Impact of Financial Liberalization on Concentration and Competition in the Ghanaian Banking System: A Panzar-Rosse Analysis

Abraham Adu[1] and Keshab Bhattarai[2]

[1]*Economics and Finance, Business School, University of Aberdeen, Scotland*
[2]*Faculty of Business, Law and Politics, Business School, University of Hull, England, UK.*
E-mail: k.r.bhattarai@hull.ac.uk

Abstract: This paper empirically investigated the evolution of market concentration in Ghana. It tests market competitiveness in banking systems post financial sector reforms. Using unbalanced panel data of 24 banks in the period 2003-2012, a period characterized with deregulation, liberalization and consolidation of the banking sector in Ghana. Market concentration in the Ghanaian banking sector is measured by the Hirschman-Herfindahl indices as well as CR3 and CR5 with this panel data. Both CR3 and CR5 had a decreasing trend indicating falling market concentration ratios and increasing rate of competition in the Ghanaian banking industry. The degree of competition based on the revenue elasticity to input approach under Panzar-Rosse framework indicates monopolistic competition in both interest based market and total revenue markets relative that in the non-interest based market in the Ghanaian banking industry.

Keywords: Ghana**,** Financial Sector Reforms, Banking, Concentration, Competition

1. Introduction

Market structure and competition in the Ghanaian banking sector are major economic policy issues in recent years. Policy makers are trying to change the market structure and to make the banking system more competitive. High degree of competition in the banking sector is seen to be a main factor to bring a high level of efficiency in the production and delivery of banking services and banking products for households and firms in urban and rural areas. Policy makers in Ghana embarked on a continuum

financial sector reforms since 1983. These financial sector reforms include the advent of new information technology and increasing integration with the Sub-Saharan African banking system. Liberalization of the financial sector has also culminated in the entry of new banks in the market. Deregulation amplified the scope of activities and delimited banking activities. It also helping Ghana to be more integrated with the global market. This has also added extra pressure on the participating banks. Thus, the Ghanaian financial system has changed dramatically. The level of competition in the banking sector is increasingly over the past decade. The Ghanaian banking system is becoming more competitive nationally and internationally.

There are a series of studies on the bank performance in the US and European markets as well as in BRICS countries including Brazil and China (Nathan and Neave (1989), Molyneux, Lloyd-Williams and Thornton (1994), Bikker and Haaf (2002), Casu and Girardone (2006), Yuan (2006) and Mathews, Murinde and Zhao (2007)). Relatively little is done on the concentration and competition in the Sub-Saharan African context; particularly in the Ghanaian banking market is mute. This paper contributes to the analysis of the change in the degree of competition in Ghana post financial sector reforms using the Panzar-Rosse (1987) method. It complements to the comparative static general equilibrium analysis of the banking sector in our other study. In line with empirical banking literature including Bikker and Haff (2002), Casu and Girardone (2006), Molynuex et al (2006), Perera et al (2006) this paper employed the reduce-form revenue equations of the market participants derived from the marginal and cost functions and the zero profit constraint in banking market equilibrium as specified by Panzar-Rosse (1987). Bhattarai (2017) applied dynamic CGE model to find impacts of financial liberalization in Nepal.

The paper is organized as follows. Section 2 introduces the Panzar-Rosse method as described other previous studies. Section 3 describes the evolution, structure and soundness of the Ghanaian banking market. Section 4 outlines the structural and non-structural methodologies applied to the Ghanaian banking market and data sources. Section 5 provides the empirical analysis in the spirit of Panzar-Rosse (1987) analytical framework in determining the competitive behavior of Ghanaian banks. Section 6 concludes with policy recommendations.

2.   Method of Analysis

We adopt the Panzar-Rosse method that is widely used (Panzar-Rosse (1987) in testing for the level of competitiveness in financial systems. This is because; there

are fewer assumptions inherent in its estimation procedures. In addition, it uses bank-level data that consider bank-specific differences including types of banks in terms of ownership and size. These advantages in estimation make it possible to compare the Ghanaian banking system with other banking systems in both developed and developing economies. No such analysis exists for Ghana in the literature.

The basis analytical frameworks are given in seven equations. Given the zero profit constraints in equilibrium, the PR estimation consist of estimating the reduced revenue equation equations (R_i^*) of the banks derived from marginal revenue and cost functions.

$$R_i = (y_i, n_i, z_i) \tag{2.1}$$

$$C_i = (y_i, p_i, x_i) \tag{2.2}$$

Both revenue and costs are functions of output, number of banks and prices. Then revenues are affected by exogenous variable z and costs by x exogenous variables.

In equilibrium, marginal costs (MC_i) equate marginal revenues (MR_i) due to bank i profit maximization.

$$\text{Thus: } MC_i(y_i, p_{i,j}, x_i) = MR_i(y_i, n, z_i), \tag{2.3}$$

Given the zero profit constraints, profit of bank i is defined by $\pi_i = R_i(y_i, n_i, z_i) - C_i(y_i, p, x_i)$. This implies that, in equilibrium, the zero profit constraints hold at the market level:

$$\frac{\partial R_i}{\partial R_i \ (y_i, n_i, z_i)} - \frac{\partial C_i}{\partial C \ (y_i, p_i, x_i)} = 0 \tag{2.4}$$

The profit maximizing output is given by equation (2.5) with equilibrium values assigned *:

$$y_i^* = y_i^*(z_i, p_i, x_i) \tag{2.5}$$

Substituting equation 2.5 into equation 2.1 with the assumption that n is determined endogenously yields the reduced form revenue equation:

$$R_i^* = R_i^*(y_i^*(z_i, p_i, x_i), n^* z_i) \equiv R^*(z_i, p_i) \tag{2.6}$$

The sum of these elasticities indicates the *H-statistic* with respect to the input prices allowing inference about the bank's competitive conduct is defined by Panzar-Rosse as:

$$H = \sum_{j=i}^{n} \frac{\partial R_i^*}{\partial p_i} \times \frac{P_{i'j}}{R_i^*} \tag{2.7}$$

The sign and the magnitude of the *H-statistic* is a measure of competition, which corresponds to the sum of the elasticities of the reduced form revenue equation with respect to factor prices.

Table 1 presents the key discriminatory powers of the H-statistic. The economic interpretation of the Panzar-Rosse method is that: under perfect competition, a change in input prices results in an equal change in revenue. Here, the factor prices are exogenous to bank *i* and the elasticity of the perceived demand of the bank is non-decreasing in the number of rivals amid free entry and exit of banks' from the banking system. The long-run equilibrium under perfect competitive banking market is characterized with banks operating in the minimum level of average costs that is equal to the price; hence, *H*-statistic is equal to 1. In contrast, in a monopolistic competition, an increase in input prices will increase marginal cost, thereby reducing equilibrium output and revenue which is consistent with H statistic values less than or equal to zero. Given differentiated products offered by the banks, the profit maximizing firms are face a falling aggregate demand curve and behave like monopolists, thereby resulting in equalizing marginal costs and marginal revenues at the equilibrium level. Owing to the market exit and entry of imperfect substitutes, the demand curve also shifts to correspond with the monopolist earning zero profits. Additionally, negative value for H-statistic is associated with monopoly or perfectly collusive oligopoly. Such that an increase in input prices causes marginal costs to rise and by setting marginal costs to marginal revenues equally reduces the equilibrium output and the banks' revenues.

Table 1: Interpretation of Panzar-Rosse H-statistics

Values of H	*Market Structure*
$H \leq 0$	Monopoly, Colluding oligopoly, conjectural variations of oligopoly
$0 < H < 1$	Monopolistic competition
$H = 1$	Perfect competition, natural monopoly in a perfectly contestable market

Source: Panzar-Rosse (1987)

The preceding assumptions ought to be considered prior to assessing banks' market conduct and interpreting *H*-statistic values:

- banks operate in (long-run) equilibrium.
- with the exception of a purely monopolistic market structure, the performance of the banks is influenced by the actions of other participating banks.
- the cost structure is homogenous and the production function is a standard Cobb-Douglas function with constant return to scale.
- price elasticity of demand for bank products is greater than 1.

It is pertinent to review previous studies using the Panzar-Rosse Analytical Framework. Empirical evidence on the degree of competition in the banking market using the Panzar-Rosse (1987) methodology is varied. Shaffer (1982) reveals monopolistic competition among banks in New York post deregulation of deposit interest rates in the 1980s. Nathan and Neave (1989) reports that part of the Canadian banking market exhibit characteristics of contestability. They found perfect competition for 1982 whereas monopolistic competition for 1983-1984 for Canadian banks. Molyneux et al (1994) tested the Panzar-Rosse H-statistic on a sample of banks in France, Italy, Germany, Spain and the UK for the period 1986-1989. They found monopolistic competition in the market structure of all the EU countries except Italy where the monopoly hypothesis that could not be rejected-a result that is later contradicted by Coccorese (1998) and Trivieri (2007). De Bandt and Davis (2000) also assessed the effect of the Economic and Monetary Union on market conditions for banks in the Eurozone over the sampled period 1992-1996. Additionally, they compared the behaviour of large and small banks in the Eurozone vis-à-vis a US banking sample. They concluded that, relative to US banks, the behaviour of large banks are not fully competitive while smaller banks in France, and Germany is characterized with lower level of competition.

Other research by Rime and Stiroh (2003) on banks in Switzerland and Bikker and Groenveld (1998) on 15 EU countries also suggests the presence of monopolistic competition in the EU banking market structure. Bikker and Haaf (2002) later confirmed this finding. Bikker and Haaf (2002) examined the competitive conditions and market structure for 23 developed countries including Europe, the US, Canada, Japan and Australia for the period 1988-1998. They reported that the market structure of banks in most of those countries exhibits monopolistic competition. Their estimation also showed that competition is weaker among small banks that operate

mainly in local markets and stronger in inter-national markets which is typically operated by large banks. Further works have extended the standard specification of the PR H-statistic to account for bank efficiency. Casu and Girardone (2006) examined 15 former EU member countries and concluded that the degree of concentration has no association with the level of competition. Similarly, Staikouras and Koutsomanoli-Fillipaki (2006) find evidence of monopolistic competition for 25 EU member countries for the period 1998-2002. They document that, while larger banks behave more competitive relative to smaller banks, new EU member countries showed higher levels of competition than earlier EU member countries. Equally, the competitive condition among major UK banks is characterized by monopolistic competition (Mathews, Murinde and Zhao 2007). Mathews, Murinde and Zhao (2007) conclude that, even though competition appears to have become less intense in off-balance sheet activities, the level of intensity in the core market remained unchanged for the UK banking market.

Contemporary research works on emerging and developing economies on competitive market structure using the PR method is also getting momentum. Yuan (2006) examined the Chinese banking industry and documents that; China's financial system was near to perfect competition prior to the entry of foreign banks. The evolution of market structure in emerging banking markets during the 1990s were examined by Gelos and Roldos (2004). They found that while concentration in the emerging banking systems increased during the 1990s, the banking markets in 8 Central European and Latin American countries have not become less competitive. In addition, the deregulation of financial systems by way of lowering barrier of entry did not culminate in a fall in competition. However, the level of competition in Uganda banks increased significantly due the entry of foreign banks (Hauner and Peiris 2005).

However, research on the Ghanaian banking market is scant. Following Gelos and Roldos (2002), Buchs and Mathisen (2005) examined the degree of competitiveness in Ghana's financial system over the period 1998-2003. Their results indicate monopolistic market conditions in the Ghanaian banking system over the period. They concluded that the structure of the Ghanaian banking system as well as other market characteristics constitutes an indirect barrier to entry. However, Owusu-Antwi and Antwi (2013) investigated the market structure of Ghana's banking industry over the period 1988-2011 using non-structural methods and find perfect condition for Ghanaian banks. Interestingly, according to Owusu-Antwi and Antwi

(2013) there is no evidence of a change in the level of competition because of financial liberalization in Ghana.

3.   The Competitive Environment in the Ghanaian Banking Sector

Tables 2 provide selected statistics for the structure of the Ghanaian banking industry. Of the 25 universal banks in Ghana, 20 percent are state-owned and 80 percent are privately owned (14 foreign, 5 domestic and 1 foreign-domestic ventures). The banking penetration ratio at one commercial bank branch per 54,000 inhabitants witnessed an increasing trend as deposit account holders surged. Nevertheless, banking services reaches only 10 percent of a population of 25 million (Ghana Statistical Service, 2016). Likewise, bank coverage varies widely across the 11 regions. 40 percent of bank branches are in the greater Accra region even though this region represents only 16 percent of the country's population. This is indicative of geographical concentration of banks and lack of wider access to banking services in the local economy. Even though the rural encashment area is served with a huge 137

Table 2: Structure of the Ghanaian Banking Industry (2003 to 2012)

Indicators/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Percentage Share of Total Assets										
State	0.40	0.39	0.37	0.37	0.36	0.34	0.31	0.33	0.32	0.27
Private-Domestic	0.92	0.77	0.11	0.13	0.14	0.18	0.19	0.16	0.18	0.13
Private-Foreign	0.51	0.53	0.51	0.50	0.50	0.48	0.50	0.50	0.50	0.55
Market Share										
Assets share of the 3 largest banks	0.54	0.47	0.45	0.43	0.42	0.39	0.35	0.31	0.32	0.32
Assets share of the 5 largest banks	0.74	0.65	0.65	0.62	0.58	0.53	0.50	0.46	0.46	0.46
Deposit share of the 3 largest banks	0.55	0.53	0.49	0.46	0.45	0.40	0.35	0.32	0.33	0.33
Deposit share of the 5 largest banks	0.72	0.60	0.65	0.62	0.62	0.60	0.54	0.49	0.48	0.47
Loan Share of the 3 largest banks	0.54	0.51	0.47	0.42	0.45	0.42	0.36	0.29	0.26	0.27
Loan Share of the 5 largest banks	0.72	0.72	0.66	0.56	0.59	0.56	0.49	0.45	0.41	0.40
Bank branches per 100,000 people	3.1	3.1	3.2	3.6	4.6	4.8	5.1	5.4	5.4	5.7
Borrowers per 1,000 people	16.2	18.2	27.5	19.2	23.1	23.5	37.5	33.8	35.3	35.5
Depositors per 1,000 people	178.1	198.1	208.6	208.6	219.8	246.7	271.3	282.9	346.5	456.7
Total bank assets to real GDP (%)	0.23	0.23	0.23	0.25	0.17	0.19	0.21	0.24	0.24	0.23
Banks loan to private sector (% of GDP)	0.27	0.31	0.31	0.21	0.23	0.28	0.29	0.28	0.28	0.32

Sources: World Bank Global Financial Developments and Ghana Banking Survey-various years

rural and community banks, their total asset relative to the universal banks' is scanty.

The value for the ratio of total banking sector assets to real GDP shows the significance of the banking system in the Ghanaian economy. The growth of aggregate total-assets to GDP ratio is somewhat attributed to financial deepening between 2003 and 2012 even though after reaching almost 25 percent in 2006, it decreased to 19 percent in 2008. The increase of total-assets to GDP ratio in 2012 is symptomatic of financial deepening in Ghana's financial system.

4. Description of Data

We use Bank-level data from individual bank's annual report and the Bank of Ghana annual reports. The sample considers all the Class 1 universal banks operating in Ghana for the sampled period of nine years from 2003 to 2012. There are a minimum of 17 banks (for 2003) and a maximum of 25 universal banks (for 2012) in each year during the period. Two small banks namely Energy Banks (Ghana) and the Royal Bank Ltd were not included due to lack of data. While there are other financial institutions (rural & community banks, leasing & finance companies, savings & loans companies, microfinance companies and credit bureau's) that provide banking and limited banking activities to households and firms, yet the share of universal banks on total financial institutions assets is more than 12 percent over the sampled period (Bank of Ghana Annual Report 2013). In addition, the nine-year sample period is regarded as satisfactory in capturing the characteristics of Ghanaian banking industry due to the entry of 8 foreign banks and the merger of two banks. In that regard, the sample used in this study may be a reflective of the Ghanaian banking industry.

Table 3 presents the correlation matrix of the variables used in the Panzar-Rosse Model. It is observed that there is lower correlation among explanatory variables. Noticeably, low values are reported for LIEXP/TDEP and LDE/FA. These figures suggest the finding of close to zero and non-significant elasticities in the next step of the PR analysis. In addition, issues on multi-collinearity may not be a serious problem in concomitant with estimating the parameters.

5. Empirical Analysis

5.1. Concentration Indices

Table 4 depicts the market share of the three and five largest banks in terms of assets, deposits and loans and advances as measured by the CR3 and CR5. The

Table 3: Correlation Matrix (2003-2012)

	LTrev	LINC/TA	LIEXP/TDEP	LWA/TDELONA	LDE/FA	LITLA/TA	LTA	LNPL/TLO	Linfl	LGDPP
LTrev	1.00									
LINC/TA	0.34	1.00								
LIEXP/TDEP	0.04	0.42	1.00							
LWA/TDELOAN	-0.26	-0.28	-0.14	1.00						
LDE/FA	0.13	0.02	0.04	-0.26	1.00					
LITLA/TA	0.28	0.88	0.13	-0.33	-0.01	1.00				
LTA	0.57	-0.46	-0.18	-0.02	0.15	-0.48	1.00			
LNPL/TLO	0.86	0.06	-0.03	-0.23	0.10	0.04	0.60	1.00		
Linfl	0.12	0.09	0.14	0.15	0.06	0.04	-0.01	0.11	1.000	
LGDPP	0.05	-0.099	0.05	0.23	0.14	-0.11	0.12	0.06	0.471	1

Table 4: Bank Concentration Ratios (%) for Deposits, Loan and Assets (2003 to 2012)

Year	No. of Banks	Deposits		Loans		Assets	
		CR3	CR5	CR3	CR5	CR3	CR5
2003	17	0.55	0.72	0.54	0.72	0.54	0.74
2004	18	0.53	0.6	0.51	0.72	0.47	0.65
2005	20	0.49	0.65	0.47	0.66	0.45	0.65
2006	23	0.46	0.62	0.42	0.56	0.43	0.62
2007	23	0.45	0.62	0.45	0.59	0.42	0.58
2008	23	0.4	0.6	0.42	0.56	0.39	0.53
2009	25	0.35	0.54	0.36	0.49	0.35	0.5
2010	25	0.32	0.49	0.29	0.45	0.31	0.46
2011	25	0.33	0.48	0.26	0.41	0.32	0.46
2012	27	0.33	0.47	0.27	0.4	0.32	0.46

Source: Author's calculations based on Ghana Banking Survey-various years

three-bank concentration ratio on total assets decreased from 54 percent in 2003 to 32 percent in 2012, representing a 20 percent reduction. Nevertheless, the level of and the trend for concentration ratios on deposit is quite similar to the total assets base concentration ratios in the banking sector. In 2003, the share of the CR5 banks in the total deposit of the banking sector was 72 percent but then decreased to 47 percent in 2012, representing a 26 percent decline over the period.

The CR5 banks in terms of loans and advanced to households and firms in the Ghanaian economy decreased from 72 percent in 2003 to 40 percent in 2012. In addition, the market shares of the three and five largest banks in the banking sector in terms of total assets, total deposits and total loans and advances have notably decreased over the last ten years (2003 to 2012) particularly since 2010. The increasing interest by foreign investors or foreign banks towards the domestic banking market has caused significant changes in the dynamics of the Ghanaian banking industry. The significant decrease in the concentration is a reflection on the changing market structure of the Ghanaian banking sector. Indeed, the Ghanaian banking sector presents a relatively low concentration when compared with other Sub-Saharan African banking industries (see Table 5).

Table 5: HHI: Total Asset Concentration Average International Comparison

Country	Number of Banks	HHI
Australia	31	0.14
Canada	44	0.14
Denmark	91	0.17
France	336	0.05
Germany	1803	0.03
Ghana	27	0.09
Italy	331	0.04
Japan	140	0.06
Switzerland	325	0.26
UK	186	0.06
US	717	0.02

Table 5 indicates that Algeria as an economy having the most concentrated banking sector with 86 percent of assets held by the top-three banks against 50 percent in Morocco and 45 percent in Tunisia. Markedly, there is increasing market competition in the Ghanaian banking industry. The rate of change in CR3 in terms of assets, deposits and loans is more than that of CR5, which also indicative of the emergence of new larger players in the banking sector.

It is observed in **Table 6** that, the values of HHI for all the most important indicators of the banking industry decreased over the sample period. The evidence suggests that between 2003 and 2005, the Ghanaian banking industry was moderately concentrated (HHI were above 0.10) in deposits, assets and loans to households and firms. During the period, the HHI for deposits was 0.1304 in 2003 but decreased by almost half to 0.0625 in 2012. Likewise, assets and loans also witnessed similar reductions in HHI. The HHI for assets and loans were 0.1305 and 0.1237 in 2003 and decreased to 0.0609 and 0.060 respectively in 2012. Even though, there is significant decline in HHI for deposits, assets and loans from 2003 to 2006, the most significant decline is witnessed in the HHI for loans, which decline from 0.1237 to 0.0837, for 4 years period.

Relatively, HHI for deposits and assets from 2003 to 2006 were 0.1304 and 0.1305 but decreased to 0.0993 and 0.0945 over the 4 year period respectively. Similarly, the annual figure for HH indices indicate that there is a year lag in terms of deposits and assets market behind the loan market in the Ghanaian banking industry.

<div align="center">**Table 6: Herfibdahl-Hirschman Index**</div>

Year	No. of Banks	Deposits	Assets	Loan
2003	17	0.13037035	0.13046511	0.12374881
2004	18	0.11910909	0.10293223	0.12374181
2005	20	0.10867451	0.10294369	0.10507635
2006	23	0.09937744	0.09453256	0.08370853
2007	23	0.09722355	0.09043894	0.080177
2008	23	0.080177	0.076447	0.09732249
2009	25	0.067508	0.0686	0.089989
2010	25	0.062288	0.060207	0.065579
2011	25	0.064115	0.060938	0.06051
2012	27	0.06246	0.060935	0.060028

Souce: Author's calculation based on Ghana Banking Survey Various Years

While the break point for loan market is 2006, for deposits and assets markets is 2007. Evidently, the lower HHI for loan is an indication that the loan market in the banking sector is more competitive relative to deposits and assets markets in 2006. The overall results, suggest less concentrated (as suggested by US 1992 Merger Guidelines) banking market in Ghana in Sub-Sahara Africa compared with other international banking sectors in terms of total asset concentration (**see Appendix 1**).

5.2. Competition Test

This paper analyze competition in the Ghanaian banking industry using the following fixed effect reduced form panel data regression (PR) model is estimated for the interest based market:

$$\log(INC_{it}) = \alpha + \beta_1 \left(\log IEXP/TDEP_{it}\right) + \beta_2 \left(\log WA/TDEPLOAN_{it}\right) + \beta_3 \left(\log DE/FA_{it}\right)$$
$$+ \beta_4 (TLA/TA_{it}) + \beta_5 (TA_{it}) + \beta_6 (NPL/TLO_{it}) + \gamma_1 \log(\pi_{it}) + \gamma_2 \log(GDP_{it}) + \lambda_t + \varsigma_t + \varepsilon_{it}$$

$$(2.8)$$

INC in Equation (2.8) is the dependent variable to estimate the *H-statistic.* $_{INC}$ is the log of the ratio of interest income to total assets for bank *i* at time *t.* The choice of $_{INC}$ as the dependent variable is consistent with the approach that financial intermediation is the core business in universal banking. De Bandt and Davis (1999), Bikker, applied this approach and Haff (2002) and Molynuex *et al.* (2006) since the ratio of interest revenue to total assets of the balance sheet form an equation of

prices. However, Shaffer (1982) and Nathan and Neaves (1989) opted for total revenue as dependent variable. $i = 1,...n$ = number of observed banks in the Ghanaian banking market.

Factor input prices for funds are represented with the variables $WA/TDEPLOAN_{it}$, $IEXP/TDEP_{it}$ is the total interest expenses to total deposits, is the ratio of personal (wages) expenses to total deposits and loans which indicates costs of labour inputs, DE/FA_{it} is the price of physical capital expenditure and other expenses related to fixed assets which represents the cost of capital inputs for individual bank. The individual bank specific control variables are TLA/TA_{it} is the ratio of total loans and advances to total assets TA_{it} is total assets and NPL/TLO_{it} is the ratio of non-performing loans to total loans outstanding ratio.

Macroeconomic risk component of the Ghanaian economy is proxy as π_{it} since the interest rate spread (or the transaction cost) charged by banks is determined by inflationary pressures and GDP_{it} represents the economic growth rates for the period under-study. In addition, λ_t represents time specific constant or time effect accounted for by including time dummy variables, ς_t indicate bank specific constant or individual effect and ε_{it} correspond to error terms with the endogenous variable, INC_{it}. Since the PR model follows the log-linear form, as indicated above the sum of factor, labour and capital elasticities indicate the H-statistic for the banking market. It follows that the value of the H-statistic is associated with the competitive environment and corresponding behaviour of banks. Following Perera *et al.* (2006) an additional specification of the form is developed for total revenue of banks for the total banking market:

$$\log(T\operatorname{Re}v_{it}) = \alpha + \beta_1\left(\log IEXP/TDEP_{it}\right) + \beta_2(\log WA/TDEPLOAN_{it}) + \beta_3(\log DE/FA_{it})$$
$$+ \beta_4(TLA/TA_{it}) + \beta_5(TA_{it}) + \beta_6(NPL/TLO_{it}) + \gamma_1\log(\pi_{it}) + \gamma_2\log(GDP_{it}) + \lambda_t + \varsigma_t + \varepsilon_{it}$$

$$(2.9)$$

where the dependent variable $T\operatorname{Rev}v$ is the sum of interest income, fees and commissions and other operating income.

Next, it is imperative to note that both interest based market and total market are computed with a fixed effect (within) panel regression. The fixed effect is motivated by country specifics that face banks in terms of supervisory and macroeconomic environ. In addition, we intend to capture the effect of model variables that are peculiar to the individual bank data that are constant overtime. Lastly, for consistency the independent variables in both interest based market and

total banking market are the same.

5.3. Tests of Equilibrium

A key fundamental assumption of the PR model is in the long run, factor, capital and labour inputs are not associated with industry return. This proposition is tested empirically when the sum of the elasticities, $\beta_1(\log IEXP/TDEP_{it}) + \beta_2(\log WA/TDELOAN_{it}) + \beta_3(\log DE/FA_{it}) = 0$ Following Casu and Girardone (2006) and Perera *et al.* (2006) we test the proposition that with the presence of long-run equilibrium, factor prices are not linked with industry return in the Ghanaian banking system.

$$\log(ROA_{it}) = \alpha + \beta_1\left(\log IEXP/TDEP_{it}\right) + \beta_2(\log WA/TDEPLOAN_{it}) + \beta_3(\log DE/FA_{it})$$
$$+ \beta_4(TLA/TA_{it}) + \beta_5(TA_{it}) + \beta_6(NPL/TLO_{it}) \tag{3.0}$$
$$+ \gamma_1 \log(\pi_{it}) + \gamma_2 \log(GDP_{it}) + \lambda_t + \varsigma_t + \varepsilon_{it}$$

ROA is return on assets with the same independent variables as in the interest based market and total market. The parameters in Equation 3.0 are estimated using fixed effect estimators. The Walt test for null hypothesis of linear combination is not rejected as reported in Appendix 2. The F-statistic is 0.123 with p-value of 0.611. The results indicate that input prices are not related with banking industry return. These results validate the empirical results reported in **Tables 7** and **8**.

Robustness checks: To validate PR Model results, the H-statistic is estimated using pooled ordinary least square method as well as random effect method. The estimates from both methods lead to similar conclusion as reported in Appendix 3.

Table 7 displays the fixed effect estimates for the interest based product market model. The model is statistically significant and has reasonably sound explanatory power evident from the R-square value of 0.887. The estimated model explains almost 89 percent in the ratio of interest income equation to total assets equation. This confirms that, the chosen independent variables are highly explanatory. All the coefficients with the exception of the price of physical capital expenditure and other expenses related to fixed assets are statistically significant. The sum of elasticity in terms of factor prices is 0.976 suggesting an imperfect competition market structure in the Ghanaian banking industry.

Similarly, the Wald tests for perfect competition (H=1) and for monopoly (H=0) rejects the null hypothesis and reconfirms the conclusion that interest based income banking market is characterized with monopolistic competition. The higher value of the sum of H-statistic indicates that there is higher competition in interest income

based market because of financial liberalization. The reported co-efficient LWA/ TDELOAN was 0.172 and is positive and significant which suggests that there are higher proportion of qualified personnel in the Ghanaian banking market due to the increasingly entry of foreign-owned private banks.

However, the price elasticity of labour appear to confirm that costs of banking personnel has a higher impact on interest revenue during the period 2003 to 2012. Significantly, in the interest-based market, the cost of funds has higher influence on

Table 7: H-statistics of Ghana Banking Systems (2003 to 2012)

	Interest Based Product Market Model		
	Coefficient	*Standard Error*	*P-value*
LIEXP/TDEP	0.731	0.040	0.000
LWA/TDELOAN	0.172	0.046	0.000
LDE/FA	0.074	0.021	0.001
LTLA/TA	0.808	0.014	0.000
LTA	-0.007	0.017	0.668
LNPL/TLO	0.068	0.013	0.000
Linfl	0.160	0.049	0.002
LGDPP	-0.138	0.037	0.000
Constant	0.039	0.015	0.008
Adjusted R-squared	0.887		
No. of observations	229		
PR H-statistic	**0.976**		
Wald test (F-statistic) for H=1	25.59		
p-value of F-statistic	0.000		
Wald test (F-statistic) for H=0	120.5		
p-value of F-statistic	0.000		
Perfect Competition H=1	Reject**		
Monopoly H=0	**Reject****		

Note: in the interest based product model , dependent variable is log of total interest income to total assets. All the independent variables are measured in log scale. PR H-statistic (in bold). The Wald test is used to test the hypothesis that at least one of the predictors' regression coefficients is not equal to zero. The Wald test is used to test H=0 and H=1 hypotheses, the null hypothesis is that the regression equation overall is not statistically significant and it follows an F-distribution. The number in the parentheses indicates the degrees of freedom of the distribution. ***, **and* indicate significant at 1%, 5% and 10% level respectively.

Source: Author's calculations based on Ghana Banking Survey (2003-2012)

Table 8: H-statistics of Ghana Banking System (2003 to 2012)

	Total Market Model		
	Coefficient	*Standard Error*	*P-value*
LIEXP/TDEP	0.165	0.021	0.000
LWA/TDELOAN	0.063	0.038	0.097
LDE/FA	0.001	0.015	0.952
LTLA/TA	0.443	0.018	0.000
LTA	0.480	0.016	0.000
LNPL/TLO	0.567	0.018	0.000
Linfl	0.436	0.044	0.000
LGDPP	0.064	0.034	0.061
Constant	0.114	0.015	0.000
Adj. R-squared	0.885		
No. of observations	229		
PR H-statistic	**0.229**		
Wald test (F-statistic) for H=1	30.42		
p-value of F-statistic	0.000		
Wald test (F-statistic) for H=0	60.72		
p-value of F-statistic	0.000		
Perfect Competition H=1	Reject**		
Monopoly H=0	**Reject****		

Note: in the total revenue model, dependent variable is log of the sum of total interest income, fees and commissions and other operating income. All the independent variables are measured in log scale. PR H-statistic (in bold). The Wald test is used to test the hypothesis that at least one of the predictors' regression coefficients is not equal to zero. The Wald test is used to test H=0 and H=1 hypotheses, the null hypothesis is that the regression equation overall is not statistically significant and it follows an F-distribution. The number in the parentheses indicates the degrees of freedom of the distribution. ***, **and* indicate significant at 1%, 5% and 10% level respectively.

Source: Author's calculations based on Ghana Banking Survey (2003-2012)

income (revenue) with elasticity of 0.731. Other bank-specific variables also show that lending activities measured by total loans and advances to total assets is positive suggesting an affirmative effect of lending activities on the revenue of participating banks.

Table 8 also shows the results of the total market based model. The sum of elasticity of factor prices is 0.229 suggesting monopolistic competition in the

Ghanaian banking industry both at the interest based product market and the total bank market. However, the higher value of PR H-statistic in Equation 4.0 is symptomatic of higher competition among Ghanaian banks in the interest based product market than that of non-interest income market. That said, an analysis of the sign and significance of the regression co-efficient, mostly price of inputs documented indicate that the price elasticity of funds, labour and capital are positive and statistically significant. However, these model results vary in terms of cost of funds. The cost of funds in the interest-based market has a higher influence on income with elasticity of 0.731 relative to 0.165 in the total market.

6. Conclusion

This chapter examines the evolution of market competitive structure and revenue behaviour of Ghanaian banking industry over 9 year period (from 2003 to 2012) and investigates factors that can explain differences in the degree of competitiveness in two banking markets namely interest based market and total revenue based market. The chapter explicitly control for bank specific factors such as inflation, GDP, total assets and loans for the period 2003 to 2012. This period corresponds to an era characterized by significant reforms to restructure the banking system and to liberalize as well as deregulate the banking systems thereby improving the process of integrating Ghana's financial system as the financial hub in sub-Saharan African markets.

Results from concentration ratios show the changing structure of the banking sector. The concentration ratios including HHI show a decreasing trend in market concentration in Ghanaian banking industry and decreasing market share of largest banks over the 9-year period. This implies that the banking industry is less concentrated, hence more competitive in recent years. These changes in the dynamism of the domestic banking market are the consequence of foreign banks amid their contribution to the maintenance of stability in the banking system.

By applying the Panzar-Rosse model for the period 2003-2012 to study the revenue behaviour of banking industry for both interest based market and total revenue based market, we find monopolistic competition in Ghanaian banking industry. Equally, the rejection of perfect competition and monopoly market competition confirms it. The PR test results indicate that the banking market is in equilibrium. The value PR H-statistic in total revenue based market is lower relative to the interest income based market. This suggests that there is lower competition

among banks in non-interest income based market. The policy implementation is that, strategies ought to be developed accordingly. Larger banks are able to generate more revenue and vice versa. The existence of such scale economies is an indication that individual banks can take advantage of their respective economies of scale. Nonetheless, as indicated by the PR H-statistic, there is room for improvement with respect to the competitive behaviour of Ghanaian banks. This implies that the longevity of financial sector liberalization and reformation will improve competitive market behaviour amongst banks in the Ghanaian banking system.

Financial intermediation is vital for economic development. Existing literature indicate a causal link between the degree of financial intermediation and economic growth. In order to finance both private and public investments, Ghana needs a stable and efficient banking system next to systematic development of its financial system. The cost of financial intermediation has significant ramifications for economic performance (McKinnon and Shaw 1993, Jayaratne and Strahan 1996, Rajan and Zingales 1998, Beck, Levine and Loayza 2000, Hansen (2014)). From the late 1980s through the period of the recent economic downturn, Ghana's financial sector reforms has been characterised with notable component of structural adjustments programs.

References

Bhattarai, K., (2017). Welfare and distributional impacts of financial liberalization in an pen Economy: Lessons from a Multi-Sectoral Dynamic CGE Model for Nepal. *International Business Research*, *10*(1), pp.181-198

Bikker, J. A., & Groeneveld, J. M. (1998). *Competition and concentration in the EU banking industry* De Nederlandsche Bank NV.

Bikker, J. A., & Haaf, K. (2002). Competition, concentration and their relationship: An empirical analysis of the banking industry. *Journal of Banking & Finance, 26*(11), 2191-2214.

Buchs, T. D., & Mathisen, J. (2005). Competition and efficiency in banking: Behavioral evidence from Ghana.

Casu, B., & Girardone, C. (2006). Bank competition, concentration and efficiency in the single European market. *The Manchester School, 74*(4), 441-468.

Coccorese, P. (2005). Competition in markets with dominant firms: A note on the evidence from the Italian banking industry. *Journal of Banking & Finance, 29*(5), 1083-1093.

De Bandt, O., & Davis, E. P. (2000). Competition, contestability and market structure in European banking sectors on the eve of EMU. *Journal of Banking & Finance, 24*(6), 1045-1066.

Gelos, G., & Roldos, J. E. (2002). Consolidation and market structure in emerging market banking systems.

Gelos, R. G., & Roldós, J. (2004). Consolidation and market structure in emerging market banking systems. *Emerging Markets Review, 5*(1), 39-59.

Hauner, D., & Peiris, S. (2005). Bank efficiency and competition in low-income countries: The case of Uganda.

Matthews, K., Murinde, V., & Zhao, T. (2007). Competitive conditions among the major British banks. *Journal of Banking & Finance, 31*(7), 2025-2042.

Molyneux, P., Lloyd-Williams, D. M., & Thornton, J. (1994). Competitive conditions in European banking. *Journal of Banking & Finance, 18*(3), 445-459.

Nathan, A., & Neave, E. H. (1989). Competition and contestability in Canada's financial system: Empirical results. *Canadian Journal of Economics,* 576-594.

Owusu-Antwi, G., & Antwi, J. (2013). Do financial sector reforms improve competition of banks? an application of Panzar and Rosse model: The case of Ghanaian banks. *International Journal of Financial Research, 4*(3), 43.

Panzar, J. C., & Rosse, J. N. (1987). Testing for" monopoly" equilibrium. *The Journal of Industrial Economics,* 443-456.

Rime, B., & Stiroh, K. J. (2003). The performance of universal banks: Evidence from Switzerland. *Journal of Banking & Finance, 27*(11), 2121-2150.

Shaffer, S. (1983). The Rosse-Panzar statistic and the Lerner index in the short run. *Economics Letters, 11*(1-2), 175-178.

Staikouras, C. K., & Koutsomanoli Fillipaki, A. (2006). Competition and concentration in the new European banking landscape. *European Financial Management, 12*(3), 443-482.

Trivieri, F. (2007). Does cross-ownership affect competition?: Evidence from the Italian banking industry. *Journal of International Financial Markets, Institutions and Money, 17*(1), 79-101.

Yuan, Y. (2006). The state of competition of the Chinese banking industry. *Journal of Asian Economics, 17*(3), 519-534.

Appendix 1: PR Model Equilibrium Tests of Ghana Banking Systems (2003 to 2012)

	Coefficient	*Std. Error*	*P-value*
LIEXP/TDEP	-0.074	0.357	0.473
LWA/TDELOAN	0.155	0.512	0.233
LDE/FA	0.122	0.526	0.278
LTLA/TA	0.397	0.090	0.567
LTA	0.051	0.871	0.023
LNPL/TLO	-0.005	0.313	0.245
Linfl	0.000	0.095	0.342
LGDPP	0.039	0.047	0.674
Constant	-12.911	2.545	0.000
Wald test (F-statistic) for H=1	3.422		
p-value of F-statistic	0.002		
Wald test (F-statistic) for H=0	0.123		
p-value of F-statistic	0.611		
p-value of F-statistic	0.002		
Wald test (F-statistic) for H=0	0.123		
p-value of F-statistic 0.611			

Appendix 2: PR Model Equilibrium Tests of Ghana banking systems (2003 to 2012)

	Coefficient	*Std. Error*	*P-value*
LIEXP/TDEP	-0.074	0.357	0.473
LWA/TDELOAN	0.155	0.512	0.233
LDE/FA	0.122	0.526	0.278
LTLA/TA	0.397	0.090	0.567
LTA	0.051	0.871	0.023
LNPL/TLO	-0.005	0.313	0.245
Linfl	0.000	0.095	0.342
LGDPP	0.039	0.047	0.674
Constant	-12.911	2.545	0.000
Wald test (F-statistic) for H=1	3.422		
p-value of F-statistic	0.002		
Wald test (F-statistic) for H=0	0.123		
p-value of F-statistic	0.611		
p-value of F-statistic	0.002		
Wald test (F-statistic) for H=0	0.123		
p-value of F-statistic	0.611		

Appendix 3
Random Effects and OLS Estimates: PR Model

	Random Effects Estimates						OLS Estimates					
	Interest Based Product Market			Total Market			Interest Based Product Market			Total Market		
	Coefficient	Std. Error	P-value	Coefficient	Std. Error	P-value	Coefficient	Std.Error	P-value	Coefficient	Std.Error	P-value
LIEXP/TDEP	0.189	0.027	0.000	0.225	0.036	0.000	0.329	0.036	0.000	0.135	0.040	0.000
LWA/TDELOAN	0.381	0.038	0.000	0.254	0.043	0.000	0.263	0.026	0.000	0.353	0.029	0.000
LDE/FA	0.256	0.051	0.000	0.163	0.048	0.000	0.163	0.042	0.000	0.284	0.039	0.000
LITLA/TA	0.014	0.006	0.000	0.016	0.007	0.153	0.033	0.009	0.002	0.025	0.012	0.002
LTA	0.035	0.015	0.000	0.028	0.016	0.000	0.005	0.022	0.000	0.017	0.024	0.000
LNPL/TLO	(0.167)	0.023	0.000	0.052	0.022	0.000	-0.162	0.306	0.000	-0.182	0.036	0.045
Linfl	-0.341	0.033	0.000	-0.159	0.328	0.000	0.063	0.32	0.000	0.164	0.057	0.000
LGDPP	0.002	0.016	0.000	0.129	0.024	0.000	0.053	0.002	0.000	-0.153	0.434	0.000
Constant	-1.226	0.277	0.000	-0.724	0.046	0.013	0.053	0.384	0.863	-0.016	0.639	0.968
Adj. R-squared	0.596			0.636			0.714					
Wald Chi-sq	272.67		0.000	**129.43**		**0.000**						
F-statistic						**0.000**	52.693		0.000	38.364		0.000
H-statistic	0.826			0.6428			0.755			0.769		
Wald Test for H=1												
Chi-Sq	22.454		0.000	28.054		0.000						
F-statistic							9.424		0.003	83.636		0.000
Wald test for H=0												
Chi-sq	178.675		0.000	104.960		0.000						
F-statistic							149.26		0.000	**19.394**		**0.000**
No. of obs	**229**			**229**			**229**			**229**		

Note: For model description see **Tables 7 and 8**