

Dynamic of Banking Sector in Benin: Do More Competition Imply More Efficiency?

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Abstract

This paper examines the dynamics of the financial system including banks and Decentralized Financial Systems (DFS) in Benin. While the reforms have produced the expected effect in terms of financial depth, compared to other developing countries, financial deepening is still weak - despite a remarkable contribution of DFS - with respect to the economy's medium and long-term production or growth objectives. The result is an expansion of financial dualism with the financial micro intermediation development. Is the consequent financial architecture efficient in providing appropriate solutions to the economy's financing constraints? Concentration and competition are evaluated according to different indicators: the market shares of the first banks, the Lerner index and the H-statistics indicate a concentration structure with a low level of competition. If this has improved since 2010, they call for an analysis of the efficiency of the banking market in Benin. We apply then the Panzar and Rosse methodology to account for technical inefficiencies in the banking system as a whole. The results confirm the absence of an explicit relationship between competition and efficiency; they also recommend a better organization of the Benin's financial system to meet the requirements of financial stability, economy financing, and financial inclusion.

Keywords: Bank, Financial architecture, Concentration, Competition, Efficiency.

1. Introduction

Since the democratization movements in Africa, inaugurated by the historic national conference in Benin, the financial systems have undergone deep changes in terms of financial liberalization. They are part of programs for interest rates liberalization, financial deregulation, privatization of financial institutions and the openness of the financial sector to foreign investment. Since independence in 1960, public policies, particularly under the socialist regime of the 1970s and 1980s, have been nationalistic, with strong State involvement in the creation and management of financial institutions. It is then, the regime of financial repression with the consequences in terms of economy financing. Thus, the application of financial liberalization policies recommended, aimed at increasing financial intermediation and the development of financial markets in order to increase the capacity of the financial system to collect savings for productive investment and support economic growth.

The concept of financial liberalization was introduced by McKinnon (1973) and Shaw (1973): as a solution to financial repression, financial liberalization is essentially characterized by the setting of nominal interest rates below the level that would allow the balance between supply and demand for loanable funds, non-interest-bearing mandatory reserves at banks, a policy of credit control and selection, and finally exchange controls. The benefits of financial liberalization lie in bank intermediation and the financial markets development: lower intermediation costs between lenders and borrowers, better risk diversification and easy access by borrowers to loanable funds promote investment and economic growth (Kapur, 1983; Mathieson, 1980; Roubini and Sala i Martin, 1995; King and Levine, 1993). The neo-structuralists such as Taylor (1983) and Van Wijnbergen (1983) and post-Keynesians such as Stiglitz and Weiss (1981) criticize this approach, highlighting the role of the informal sector and information asymmetries. In Benin, what have been the effects of different financial liberalization policies on the dynamics and efficiency of the financial system to achieve this economic growth effect? The financial development, the economy financing and the financial system efficiency allows assessing these effects over time.

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To define financial development, Levine (2004) identifies five fundamental principles: (i) the generation of ex-ante information contributing to investment and optimal resource allocation, (ii) the monitoring and ex-post control of projects, (iii) the trade facilitation, diversification and risk management, (iv) the resource mobilization, and (v) the promotion of trade in goods and services. Thus, financial development occurs when financial instruments, markets and intermediaries contribute to improving informational and transactional problems through these functions, each of which should affect the investment choices of firms or household savings (Diamond and Dibvig, 1983). In the literature, many indicators are used to assess the financial development of the economy. By measuring the main indicators, the objective of this paper is to assess the dynamics of the country's financial architecture, given the financial depth and financing of the economy. The specificity of the financial system in Benin enables to assess the financial depth given the alternative financing institutions represented by the Decentralized Financial Systems (DFS) besides the banking system.

The financial architecture is the result of the financial system dynamics, including the financial market and financial intermediaries. Given the narrowness of the financial market, the role of financial intermediaries becomes quite crucial in Benin as in most of the developing economies. Financial intermediaries collect household savings by providing opportunities for deposits, portfolio diversification and profitable investments, while ensuring the liquidity of their investments (Levine, 1997). What is the situation of financial intermediaries in Benin? Over the recent period, the banking system has witnessed the entry of new banks into the market: we assess these recent developments in order to deduce the performance of banking institutions in terms of the market share, the market power, the competition and efficiency.

After this introductory section, the rest of the paper is organized as follows. Section 2 gives the state of art related to concentration, competition and efficiency. The level of concentration of the Benin's banking system is assessed regarding on market shares in terms of balance sheet and portfolio perspective in section 3. We discuss the competition level of the banking system in section 4 and section 5 presents the efficiency with score analysis and estimation of an econometric model. Section 6 concludes the paper.

2. Concentration, Competition and Efficiency: The State of Art

In the literature, two approaches to measuring efficiency are often used: the non-parametric scoring approach and the parametric stochastic frontier approach, all are based on intermediation or production perspective. The resulting determinants of banking efficiency are diverse and vary from one country. For some studies on the subject, the effects of environmental variables on banking efficiency are assessed (Dietsch and Lozano-Vivas, 2000; Christopoulos et al., 2002) while other studies consider banking or market-specific variables that may explain differences in efficiency across banks or banking systems (Halkos et al., 2004; Hauner, 2005; Hahn, 2005; Havrylychuk, 2006; Pasiouras, 2008). Thus, the assessment of the efficiency of the banking system is made from a concentration or competition perspective.

Different studies assess the effects of concentration on banking efficiency using different concentration indices, such as the Herfindahl-Hirshman Index and the market share held by the three or five largest banks (Lensink et al., 2008; Fries and Taci, 2005). But does concentration imply little competition? Cetorelli (1999) shows that, in general, the relationship between concentration and competition is not as straightforward. This is the case in contestable markets, where free entry and exit ensure competitive pricing in a concentrated market (Baumol et al., 1982), with the threat of market entry being a determining factor in banks' behavior (Besanko and Thakor, 1992). Consequently, competition as measured by market power cannot be assessed by structural indicators alone, such as the number of banking institutions, the Herfindahl-Hirshman Index and other concentration indicators. Empirical evidence is mixed on the existence and the nature of the relationship between these two phenomena. For an overall analytical perspective, the study uses indicators to measure both competition and concentration in the Benin's banking system. It is thus in line with the work of Maudos and Fernandez de Guevara (2007) and Pruteanu-Podpiera et al. (2008), who use not only a measure of banking market concentration, but also a measure of competition.

Two opposing hypotheses are put forward to explain the link between competition and efficiency of the banking system. Theoretically, under the SBP hypothesis, which links Structure, Behaviour, and Performance, a monopoly firm will charge higher prices than if it is in a competitive market, leading to a de facto loss of efficiency (Bain 1956). In the banking market, it consists of high lending rates that can cover inefficient costs. From this point of view, there is a positive relationship between the level of competition and the efficiency of the banking system. Demsetz (1973) offers an alternative explanation that the more efficient a bank is, the more its profit level and market share can increase: there is a negative relationship between efficiency and competition, contrary to the SBP paradigm.

This structure-efficiency hypothesis is assessed in the banking market with the existence of information asymmetries. Theoretically, a competitive environment reduces banks' incentives to invest in long-term customer relationships, which should help to control moral hazard and adverse selection risks, reducing their efficiency. Dell'Ariccia (2000) shows that as more banks enter the market, they will have fewer incentives to select and monitor projects due to distress of customer losses. In opposite, if banks apply the selection criterion, Shaffer (1998) shows that the average quality of the loan portfolio decreases as the number of banks increases, since selection is likely to reveal the type of borrower.

From an empirical point of view, Berger and Hannan (1993), Goldberg and Rai (1996) and Vander Venet (2002) test the link between cost efficiency and market structure variables and generally conclude in favor of the structure-efficiency hypothesis. Bamba (2005) notes that in Côte d'Ivoire, the financial system remains a highly concentrated sector in which a few leading banks have significant market power. The resulting credit rationing reinforces adverse selection and moral hazard effects with high rates despite interest rate liberalization. The oligopolistic behavior of banking firms is said to have resulted in fairly high operating costs while the system is generally inefficient in the allocation of resources to the productive sector despite the over-liquidity of the system. Ary Tanimoune (2003) carried out the same exercise for all WAEMU countries, but analyzing the impact of structural and macroeconomic variables on the profitability of banks in member countries: over the 1990-1999 period, banks would have benefited from financial liberalization without, however, inducing positive intermediation rent effects on the private sector in terms of the volume and cost of credit.

Thus, from the concentration point of view, two indicators are also referred to; these are the Herfindahl-Hirshman index and the market share held by the first N largest banks (Lensink et al., 2008), with N varying between three, four and five depending on the banking system considered. Moreover, from a competition perspective, two measures of banks' market power are considered: a first approach is to calculate the Lerner index, and a second approach is to calculate the H - statistic for each bank. This assessment is important since the level of banking competition may well affect the effectiveness of the central bank's monetary policy: according to Bensaid and De Palma (1995), if the demand for bank credit is sufficiently convex, changes in monetary policy are amplified through the banking circuit. The strong emphasis on competition in the banking system to assess its efficiency implies a microeconomic approach that reflects the behavior of the banking firm. For this reason, this analytical approach pioneered by Panzar and Rosse (1987) will be considered through the H - statistic, which uses individual bank data to assess the extent to which changes in input prices are reflected in income, given the market equilibrium hypothesis.

In a monopoly situation, an increase in input prices may result in higher marginal costs, reducing the level of equilibrium output with a fall in income. With H - statistic, Panzar and Rosse approach provides an indicator of the competitive environment, assessing the extent to which changes in input prices affect incomes, i.e. the elasticity of total income with respect to the price of inputs. Panzar and Rosse (1987) show that the sum of income elasticities with respect to each of the input prices is a measure of the competition level or the market power. When $H \leq 0$, the market is constituted as a monopoly or collusive oligopoly; if $0 < H < 1$, the market is monopolistically competitive and if $H = 1$, there is pure and perfect competition in the market. Moreover, the validity of these conclusions depends on the long-term equilibrium: to this end, Panzar and Rosse suggest the test based on the E statistic, which measures the elasticity of profit with respect to the same prices. When $E = 0$, the market is in long-run equilibrium. This test has often been applied both for developed countries (Molyneux et al., 1994; Bikker and Haaf, 2002; Weill, 2004) and for emerging countries (Gelos and Roldós, 2002; Belaisch, 2003).

3. Banking system and concentration in Benin

Four indices for measuring absolute concentration can be specified: the concentration ratio, the Hannah and Kay Index, the Hirschman - Herfindahl Index (which is a special case of the Hannah and Kay Index) and entropy. In this assessment of concentration in the Benin's banking system, we are mainly interested in the market share ratio held by the first n largest banks and then in the Hirschman-Herfindahl Index. For the first concentration indicator, we look at the total assets of active banks over the period 2005-2016 for which ten banks were represented, accounting for more than 98% of the total balance sheets of the banking system.

The analysis covers the three years 2005, 2010 and 2016 for total balance sheet CFA 714.690 billion, CFA 1574.801 billion and CFA 3170.239 billion respectively; this has the advantage of allowing an appreciation of the comparative dynamics over the decade. For an analysis reduced to the first, second, fourth and fifth ($N/2$) banks in the system, the market shares are calculated and summarized in Table 1 below. Benin's largest bank accounted for 39.42%, 30.94%, 26.83% and 27.94% of the market share in 2005, 2010, 2015 and 2016 respectively.

This is Bank of Africa, which with 40% of market share in 2005 nevertheless lost a part of market and holds only 28% in 2016, to the benefit of other banks. It is therefore useful to note that from this point of view, a lessening in concentration power of the top bank is noted. The market share of the top two banks was 58.04% and 47.68% in 2005 and 2016 respectively. Over the decade, Bank of Africa and Ecobank Benin, which had concentrated more than half of the market until 2010, lost this power of concentration from 2015 onwards, with their market share declining to 47%. While this observation indicates a strong concentration of the market in the top two banks, it is also notable that this concentration level has declined over time.

Table 1: Market share of top banks by balance sheet size (%) and HHI

Number of bans or branch	2005	2010	2015	2016
Market share (%)				
Top branch	39.42	30.94	26.83	27.94
Top two branches	58.04	50.49	46.9	47.68
Top four branches	76.9	73.4	72.06	73.69
Top five branches	84.81	80.38	80.9	82.42
Hirschman-Herfindahl Index				
StandardHHI	0.2216	0.1756	0.1659	0.1709
NormalizedHHI	0.1351	0.0840	0.0732	0.0788

Source: Author.

The same remark can be made on the evolution of the top three and four branches in the country with sometimes, change in related position by one and other branches, addressing instability of the ranking. Notwithstanding the decline in market share of the top four banks over time, with nearly 75% of the market, there is still a trend towards concentration, with a slight regression in favor of other banks. Overall, the market share of the top five banks has increased from 84.81% in 2005 to 82.42% in 2016, indicating also reduction in the power of concentration.

This analysis shows that the market share remains significant for top branches, indicating a high concentration of market power by the big banks. However, over the decade 2005-2016, a slight decline is observed from one year to the next, indicating a decline in concentration. The entry of new banks into the market and customer or the product policies have been conducive to less concentration and more competition in the Benin's banking system over the period. This trend, which is not without effect on sector efficiency, can be assessed with the Herfindahl-Hirshman index. The Hirschman-Herfindahl index is a parameter indicating competition between firms operating on the same market, combining the number of firms and their respective market shares to define the level of concentration or competition. The Herfindahl-Hirshman Index (*HHI*) is obtained from the market shares of the banks composing the system. Let

$$HHI = \sum_{i=1}^n S_i^2$$

S_i represents the market share of the branch i and n represents the number of branches; consequently, the index varies between $1/n$ and 1. The analysis will be based on the normalized index noted HHI^* and obtained by, $HHI^* = (HHI - \frac{1}{n}) / (1 - \frac{1}{n})$ where HHI^* varying from 0 to 1. Simply, if the index HHI^* tends to 0, the market has a competitive behavior whereas inversely, if the normalized index tends to 1, the market has monopolistic behavior. Thus, the higher the HHI , the more financial intermediation is concentrated among a small number of firms.

Generally speaking, when the HHI is below **0.1**, the market concentration is considered as low; when it is between **0.1** and **0.18**, it is considered as medium or moderate concentration and when it is above **0.18**, it is considered as high. Hannah and Kay (1977) show that, under certain conditions, margins are linked to the value of the Hirschman-Herfindahl Index. Stigler (1964) establishes that the higher the Hirschman-Herfindahl, the greater the probability of facing a collusion. It is an index that requires a lot of information about many firms. While its interest lies in its robustness, the limitation is that it implies the availability of data covering the industry and could give relative weight to large size. The bottom part of Table 1 presents the indices calculated for the Benin's banking system over the three years 2005, 2010 and 2015.

Overall, the *HHI* results corroborate the trends towards concentration and lessening of market power that emerged from the market shares analysis of the top *N* banks. They showed strong concentration in 2005, with *HHI* = 0.22. From 2005 onwards, there is indeed a decline in the concentration level of the banking system with 0.17 in 2010, 0.16 in 2015 and 0.17 in 2016, characterizing a moderate concentration. Thus, the entry of new banks and especially the multiplication of the agencies induces decreasing concentration and promotes competition. The same results emerge when the normalized index is invoked, going from 0.13 in 2005 to 0.084 and 0.078 in 2010 and 2016 respectively. Likewise, the reference to the US Competition Authority approach gives the same conclusions of high concentration in 2005 and moderate concentration since 2010. However, the total balance sheet of bank may disguise some specific characteristics of the banking sector, including the portfolio size, which can be assessed in terms of loans or deposits. What is the evidence from the portfolio perspective? In order to reproduce concentration from both market share and Hirschman-Herfindahl indices point, we expand the analysis focusing on the portfolio. The first portfolio variable concerns credit, including outstanding loan for all maturities. Over the three years for which data are available, total credit amounted to CFA 378.8195 billion, CFA 807.1314 billion and CFA 969.3981 billion in 2005, 2010 and 2012 respectively. The market shares are calculated; the structure leads to a classification almost identical to that of the total balance sheet as presented in Table 2. From a market share of more than one third in 2005, the top bank concentrates only 23.70% in 2012 when the market share of top two banks decreases from more than 50% in 2005 to 46.75% in 2012. From more than three quarters of the market share in 2005, the market power of the top four banks declined to 70.54% in 2012 and finally, for the top five banks, the market power decreased from 86.61% in 2005 to 78.41% in 2012.

Table 2: Market share and HHI in terms of bank portfolio

Indicators	Credit portfolio			Deposit portfolio		
	2005	2010	2012	2005	2010	2012
Market share (%)						
Top branch	31.49	27.36	23.70	38.43	32.66	29.90
Top two branches	53.37	48.53	46.75	57.02	50.80	51.57
Top four branches	76.62	70.37	70.54	76.29	73.44	72.86
Top five branches	86.61	78.10	78.41	84.77	80.30	80.64
Hirschman-Herfindahl Index						
Standard HHI	0.1905	0.1605	0.1549	0.2150	0.1797	0.1753
Normalize HHI	0.1006	0.0672	0.0610	0.1278	0.0886	0.0837

Source: Author.

Two broad observations confirm the concentration trends with the balance sheet. On the one hand, there is market concentration from in terms of claims in general and credit portfolio in particular. Over the period, there has been a decline in this concentration, explained by the entry of new banks and the sharing of the market, which may lead to competition in the sector. The Hirschman-Herfindahl index gives the same results. In 2005, it suggests a high degree of concentration and from 2010 onwards, concentration remains moderate; the decline in the market share of the leading banks has therefore related to competition in the sector. These results are also similar to those of the concentration assessment found with the banks' balance sheet. The second portfolio variable used to assess the level of concentration in the banking system concerns liabilities with outstanding deposits of all maturities. The results lead to a almost identical figure.

For example, from 38.45% in 2005, the market share of the top bank decreased to 32.66% and 29.90% in 2010 and 2012 respectively; that of the top two banks declined from 57.02% in 2005 to 51.57% in 2012; and with more than three quarters of the market in 2005, the market power of the top four banks decreased to 72.86% in 2012.

These indicators give sufficient evidence that concentration in the banking sector has remained strong over the last decade, but also that, even if it is still lower, market sharing has begun with the decline in the various market shares of the leading banks. It should be noted, however, that despite this decline since 2010, the banking system is still on the borderline of high concentration given a competitive behavior of branches. That is what we appreciate in the next section.

4. Banking system and competition level in Benin

Two indices are used to measure the market power of banks: a modified version of the *H – statistic* of Panzar and Rosse (1987) and the Lerner index. The Panzar and Rosse (1987) measures then the reaction of output to input prices, gauges the competitive behavior of banks, but imposes certain restrictive assumptions on banks' cost function. Specifically, under perfect competition, increases in input prices cause total revenue and marginal cost to move together, while in imperfect competition they do not. Estimating the level of competition or market power requires a structural approach or a contestable market approach that directly describes the behavior of banks, determined both by the market structure, the barriers to entry and the activity of other financial institutions, including insurance companies, pension funds, etc. The latter is based on the market structure of the bank and the activity of other financial institutions (Claessens and Laeven, 2004). Following the example of Carbó et al. (2009), we adopt a more flexible form of the translog income function, which allows the *H – statistic* to be determined for each bank and for each year. The function is represented by,

$$\begin{aligned} \ln R_{it} = & \varphi_i + \sum_{j=1}^3 \alpha_j \ln w_{j,it} + \alpha_4 \ln TA_{it} + \alpha_5 \ln LR_{it} \\ & + \frac{1}{2} \sum_{k=1}^3 \sum_{l=1}^3 \beta_{kl} \ln w_{k,it} \ln w_{l,it} + \frac{1}{2} \gamma_1 (\ln TA_{it})^2 + \frac{1}{2} \gamma_2 (\ln LR_{it})^2 \\ & + \sum_{k=1}^3 \delta_k \ln w_{k,it} \ln TA_{it} + \sum_{k=1}^3 \phi_k \ln w_{k,it} \ln LR_{it} + \lambda \ln LR_{it} \ln TA_{it} + \varepsilon_{it} \end{aligned} \quad [1]$$

R_{it} represents the total income of the bank i at the period t . The price of the mobilized resources noted w_1 is measured as the ratio of interest charges to the total deposits and other liabilities. The price of labor input noted w_2 is calculated as the ratio of salary costs to total assets. The third fixed asset price denoted w_3 is measured as the ratio of other operating expenses to total fixed assets. Two bank-specific control variables are included in the equation: total assets noted TA and the ratio of non-performing loan provisions to outstanding loan noted LR . The first variable is a measure of the bank's operating capacity since revenue depends on its size. The second control variable assesses the portfolio quality of the bank's loans since non-performing credit affects the bank's main income.

According to Panzar and Rosse (1987), the indicator of the competition level is determined as the sum of the income elasticities with respect to each of the input prices; this gives,

$$\begin{aligned} H_{it} = & \sum_{j=1}^3 \frac{\partial \ln R_{it}}{\partial \ln w_{j,it}} = \alpha_1 + \alpha_2 + \alpha_3 + (\beta_{11} + \beta_{12} + \beta_{13}) \ln w_{1,it} + (\beta_{21} + \beta_{22} + \beta_{23}) \ln w_{2,it} \\ & + (\beta_{31} + \beta_{32} + \beta_{33}) \ln w_{3,it} + (\delta_1 + \delta_2 + \delta_3) \ln TA_{it} + (\phi_1 + \phi_2 + \phi_3) \ln LR_{it} \end{aligned} \quad [2]$$

With monopolistic conditions, an increase in input prices will increase marginal costs, reduce equilibrium output and consequently reduce total revenues and the *H – statistic* is negative or equal to zero. If the market structure is characterized by monopolistic competition, the H statistics will lie between zero and unity. The market power measured by *H – statistic* is then obtained for each of the banks in the system and for each year. Given the availability of data on the balance sheet and financial statements of the ten banks previously selected, the statistics are calculated over the period 2005-2017

Where data come from the central bank and the banking commission in WAEMU area. H_{it} is determined by equation (2) after regressing equation (1), which estimates the parameters or elasticities. The results are reported in Table 3.

The increase (decrease) in the *H – statistic* indicates a decrease (increase) in the market power of the banks and then an increase (decrease) in the level of competition in the banking sector. The results corroborate the initial intuitions of concentration and competition in the Benin's banking system. Since the indices are non-negative over the period for all branches, we are able to reject the hypothesis of monopoly structure; on average, the *H – statistic* increases from 0.605 in 2005 to 0.614 in 2017, indicating a small change in market structure but hiding enough contrasts from one bank to another. We show these different patterns in calculating the change by branch over the period. For four banks, the statistic has fallen significantly, indicating an increase in the market power of these banks. This gain in market share has contributed qualitatively to a structure of monopolistic competition observed at the global level.

For four banks, the statistic increase significantly, attesting a decline in their market power which results in a loss of market share, contributing to the emerging structure of monopolistic competition. Overall, over the period 2005-2017, the statistic is equal to 0.619 on average, confirming the monopolistic competition of the banking system in the country.

Table 3: Market power of banks: H-statistics

N°	2005	2006	2008	2010	2012	2015	2016	2017	H-mean	H-gap
1	0.352	0.352	0.450	0.521	0.633	0.698	0.733	0.808	0.546	0.456**
2	0.525	0.525	0.670	0.638	0.579	0.638	0.608	0.551	0.597	0.027*
3	0.701	0.701	0.549	0.474	0.430	0.474	0.498	0.549	0.540	-0.152**
4	0.423	0.423	0.540	0.625	0.759	0.797	0.759	0.689	0.616	0.266**
5	0.432	0.433	0.552	0.609	0.552	0.526	0.501	0.454	0.513	0.022*
6	0.755	0.755	0.874	0.755	0.755	0.793	0.719	0.621	0.771	-0.133**
7	0.562	0.563	0.536	0.620	0.684	0.620	0.652	0.591	0.612	0.029**
8	0.792	0.712	0.577	0.467	0.467	0.421	0.467	0.421	0.537	-0.371**
9	0.722	0.729	0.755	0.783	0.811	0.826	0.833	0.826	0.782	0.104**
10	0.783	0.704	0.704	0.704	0.570	0.634	0.704	0.634	0.681	-0.149**

Source: Author. (*) and (**) indicate significance at 10% and 5% respectively.

To assess the level of competition, the second indicator of interest remains the Lerner index. It measures the relative difference between the output price and its marginal cost; from this point of view, the Lerner index is a structural indicator. Compared to the *H – statistic* of Panzar and Rosse, the Lerner index is little used in structural studies of the banking sector (Fernández de Guevara et al., 2007; Solís and Maudos, 2008; Carbó et al., 2009). Different outputs are used to estimate Lerner's index: previous work uses the total amount of claims (Pruteanu-Podpiera et al. 2008; Solís and Maudos, 2008) or total assets (Fernández de Guevara et al. 2007; Carbó et al. 2009). Consistent with the intermediation approach of banking activity, two outputs are considered: loans (*PR*) and other income-earning assets (*AR*), which constitute the mainbank's sources of revenue. Thus, with reference to the *H – statistic* estimation model, banks are assumed to use the resources, labor and other fixed assets to produce mainly loans and other earning assets. On this basis, the average price *p* is calculated as the ratio of total income to the sum of loans and other earning assets, $p_{it} = R_{it}/(PR_{it} + AR_{it})$. Subsequently, it is possible to calculate the Lerner index, defined as the relative difference between price and marginal cost.

$$L_{it} = (p_{it} - cm_{it})/p_{it} \quad [3]$$

Where the marginal cost cm_{it} is derived from the cost function, assumed to take the following translog form,

$$\begin{aligned} \ln C_{it} = & \sigma + \sum_{j=1}^3 \theta_j \ln w_{j,it} + \theta_4 \ln PR_{it} + \theta_5 \ln AR_{it} \\ & + \frac{1}{2} \sum_{k=1}^3 \sum_{l=1}^3 \rho_{kl} \ln w_{k,it} \ln w_{l,it} + \frac{1}{2} \pi_1 (\ln PR_{it})^2 + \frac{1}{2} \pi_2 (\ln AR_{it})^2 \\ & + \sum_{k=1}^3 \Delta_k \ln w_{k,it} \ln PR_{it} + \sum_{k=1}^3 Q_k \ln w_{k,it} \ln AR_{it} + \mu \ln PR_{it} \ln AR_{it} + \varepsilon_{it} \end{aligned} \quad [4]$$

The symmetry conditions of the cost function imply that the coefficients meet the constraints $\rho_{kl} = \rho_{lk}$ for $l, k = [1,2,3]$; the homogeneity conditions of the same cost function impose the following restrictions on the parameters :

$$\sum_{j=1}^3 \theta_j = 1, \sum_{k=1}^3 \Delta_k = 0, \sum_{k=1}^3 Q_k = 0 \text{ et } \sum_{k=1}^3 \rho_k = 0 \quad (l = [1,2,3])$$

Given these different considerations, the marginal cost function can be written as:

$$\begin{aligned} cm_{it} = & \frac{\partial C_{it}}{\partial (PR_{it} + AR_{it})} \\ cm_{it} = & [\theta_4 + \theta_5 + \sum_{k=1}^3 (\Delta_k + Q_k) \ln w_{k,it} + \pi_1 \ln PR_{it} + \pi_2 \ln AR_{it} + \mu (\ln PR_{it} + \ln AR_{it})] \frac{C_{it}}{(PR_{it} + AR_{it})} \end{aligned} \quad [5]$$

The Lerner index is obtained through equation [1], after regressing the cost function equation [4] and using expression [5] which defines marginal cost. Theoretically, the decrease (increase) in L index indicates a decrease (increase) in the market power of the branch. Thus, for negative values, Lerner's index may reflect greater competition in the sector with banks that may appear without any real market power: this is what Shaffer (1993) describes as super-competitive banking behavior. The results are reported in the following Table 4, for each of the banks in the sample and over the period 2005-2017, given the available data.

Table 4: Market power of banks: the Lerner Index

N°	2005	2006	2008	2010	2012	2015	2016	2017	L-mean	L - gap
1	0.687	0.618	0.501	0.406	0.329	0.296	0.266	0.240	0.429	-0.448**
2	0.525	0.472	0.602	0.574	0.520	0.574	0.546	0.496	0.542	-0.029**
3	-0.121	-0.132	-0.145	0.160	0.226	0.268	0.318	0.378	0.104	0.499**
4	0.423	0.380	0.308	0.302	0.359	0.391	0.352	0.317	0.344	-0.106*
5	0.254	0.254	0.255	0.206	0.167	0.150	0.135	0.122	0.201	-0.132**
6	-0.225	-0.246	0.284	0.246	0.271	0.284	0.299	0.314	0.184	0.539**
7	0.237	0.237	0.225	0.261	0.317	0.350	0.367	0.405	0.291	0.168
8	0.214	0.234	0.278	0.305	0.311	0.314	0.316	0.319	0.287	0.105*
9	0.113	0.123	0.146	0.173	0.206	0.224	0.244	0.266	0.180	0.154**
10	0.124	0.112	0.112	0.112	0.091	0.101	0.112	0.101	0.108	-0.024

Source: Author. (*) and (**) indicate significance at 10% and 5% respectively.

Overall, the Lerner indices have changed very little over the decade, rising from 0.223 in 2005 to 0.296 in 2017; however, this hides a dynamic market structure at the individual level. The change we calculate lead to the conclusion that for four banks in the sample, the Lerner index fell significantly, indicating a reduction in the market power over the period. The index for three banks shows a significant increase of their market power, while for three other banks, the change in the index is not statistically significant. These statistics corroborate the previous results on the monopolistic competition since, there is a loss of market power by the top branches from 2005 to 2017, resulting in gain of more market power of the rest of branches.

In summary, the two indicators, the *H - statistic* of Panzar and Rosse (1987) and the Lerner index, allow characterizing the market structure in the Benin's banking sector over the period 2005-2017. There is, a high degree of concentration leading to a monopoly by two institutions at the originand, the market division which leads to monopolistic competition at the end of the period.

This final market structure is the result of a process of rising *H - statistic* and falling L-index for some banks, with inverse process for other banks. As Carbó et al. (2009) point out, the results according to the two statistics may differ if (i) there is a large difference between the share of off-balance sheet expenses and that of revenue in the total income, (ii) operating costs fall at different rates, especially with the introduction of the Automatic Teller Machines, (iii) there is difference in economies of scale, and (iv) there is a large difference in terms of non-performing loan. For this reason, the banks involved in each process may not be the same depending on the indicator. Given this market structure in Benin, with Lerner index and H-statistics, as measures of banks market power, we next appreciate their implication in terms of efficiency.

5. Banking system and Efficiency in Benin

If the market structure measured by concentration and competition levels allows for assessing efficiency in the banking sector, theoretically there is no unequivocal relationship between these two characteristics, as the results may be contradictory depending on the approach (Bain, 1956 and Demsetz, 1973). Efficiency will therefore be assessed here by incorporating into the analysis of the cost function, in addition to the relevant variables identified earlier in equation [4], the two indicators of competition we calculated: the *H - statistic* and the Lerner index. More specifically, this concerns technical efficiency, which measures the way in which the firm chooses the optimum quantities of inputs. It assesses the distance between a firm's production function and the optimal production function given the quantities of inputs. The measurement of technical efficiency generally proceeds from two methodologies, one parametric with the estimation of a stochastic frontier model and the other non-parametric with data envelopment analysis (DEA). The first approach for determining efficiency scores will be used here given the comparative advantages. Comparing measures of technical efficiency using DEA and the stochastic production frontier approach, Weill (2006) concludes that the latter approach provides greater robustness of the scores.

Conceptually, the methods do not differ, as the scores of the other banks are calculated relative to those of the most efficient bank. The difference is in the way the frontier is established. While the non-parametric approach uses linear programming, the parametric approach uses econometric regression.

The parametric approach includes two equations: a stochastic frontier function and a technical inefficiency function. By regressing the cost function, the deviation of the frontier is included in the error term, making the results less sensitive to the factors in consideration in the cost function. Equation [4] is considered and it is important to subtract from the error term ε_{it} , the part describing the cost inefficiency. Let consider the decomposition $\varepsilon_{it} = \eta_{it} + \zeta_{it}$. η represents the symmetrical component of the error term and follows a normal distribution $N(0, \sigma_{\eta}^2)$ and ζ follows a semi-normal distribution $N(0, \sigma_{\zeta}^2)$ taking non-negative values. When $\zeta_{it} = 0$, the optimal cost frontier is obtained: the cost inefficiency is the difference between the effective cost and the minimum production cost for the same quantity of output and under the same conditions. More specifically, ζ is an inefficiency factor that can raise the effective cost above its minimum, incorporating technical and allocative inefficiencies. By definition, the first inefficiencies characterize the impossibility of reacting optimally to a change in the relative price structure and the second inefficiencies express the overemployment of inputs for the same quantity of *PR* and *AR* output. Under the error term conditions, the methodology of Aigner et al. (1977) and Jondrow et al. (1982), is used to estimate cost efficiency. Let the following equation be used,

$$X = E[\exp(-\zeta|\varepsilon)] = \left[\frac{1 - \phi(\sigma_{\zeta} - \frac{\lambda_{\zeta}}{\sigma_{\zeta}})}{1 - \phi(-\frac{\lambda_{\zeta}}{\sigma_{\zeta}})} \right] X \exp \left\{ -\lambda_{\zeta} + \frac{1}{2} \sigma_{\zeta}^2 \right\} \quad [6]$$

where $\lambda_{\zeta} = \varepsilon \sigma_{\zeta} / \sigma^2$, $\sigma_{\zeta}^2 = \sigma_{\zeta}^2 \sigma_{\eta}^2 / \sigma^2$ and $\sigma^2 = \sigma_{\zeta}^2 + \sigma_{\eta}^2$. $\phi(\cdot)$ represents the standard normal distribution function. Following Lapteacru and Nys (2011), the estimation of efficiency scores results from the Battese and Coelli (1988) formula, the values of ζ being non-null. The technical efficiency take values between zero and unity; when it tends to zero, the branch is more efficient. Like Lapteacru and Nys (2011) and Solís and Maudos (2008), the constraint $0 \leq X \leq 1$ is moved by a logistic transformation of cost efficiencies as $X_{it} = \exp(ET_{it}) / (1 + \exp(ET_{it}))$. Then, the efficiency scores are calculated with the equation [7].

$$ET_{it} = \ln \left[\frac{X_{it}}{1 - X_{it}} \right] \quad [7]$$

The estimation of equation [6] gives the average values of technical efficiency to be computed by applying equation [7]. For each year and for each bank, they are presented in the Table 5.

Table 5: Technical efficiency of banks in Benin

N°	2005	2006	2008	2010	2012	2015	2016	2017	ET-mean	ET - gap
1	0.687	0.618	0.501	0.406	0.438	0.526	0.473	0.568	0.519	-0.119**
2	0.785	0.749	0.607	0.491	0.531	0.478	0.573	0.516	0.581	-0.269**
3	0.758	0.855	0.735	0.595	0.482	0.578	0.521	0.625	0.651	-0.133*
4	0.659	0.826	0.890	0.721	0.584	0.525	0.631	0.567	0.701	-0.091**
5	0.715	0.718	0.864	0.873	0.707	0.636	0.573	0.687	0.760	-0.028*
6	0.415	0.779	0.982	0.899	0.856	0.771	0.694	0.624	0.777	0.210
7	0.651	0.452	0.853	0.872	0.735	0.721	0.649	0.584	0.745	-0.067**
8	0.712	0.710	0.926	1.167	0.824	0.801	0.786	0.707	0.799	-0.005
9	0.553	0.776	0.537	1.013	0.800	0.694	0.873	0.856	0.812	0.304**
10	0.512	0.602	0.843	0.849	1.386	0.872	0.756	0.735	0.804	0.222**

Source: Author. (*) and (**) indicate significance at 10% and 5% respectively.

In contrast to the analysis of concentration levels and competition in particular, the results relating to the cost efficiency of bank reflect technical inefficiencies overall. Six of the ten branches had technical inefficiency scores, showing a significant decline in the technical performance of these institutions. Two banks had over the period, a significant efficiency improvement while for with two banks, the results do not highlight any technical efficiency change (there is no improvement, nor deterioration). Among other explanations, the structure of the banking market could be at issue; indeed, the dynamics towards competition are not yet over and the market shares of the top five banks are still preponderant. This is a potential source of inefficiency in the input combination process for production.

Furthermore, competition indicators pointed out monopolistic competition in the Benin's banking system; this market structure, which does not promise well for competitive and efficient structure, explains the technical inefficiencies we observe. From the point of view of the intermediation approach we adopted, the quality of the loan portfolio could also be one of the causes to be considered in explaining these inefficiencies, given the provisions and credit losses.

Moreover, the evolution of the scores suggests that banks' cost efficiency has improved as they have gained market share, whereas a loss of market power by banks is accompanied by lesser efficiency. The results confirm as indicated above, that there is not unambiguous relationship between competition and efficiency: both SBP and structure-efficiency logic can therefore prevail. To characterize such a relationship in the Benin's banking system, we perform next an econometric test. To this end, the efficiency scores of adjusted cost *ET* are regressed on the market power indicator. In addition to the Lerner index or H-statistics, control variables as bank specific characteristics are considered in the following equation,

$$ET_{it} = \theta_0 + \theta_1 LH_{it} + \theta_2 \ln TA_{it} + \theta_3 RC_{it} + \theta_4 RD_{it} + \theta_5 \ln PO_{it} + \theta_6 \ln GT_{it} + \theta_7 SC_{it} + \varepsilon_{it} \quad [8]$$

Where *LH* is the indicator of market power, alternatively represented by the *H – statistic* (Model 1) by the Lerner index (Model 2). *TA* is the bank's total assets to control for the size effect on technical efficiency. *RC* and *RD* are market shares in terms of credit and deposits respectively. *PO* is control variable for portfolio quality represented by the provision on non-performing loans and *GT* assesses the network effect, represented by the number of agencies. Finally, *SC* is a dummy variable, taking the value **1** if the capital is held by foreign shareholders for more than 50% in order to control the effect of foreign capital. The Breusch and Pagan LM test rejects the OLS residuals hypothesis at the 5% level of significance indicating that ordinary least squares are inappropriate; hence the estimation of the models with random effects is done; the Hausman test does not reject this one. The results of the random effects panel model are reported in the Table 6.

Table 6: Estimates of relationship between efficiency and competition

Variables	Model 1 with H		Model 2 with L	
	Coefficient	t-Test	Coefficient	t-Test
Constant	2,587***	3,25	3,872***	2,98
Total asset	0,358	1,54	0,586	0,145
Lerner index	-	-	0,341***	3,25
H-statistic	0,089***	4,61	-	-
Loan share	1,251***	5,26	0,982***	3,56
Deposit share	1,652***	11,28	0,084*	1,77
Risk provisions	-0,257**	-1,98	-1,009**	-1,99
Agency	0,047**	2,05	0,365***	3,56
Shareholding	1,547	1,26	0,098	0,105
Nb. Obs.	770		770	
LM test	312,54**		514,01**	
Hausman test	5,02		3,89	

Sources: Authors. (***), (**), (*) indicates significance at 1%, 5% and 10% respectively.

Statistically, the results establish a positive relationship between cost efficiency and the *H – statistic* and Lerner index. Then we conclude that the market power positively affects cost efficiency: the higher the market power, the more efficient the bank remains in reducing financial intermediation costs. The significance at the 1% level of significance of the two market power indicators leads to the conclusion that any increase in market power is accompanied by an improvement in the cost efficiency of banks in Benin. This result reinforces the idea of the banking market sharing with the emergence of new banks that participate in the concentration decline and the strengthening of monopolistic competition.

Furthermore, the control variables indicate some important results. On the one hand, the bank's participation in the credit and deposit market is a key determinant in analyzing efficiency, maybe as a result of the intermediation approach we use; it tends to increase the efficiency of banks by controlling operating costs. On the other hand, risk provisions and the number of agencies have a negative impact on banks cost efficiency; while for the former, the costs of monitoring the risky portfolio may explain this result, the multiplication of agencies also appeared to be a source of inefficiency in the sector.

Finally, the coefficients related to total assets and bank shareholding are insignificant; these variables would therefore not explain the efficiency of credit institutions in Benin.

6. Concluding Remarks

The objective of this paper is to analyze, the financial system in Benin, through the prisms of financial development, the concentration, the competition and the efficiency of the system over the recent period. The financial liberalization of the 1990s has had a positive impact on the financial depth and economy financing in the country, with a substantial increase in credit to both the private and public sectors, with although an increasing public share. However, compared to other WAEMU countries, this progress remains limited in terms of financial development even there is intense activity of Decentralized Financial Systems (DFS), which supplement banks in the financial architecture. Although the contribution of DFSs' is increasingly significant, it does not yet allow closing the gap with respect to the level of financing of the comparator countries. Finally, there are major structural (terms or maturities) and sectorial disparities the country: while short-term credits are predominant, a significant proportion of credits is oriented towards services.

The last part of the paper is devoted to the analysis of the structure of the banking system over the recent period. Over the period 2005-2017, an assessment of the levels of concentration and competition leads to the conclusion that the process of concentration decline has not yet been completed and that the market is continuously shared by old and new banks. This situation leads to a structure of monopolistic competition which has no effect on the cost efficiency of banks: the market shares and the Hirschman-Herfindahl index for the concentration level, on the one hand, and the H-statistic and the Lerner index for the competition level, on the other hand, allow us to give evidence of such conclusion. Finally, a positive relationship is found between the market power of banks and their cost efficiency.

This calls for a strengthening of the competitive dynamics in the sector; this is necessary for transformation of the banking system to meet the objective of economy financing for investment and growth in the country.

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