge, efficiency studies on banking markets in Africa by authors such as Mlambo and Ncube (2011), Aboagye (2012), Saka *et al.* (2012), Isshaq and Bokpin (2012) and Bokpin (2013) has provided little or no evidence on the effects of income diversification. This study attempts at addressing such a gap in the empirical literature. This study proxies bank performance using cost and profit efficiency as opposed to the profitability ratio used by Gambacorta *et al.* (2014).

3. Methodology

3.1 SFA

In the estimation of the cost and profit efficiency frontier, this paper follows Maudos *et al.* (2002), Kasman and Yildirim (2006) among several others and employs the SFA technique of Aigner *et al.* (1977) and Meeusen and van der Broeck (1977). Under the SFA approach, a bank is assumed to be inefficient if it produces outputs at cost higher than its peers operating under the same conditions to produce similar outputs. Theoretically, the observed deviations from the efficient frontier are classified into managerial inefficiency and random noise. The panel data specification of the translog function is given by:

$$TC_{i,t} = lnTC(y_{i,t}; w_{i,t}; \beta) + \varepsilon_{i,t} \quad (1)$$

where TC is the total operating cost, y_i and w_i is a vector of outputs and input prices, respectively, and:

$$\varepsilon_{i,t} = v_{i,t} + u_{i,t} \tag{2}$$

where $v_{i,t}$ is the random noise that captures the errors in measurement while $u_{i,t}$ captures inefficiency arising from managerial slack. The multiproduct cost (profit) function in the translog form is modelled as:

$$\begin{aligned}\ln\left(\frac{TC}{w_3}\right)_{i,t} = {} & \beta_1 lny_{1_{i,t}} + \beta_2 lny_{2_{i,t}} + \beta_3 \ln\left(\frac{w_1}{w_3}\right)_{i,t} + \beta_4 \ln\left(\frac{w_2}{w_3}\right)_{i,t} + \beta_5 lny^2_{1_{i,t}} \\ & + \beta_6 lny^2_{2_{i,t}} + \beta_7 (lny_1 lny_2)_{i,t} + \beta_8 \left(\ln\left(\frac{w_1}{w_3}\right)\right)^2_{i,t} + \beta_9 \left(\ln\left(\frac{w_2}{w_3}\right)\right)^2_{i,t} \\ & + \beta_{10}\left(\ln\left(\frac{w_1}{w_3}\right)\ln\left(\frac{w_2}{w_3}\right)\right) + \beta_{11}\left(\ln\left(\frac{w_1}{w_3}\right) lny_1\right)_{i,t} \\ & + \beta_{12}\left(\ln\left(\frac{w_1}{w_3}\right) lny_2\right)_{i,t} + \beta_{13}\left(\ln\left(\frac{w_2}{w_3}\right) lny_1\right)_{i,t} + \beta_{14}\left(\ln\left(\frac{w_2}{w_3}\right) lny_2\right)_{i,t} \\ & + \beta_{15} lnE_{i,t} + \beta_{16} lnE^2_{i,t} + \beta_{17}(lnElny_1)_{i,t} + \beta_{18}(lnElny_2)_{i,t} \\ & + \beta_{19}\left(lnEln\left(\frac{w_1}{W_3}\right)\right)_{i,t} + \beta_{19}\left(lnEln\left(\frac{w_2}{W_3}\right)\right)_{i,t} + \beta_{20} yr_t + v_{i,t} + \mu_{i,t}\end{aligned} \tag{3}$$

where TC is the total production cost of a bank, made up of costs, $w_i (i = 1,2,3)$ where w_i is price of labour, w_2 is the price of deposit funds and w_3 is the price of capital; the y_i $(i = 1,2)$ are the output quantities where y_i is total loans, y_2 is other earning assets; $v_{i,t}$ and $\mu_{i,t}$ are the two-sided error terms assumed to follow a normal distribution and normal truncated distribution, respectively. In line with Mester (1996) and Maudos *et al.* (2002), we include the financial capital (equity), E in the estimations to control for banks degree of risk. A year dummy, yr to control the effect of technological improvements of efficiency.

In line with prior studies, the alternative profit efficiency is preferred over the standard profit frontier using profit after tax (PAT) as the dependent variable. The TC in Equation (3) is replaced with net profit after tax. In order to address cases of negative profitability, we transform the dependent variable to $\ln(PAT + \min|PAT| + 1)$, where $\min|PAT|$ is the minimum absolute value of profit after tax. This enables the logarithmic transformation of negative profit values. Symmetry and linear restrictions are imposed by normalizing TC, PAT, w_1 and w_2 by w_3. To allow for allocative inefficiency (Berger and Mester, 1997), we exclude the estimation of input share equations in the Shepherd's Lemma restriction. The Battese and Coelli (1992) specification under the assumption of a truncated normal random distribution was employed in the estimation of the translog models.

3.1.1 Output variables and input prices. We define our output variable from intermediation approach which assumes that banks acts as financial intermediaries in accepting deposits and transferring them into loan assets for deficit spending units. This study employs outputs variables in loans and other earning (investment) assets while deposits, fixed assets and personnel expenses are the three inputs used in generating the output variables. The prices for the input variables are defined as; the

ratio of depreciation expense to fixed assets as proxy for cost of fixed assets, $w1$; price of labour (Beccalli *et al.*, 2006); $w2$ is the ratio of staff expenses to total assets and the ratio of interest expense to total deposits as proxy for price of deposits, $w3$. The summary statistics of the variables in the translog model is presented in Table II.

3.2 Bank income diversification

Following Laeven and Levine (2007), Chronopoulos *et al.* (2011) and Elyasiani and Wang (2012), the Herfindahl Hirschman index (HHI) of bank income is employed to measure bank income diversification. The diversification of bank income is given as:

$$hhi_{div} = 1 - \left[\left(\frac{non}{totinc}\right)^2 + \left(\frac{net}{totinc}\right)^2\right] \quad (4)$$

where *totinc* is the total bank income. It is made up of non-interest income, *non* and net interest income, *net*. As a concentration measure, higher values of the *hhi* reflects concentration while lower value reflects diversification. From the specification in Equation (4), higher values of hhi_{div} would reflect highly diversified bank income and vice versa.

3.3 Empirical model

In order to test the hypothesized relationship between income diversification and efficiency, the estimated efficiency cost and profit scores are employed as the dependent variable in the second stage regression analysis. The empirical relationship between cost and profit efficiency and bank income diversification is modelled on the works of Elyasiani and Wang (2012) and Gaganis *et al.* (2013):

$$U_{i,t} = \beta_0 + \beta_1 hhi_{div_{i,t}} + \beta_2 lnta_{i,t} + \beta_3 llp_{i,t} + \beta_4 eqt_{i,t} + \beta_5 lota_{i,t} + \beta_6 tang_{i,t} + \beta_7 hhil_t + \varepsilon_{i,t} \quad (5)$$

		Mean	Median	SD	Min.	Max.	n
Outcomes							
Cost	C	106,747,509	26,788,887	547,990,173	0.000	5,980,992,386	205
Profits	P	9,781,527	4,146,942	16,253,068	−23,585	82,189,881	205
Outputs							
Loans and advances	$y1$	267,990,871	177,426,729	342,086,295	825,957	2,065,056,490	205
Investment	$y2$	116,610,495	33,535,065	271,067,584	121,928	2,204,136,732	202
Inputs							
Fixed assets	$x1$	19,083,325	10,669,986	24,166,318	53,893	166,951,823	205
Deposits	$x2$	428,288,258	243,669,748	600,134,784	2,270,100	4,284,732,561	205
Staff expenses	$x3$	13,190,328	6,888,789	17,104,956	11,708	94,760,008	183
Input prices							
Price of fixed capital	$p1$	7.8848	1.6890	56.4037	0.0044	769.3928	205
Price of labour	$p2$	0.0390	0.0218	0.0567	0.0000	0.3716	183
Price of deposits	$p3$	0.2291	0.1026	0.5576	0.0001	4.5597	205
Risk							
Equity	E	83,929,222	49,204,433	113,674,673	948,800	650,824,599	205

Note: All monetary values are in Ghana Cedis

Table II. Summary of profit, cost, output, inputs and input prices

$$U_{i,t} = \beta_0 + \beta_1 hhi_{div_{i,t}} + \beta_2 hhi^2_{div_{i,t}} + \beta_3 lnta_{i,t} + \beta_4 llp_{i,t} + \beta_5 eqt_{i,t} + \beta_6 lota_{i,t} + \beta_7 tang_{i,t} + \beta_8 hhil_t + \varepsilon_{i,t} \quad (6)$$

where hhi_{div} is the proxy for bank income diversification explained in Equation (4); hhi^2_{div} is the quadratic term for bank income diversification; *lnta* is measured as the natural logarithm of total assets. This is used a proxy for bank size. Studies[5] by Ataullah *et al.* (2004), Hauner (2005) and Chen *et al.* (2005), Isik and Hassan (2003), Girardone *et al.* (2004) and Weill (2004) and among several others have found inconclusive evidence on the size-efficiency relationship. *llp* proxies for bank asset quality, measured as the ratio of loan loss provisions to total loans; a priori, we expect that banks with low asset quality reflected by high *llp* would have high inefficiency. *eqt* is the ratio bank equity to total assets and captures the effect of bank capitalization. From the empirical literature, *eqt* has been found to exhibit mixed relationship with efficiency, with higher bank equity (low leverage) found to improve the efficiency of banks (less efficient) (Casu *et al.*, 2004; Carvallo and Kasman, 2005; Chang and Chiu, 2006) and vice versa (Altunbas *et al.*, 2007). As per the agency theory, threat of bankruptcy forces bank managers to be efficient to meet interest expense, hence highly levered (low capitalised) banks are expected to efficient. *lota* is the ratio total loans and advances to total assets. Increasing *lota* implies higher bank intermediation could either imply efficient utilisation of resources in generating more loan assets or an indication of risk taking behaviour of the banks (Ariff and Can, 2008; Lozano-Vivas and Pasiouras, 2010). In respect of the former, a positive relationship is expected but a negative relationship is expected for the latter. *tang* is the ratio of fixed assets to total assets. Following Elyasiani and Wang (2012), it is expected that banks with high ratio of intangible assets to total assets (low tangibility) are less efficient. *hhil* is the Herfindahl index for bank lending which measures the level of lending concentration in the banking industry. The variable is employed to test the quite-life hypothesis of Hicks (1935) that industry concentration leads efficiency declines because of managerial slack. Hence, a negative relationship is expected with both cost and profit efficiency. The two-way error terms, $\varepsilon_{i,t} = \mu_i + v_{i,t}$, where μ_i and $v_{i,t}$ are the unobservable firm-specific effects and the time-varying error terms which are IID, respectively. The descriptive statistics of the variables in Equations (5) and (6) are presented in Table III.

	Mean	Median	SD	Min.	Max.	*n*
hhi_{div}	0.3821	0.4100	0.1097	0.0100	0.5000	205
lnta	19.640	19.800	1.2628	16.198	22.451	205
llp	0.0565	0.0144	0.1714	−0.0037	1.5409	205
eqt	0.1492	0.1183	0.1201	0.0304	0.8704	205
lota	0.4041	0.3935	0.1417	0.0399	0.7045	205
tang	0.0389	0.0297	0.0362	0.0006	0.2756	205
hhil	0.0872	0.0863	0.0213	0.0538	0.1228	205

Table III. Potential correlates of efficiency

Notes: hhi_{div}, 1-Herfindahl index for income; *lnta*, log of total assets; *llp*, loan loss provisions to total loans; *eqt*, equity to total assets; *lota*, loans to total assets; *tang*, fixed assets to total assets; hhil, Herfindahl index for loans

3.4 Data

We employed annual bank-level data from 2003 to 2011 for 26 banks out of the 27 banks in existence over the period. The bank exempted was because it had only one observation for the study period. All the bank-level data were sourced from the Banking Supervision Department of Bank of Ghana[6]. The data are extracted from the financial statements (income and balance sheet statements) of the all sampled banks. The chosen period was partly as a result of data availability which also coincides with the passage of an Act to usher in the era of universal banking that re-directed the focus of banks non-interest generating activities.

4. Empirical results

The estimated cost and profit efficiency scores[7] are presented in Table IV. Overall, we observe relative high cost efficiency (CE) for Ghanaian banks over the study period. The average CE of 82.22 per cent indicates that the average Ghanaian bank operates at about 17 per cent below the efficient frontier. This reflects the ability of banks to exhibit high levels of both technical and allocative efficiency. The CE is similar to what Das and Gosh (2006)[8] found in the Indian banking industry between 1992 and 2004. The average profit efficiency indicates that Ghanaian banks are able to attain only 43.01 per cent of their potential revenue compared with the banks on the efficient frontier. The dispersion in CE is also lower compared with the dispersion PE over the study period. This result is consistent with other studies that have found high levels of CE than profit efficiency in the banking industry (Berger and Mester, 1997; Maudos *et al.*, 2002; Kasman and Yildirim, 2006; Das and Gosh, 2006; Pasiouras *et al.*, 2009).

We further examine the relationship between efficiency and bank size. The relationship between CE and bank size is presented in Table V. Small banks are found to have low efficiency in cost compared to large banks. This reflects the economies of scale and scope advantages that characterize large scale banking operations and results in low per unit cost of production.

The evolution of profit efficiency across the different size groups is also presented in Table VI. Consistent with CE, we find large banks to have high levels of efficiency in profits compared to small banks. This indicates that large banks are better at maximizing their earning potential compared to small banks. This could be partly explained by high efficiency in cost of production which translates into higher sales in the form of interest income.

	Cost efficiency			Profit efficiency		
Years	Mean	SD	*n*	Mean	SD	*n*
2003	0.8187	0.1482	18	0.5736	0.3579	18
2004	0.8322	0.1011	17	0.4913	0.3288	17
2005	0.8248	0.1091	20	0.5804	0.3311	20
2006	0.8012	0.1146	16	0.4159	0.3382	16
2007	0.8346	0.0676	18	0.4608	0.3113	18
2008	0.8251	0.0916	22	0.2991	0.2547	22
2009	0.8321	0.0881	24	0.3467	0.3705	24
2010	0.7981	0.1328	24	0.3784	0.3268	24
2011	0.8336	0.0753	21	0.3962	0.3207	21
Average	0.8222	0.1043		0.4301	0.3335	

Source: Authors estimation from research data

Table IV.
Evolution of profit and cost efficiency (2003-2011)

Years	Small		Large	
	Mean	SD	Mean	SD
2003	0.7027	0.2936	0.8518	0.0593
2004	0.7600	0.1937	0.8545	0.0446
2005	0.8248	0.1154	0.8248	0.0852
2006	0.8213	0.1047	0.7410	0.1381
2007	0.8310	0.0761	0.8474	0.0227
2008	0.8128	0.1077	0.8466	0.0529
2009	0.8342	0.0854	0.8295	0.0954
2010	0.8344	0.0870	0.7859	0.1449
2011	0.8454	0.0663	0.8307	0.0792
Average	0.8178	0.1148	0.8263	0.0936

Source: Authors estimation from research data

Table V.
Cost efficiency and bank size

Years	Small		Large	
	Mean	SD	Mean	SD
2003	0.8281	0.1749	0.5009	0.3671
2004	0.5828	0.2873	0.4631	0.3462
2005	0.5850	0.3292	0.5560	0.4155
2006	0.3498	0.3406	0.6144	0.2766
2007	0.4168	0.3262	0.6149	0.2180
2008	0.3064	0.2985	0.2862	0.1697
2009	0.3041	0.3459	0.3971	0.4087
2010	0.2776	0.3481	0.4120	0.3226
2011	0.3100	0.4573	0.4177	0.2932
Average	0.4159	0.3451	0.4437	0.3234

Source: Authors estimation from research data

Table VI.
Profit efficiency and bank size

Before estimation of the regression models, we test for the presence of strong collinearity among the independent variables. The results of the correlation analysis indicate weak collinearity among the independent variables. Using the threshold of 0.70 as suggested by Kennedy (2008), the estimation of the regression models would not be biased by multicollinearity. In respect of the quadratic model, the high correlation between hhi_{div} and hhi^{2}_{div} suggests the estimated results may suffer from multicollinearity biases. In order to address this problem, the centring of the hhi_{div} is undertaken. This transformation is done by taking the difference between the hhi_{div} and it is mean values to generate new hhi_{div}. This correlation matrix is presented in Table VII.

4.1 Income diversification and efficiency

The results of the empirical estimations are presented in Table VIII. Since the efficiency scores generated from the SFA ranges between 0 and 1, Tobit estimation was employed in estimation of the pooled sample. The relationship between hhi_{div} and CE is positive but insignificant. This indicates that highly diversified banks have high efficiency in cost. This is consistent with the conglomeration hypothesis. In the case of profit efficiency, a negative relationship is found with hhi_{div} at 1 per cent. This implies that diversified banks are less profit efficient. Since profit efficiency accounts for efficiency

	hhi_{div}	hhi^2_{div}	*size*	*llp*	*eqt*	*lota*	*tang*	*hhil*
hhi_{div}	1							
hhi^2_{div}	0.969***	1						
size	0.064	0.038	1					
llp	−0.029	−0.064	−0.241***	1				
eqt	−0.248***	−0.240***	−0.388***	0.322***	1			
lota	0.064	0.054	0.197***	−0.311***	−0.396***	1		
tang	0.085	0.069	−0.459***	0.035	0.230***	−0.072	1	
hhil	0.083	0.129*	−0.048	−0.156**	−0.150**	−0.140**	0.036	1

Notes: hhi_{div}, 1-Herfindahl index for income; hhi^2_{div}, the square of hhi_{div}; lnta, log of total assets; llp, loan loss provisions to total loans; eqt, equity to total assets; *lota*, loans to total assets; *tang*, fixed assets to total assets; hhil, Herfindahl index for loans. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

Table VII. Pearson correlation matrix

	Model 1 Linear model				Model 2 Quadratic model			
	CE		PE		CE		PE	
	Coef.	*z*	Coef.	*z*	Coef.	*z*	Coef.	*z*
Constant	0.540 (0.146)***	3.71	0.798 (0.602)	1.33	0.509 (0.145)***	3.5	0.995 (0.601)*	1.66
hhi_{div}	0.019 (0.063)	0.31	−0.776 (0.259)***	−3.00	0.663 (0.260)**	2.55	−3.783 (1.087)***	−3.48
hhi^2_{div}					−1.074 (0.421)**	−2.55	4.911 (1.744)***	2.82
lnta	0.001 (0.006)	0.18	0.008 (0.027)	0.31	0.001 (0.006)	0.16	0.017 (0.027)	0.63
llp	−0.041 (0.062)	−0.65	0.085 (0.273)	0.31	−0.074 (0.063)	−1.19	0.311 (0.283)	1.1
eqt	0.351 (0.070)***	5.03	−0.881 (0.284)***	−3.1	0.353 (0.069)***	5.12	−0.923 (0.284)***	−3.25
lota	0.363 (0.055)***	6.61	−0.645 (0.219)***	−2.95	0.345 (0.055)***	6.23	−0.551 (0.223)**	−2.48
tang	−0.248 (0.226)	−1.1	1.401 (0.935)	1.5	−0.327 (0.227)	−1.44	1.771 (0.945)*	1.88
hhil	0.701 (0.314)**	2.23	0.849 (1.241)	0.68	0.808 (0.310)***	2.61	0.336 (1.243)	0.27
Wald χ^2 (7/8)	59.59		25.12		67.2		34.26	
Prob > χ^2	0.000		0.0007		0.0000		0.0000	
Log likelihood	187.84		−79.68		191.069		−74.96	
Banks	26		26		26		26	
Observations	180		180		180		180	

Notes: CE, cost efficiency scores from SFA; PE, alternative profit efficiency scores from SFA; hhi_{div}, 1-Herfindahl index for income; lnta = log of total assets; llp, loan loss provisions to total loans; eqt = equity to total assets; *lota*, loans to total assets; tang, fixed assets to total assets; hhil, Herfindahl index for loans. *,**,*** Significant at 10, 5 and per cent levels, respectively

Table VIII. Income diversification and efficiency

on both cost and revenue sides, this suggests that inefficiencies on the revenue side outweigh any efficiency gains on the cost side.

In examining the non-linear relationship between efficiency and diversification, we introduce the quadratic term of diversification, hhi^2_{div} in the equations. The results are also presented in Table VIII (Model 2). We observe a positive and statistically significant relationship between the linear term of hhi_{div} and CE at 5 per cent while the quadratic term, hhi^2_{div} is negatively related to CE at 5 per cent. This indicates that hhi_{div} has a diminishing marginal effect on CE. At lower levels of income diversification, banks are able to enjoy the benefits of economies of scope and produce at lower per unit cost. However, efficiency gains are diminished at excessive high levels of diversification. This suggests that over-diversification into non-interest generating activities is not efficiency-enhancing. In respect of profit efficiency, the linear term

maintains the negative sign at 1 per cent while the quadratic term becomes positive at significance of 1 per cent. This suggests that revenue side inefficiencies outweighs any benefits from cost reductions at lower levels of diversification into non-interest generating activities. However, at higher levels of diversification, banks are able to maximize their revenue generating potential to offset any additional cost associated with increasing non-interest generating activities.

Consistent with our earlier observations, we find a positive relationship between bank size and CE. This reflects the economies of scale and scope advantages associated with large banking operations and in line with the findings of Vu and Turnell (2011). We also find a positive relationship between size and profit efficiency. While these results are consistent with observations in Tables V and VI, both relationships are insignificant.

Bank equity exhibits significant positive relationship with CE at 1 per cent. This indicates that banks with high-equity capital are more cost efficient. Thus Ghanaian banks become more cost efficient with increases in the equity to assets ratio. This is explained by the important role of bank equity capital as a cover for future losses. Hence, highly capitalized banks are more likely to operate on the cost frontier because of low default cost. Consistent with Pasiouras *et al.* (2009) and Gaganis *et al.* (2013), a negative and significant relationship is found between equity and profit efficiency.

Bank intermediation function captured by *lota* is positively related to CE at 1 per cent. This indicates that banks with high-intermediation activities are more cost efficient. The utilization of assets to generate more loan outputs reflects the spreading of input costs over large volume of outputs to reduce the per unit production cost. This result is consistent with the findings of Vu and Turnell (2011) in the Australian banking industry. However, a negative relationship between *lota* and profit efficiency indicates that increased intermediation activities leads to reduced profit efficiency. This could be explained by the poor quality of credit created. This result in high loan defaults and reduced interest income hence lower profits. Asset tangibility, *tang* is negatively related to CE but positively related to profit efficiency. The positive relationship with profit efficiency is only significant in Model 2.

Finally, we find a positive relationship between cost and profit efficiency and bank market concentration, proxied by *hhil*. The relationship is only significant in the cost models at significance levels of between 5 and 1 per cent. This suggests that market concentration improves CE and inconsistent with the quiet-life hypothesis that market concentration results in efficiency declines. This finding is similar to that of Aboagye (2012).

4.2 Test of robustness

We perform a battery of sensitivity analysis by examining effect of bank-specific characteristics on the relationship between income diversification and cost and profit efficiency scores. Specifically, all the independent variables are interacted with hhi_{div} and included in Equation (1). The estimated results are presented in Table IX with income diversification and size in column 1, income diversification and loan loss provisions in column 2, income diversification and equity in column 3, income diversification and loans ratio in column 4, income diversification and asset tangibility in column 5 and income diversification and Herfindahl index in column 6.

Consistent with the estimation in Table VIII under the CE model, the income diversification variable hhi_{div} has a positive relationship with CE in column 1. With the exception of asset tangibility, all the other bank specific characteristics exhibit varying degrees of significance with CE. The signs are generally in line with the results of the

Table IX. Income diversification, bank characteristics and efficiency

	Cost efficiency (1) Coef.	(2) Coef.	(3) Coef.	(4) Coef.	(5) Coef.	(6) Coef.	Profit efficiency (1) Coef.	(2) Coef.	(3) Coef.	(4) Coef.	(5) Coef.	(6) Coef.
Constant	−0.218	0.461***	0.508***	0.554***	0.472***	0.429**	3.121*	0.602	0.492	0.081	0.576	0.581
hhi_{div}	1.876*	−0.002	−0.078	−0.227	−0.029	0.109	−7.831*	−1.197***	−0.693*	0.777	−0.610	−0.860
$hhi_{div} \times lnta$	0.095*						0.353*					
$hhi_{div} \times llp$		0.947						−17.916**				
$hhi_{div} \times eqt$			0.567						−1.444			
$hhi_{div} \times lota$				0.612						−3.693*		
$hhi_{div} \times tang$					1.460						−10.139	
$hhi_{div} \times hhil$						−1.032						−0.738
lnta	0.038**	0.004	0.003	0.004	0.004	0.004	−0.119	0.012	0.010	0.006	0.005	0.008
llp	0.172**	−0.176	0.170**	0.182***	0.182***	0.179**	−0.092	−6.906**	−0.094	−0.150	−0.136	−0.120
eqt	0.341***	0.316***	0.150	0.284***	0.316***	0.311***	−0.866***	−0.700**	−0.328	−0.606*	−0.786**	−0.744**
lota	0.370***	0.369***	0.369***	0.131	0.370***	0.367***	−0.406*	−0.386*	−0.393*	1.006	−0.420*	−0.396*
tang	−0.391	−0.309	−0.373	−0.269	−0.878	−0.307	1.507	1.225	1.348	0.957	5.116	1.181
hhil	0.978	0.956***	0.984***	0.926***	0.934***	1.330	2.254*	2.580**	2.299*	2.388*	2.382*	2.671
Wald χ^2 (8)	47.11	43.99	45.71	45.63	43.93	43.83	26.32	30.34	23.81	26.98	24.26	23.39
Prob > χ^2	0.000	0.000	0.000	0.000	0.000	0.000	0.0009	0.0002	0.0025	0.0007	0.0021	0.0029
LL	172.329	171.029	171.648	171.594	170.961	170.917	−82.032	−80.165	−83.203	−81.718	−83.128	−83.491
Banks	26	26	26	26	26	26	26	26	26	26	26	26
Observations	180	180	180	180	180	180	180	180	180	180	180	180

Notes: hhi_{div}, 1-Herfindahl index for income; lnta, log of total assets; llp, loan loss provisions to total loans; eqt, equity to total assets; *lota*, loans to total assets; tang, fixed assets to total assets; hhil, Herfindahl index for loans. $hhi_{div} \times$ *lnta*, interaction between income diversification and size; $hhi_{div} \times$ llp, interaction between income diversification and llp; $hhi_{div} \times$ eqt, interaction between income diversification and equity; $hhi_{div} \times$ lota, interaction between income diversification and lota; $hhi_{div} \times$ tang, interaction between income diversification and tang; $hhi_{div} \times$ *hhil*, interaction between income diversification and *hhil*; LL, Log likelihood. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

basic estimation. We find the interaction of income diversification and size ($hhi_{div} \times lnta$) to be significantly related to CE at 10 per cent. The positive relationship indicates that large banks are able to benefit from cost reductions through diversification activities compared to small banks. As explained by Hunter and Timme (1986), larger banks have the ability to employ new technology resulting in cost savings and efficiency gains.

In the profit model, hhi_{div} exhibit consistent negative relationship with profit efficiency. However, the relationship is only significant in columns 1, 2 and 3 at significance levels of 10, 1 and 1 per cent respectively. This is also consistent with the basic results in Table VIII. Similar to the results of the cost model, the interaction of income diversification and size ($hhi_{div} \times lnta$) enters the profit model as positive and significant at 10 per cent. This suggests that diversification enhances the ability of large banks to maximize their revenue generation potential. We also find the interaction between income diversification and bank risk ($hhi_{div} \times llp$) to be negatively related to profit efficiency at 5 per cent. This suggests that any gains from diversifying into non-interest generating activities are off-set by high *llp* (low asset quality). Since hhi_{div} is negative, deterioration in asset quality worsens such negative effect. Finally, we also find the interaction of income diversification and loans generation ($hhi_{div} \times lota$) to be negative and significant at 10 per cent. This suggests that the high intermediation cost further exacerbate the revenue inefficiencies.

5. Conclusions and policy implications

About two decades of financial liberalization policies in Africa has resulted in increased focus on non-interest generating activities. This paper examined the effect of bank income diversification on efficiency of Ghanaian banks from 2003 to 2011. The SFA was employed to estimate both cost and profit efficiency while the Herfindahl index was used to estimate the diversification of bank income. Our findings suggest the existence of high inefficiency in the revenue side of the bank's balance sheet. This was reflected by the high efficiency in cost compared with profit. Specifically, we find average efficiency in cost of 82.22 per cent and average profit efficiency of 43.01 per cent. This indicates that banks in Ghana operate 17.78 per cent below the efficient cost frontier and earn 56.99 per cent less of their revenue potential compared to efficient banks. Over the period, we also observed that large banks operate closer to the cost and profit frontiers compared to small banks.

In the second stage, we employed the Tobit estimation techniques to examine the effect of income diversification and other firm specific variables on cost and profit efficiency. The results suggest an inverted *U*-shaped relationship between CE and income diversification. This implies that income diversification is efficiency-enhancing up to a threshold level, after which benefits are diminished. In respect of profit efficiency, a "*U*-shaped" relationship was found to suggest higher levels of diversification into non-interest generating activities improves banks' ability to maximize their earning potential. At the lower levels of diversification, banks do not generate enough revenues to off-set the sunk cost of diversified operations. Overall, this suggests that diversification into non-interest generating activities enables banks maximize their earnings potential.

Our results also suggest that while equity and intermediation activities improve bank's CE, they do not help banks maximize their revenue potential. Further test of robustness to examine the impact of bank characteristics in moderating the relationship between income diversification and efficiency was also undertaken. The results suggest that less efficient large banks are able to improve achieve efficiency gains through the diversification into non-interest activities. Other bank

factors were however found to have little impact in enabling banks exploit the potential benefits of income diversification.

In conclusion, the findings of this study suggests that initial diversification into non-interest generating activities are not efficiency enhancing. The efficiency benefits are only achieved at higher levels of diversification. Additionally, diversification benefits are more pronounced among large banks compared with small banks. Hence, large banks can employ diversification strategies that ensure efficient utilization of resources to maximize their revenue potential. These findings provide useful insights for bank management and regulatory authorities in emerging markets. For instance, management should place emphasis on the effects of diversification on bottom-line profit. This will inform strategic decisions on the best models to maximize the potential benefits of non-interest generating activities.

The major limitation of this study is inability to decompose the non-interest income into its various components due to data unavailability. This presents an interesting avenue for future researchers. Threshold analysis and the effect of foreign bank presence on efficiency could also be considered by future researchers. The study could also be replicated for a cross-section of banking markets in Africa covering the periods after the liberalization policies.

Notes

1. Riordan and Williamson (1985) classify the three costs into coordination, incentive degradation and bureaucratic distortions costs.
2. Ghana commercial bank.
3. Net interest income and fees commissions are ratio of total bank income.
4. The countries covered by study includes Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.
5. Ataullah *et al.* (2004), Hauner (2005) and Chen *et al.* (2005) all find a positive size-efficiency relationship while Isik and Hassan (2003) and Girardone *et al.* (2004) and Weill (2004) find evidence in favour of a negative relationship.
6. While our sample consists of both domestic and foreign owned banks, the data set used in this study does not come with bank identifiers/names to enable a classification of that sort. Hence, we are unable estimate the models based on ownership type.
7. The translog models were estimated within the Battese and Coelli (1995) framework. However, we favour the two-step procedure over the one-step inefficiency determinants. Due to the economic insignificance of the translog coefficient (Berger and Mester, 1997; Linbo and Shaffer, 2004), the discussion of omitted from the study. However, results of the variance parameters indicate that the translog models were correctly specified. The results are not reported to conserve space but available on request from the authors.
8. Kasman and Yildirim (2006) also reported average cost inefficiency of about 20 per cent for banking systems of newly admitted countries into the EU.

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