

Testing for Competition in the Jamaican Banking Sector: Evidence From Bank Level Data¹

Denvil Duncan
Financial Stability Unit
Bank of Jamaica

Abstract

This paper presents an empirical assessment of the market structure of the Jamaican banking sector over the last thirteen years. This exercise is especially relevant given the significant consolidation trend in the banking sector following a financial crisis during this period. The increase in market concentration has significant implications for the level of competition as well as the welfare of the customers in the banking sector. In contrast to the structural model of competition, the non-structural model does not support the hypothesis of a significant positive impact of financial liberalization on bank competition. However, both models strongly reject the hypotheses of monopoly/perfect collusion and perfect competition/contestable market in favour of monopolistic behaviour (albeit declining competition) over the sample period.

¹ Denvil Duncan is a graduate student in the Department of Economics, U.W.I, Mona Campus, Kingston, Jamaica. This paper was written while Denvil Duncan served an intern in the Research and Economic Programming Division at the Bank of Jamaica. The views expressed are those of the author and does not necessarily reflect the position of the Bank of Jamaica.

1.0 Introduction

Since the early 1990s, the Jamaican banking sector has experienced significant structural changes stemming from a disorderly financial liberalization process, which preceded a severely disruptive financial crisis. As such, the last decade has important lessons in regard to factors influencing the relationship between competition and concentration, which has been unexplored. This paper aims to investigate the impact of the recent structural changes on the degree of market power, and hence, consumer welfare, with the intention to recommend an initial framework that may be used by policymakers in their assessment of the level of competition, as well as their regulatory decisions in regard to proposed mergers and acquisitions in the banking sector.

Following the shift towards a liberalized Jamaican economy in the late 1980s, the financial market, including the controls on the interest rate and the capital account, was deregulated in the early 1990s. However, as was common with many liberalizing economies at the time, this regime commenced without the necessary strengthening of the regulatory and legal framework. As a consequence, there have been significant changes in the structure of the banking sector over the past decade. During the post liberalization period, the asset size of the banking sector recorded an average annual growth rate of approximately 45.6 percent with the highest annual growth rate of 70 percent recorded at the end of 1992 (immediately following liberalization).² The dramatic expansion of the sector in the early 1990s culminated in a financial crisis in the latter part of the decade when steps were taken by the monetary authorities to stabilize the economy. Indigenous banks were particularly hard hit. At the end of the crisis, significant changes occurred both in terms of the number and the ownership structure of the banking sector.

The Bank of Jamaica (BOJ) has made strong efforts to encourage competition within the banking sector, including significant reductions in the liquid assets requirements³ (which began just prior to the commencement of the financial crisis), and moral suasion. Although concentration has increased, its explicit impact on competition in the banking sector remains an important policy question. The crisis period that started in 1996, engendered dramatic reversals in the growth of the banking sector, including a significant fall in the rate of growth of total bank assets to an average of 12.5 per cent. Another reversal was the marked reduction in the number

² See Table 1.

³ See Table 1.

of banks between 1996 and 1999. At the end of 1989, there were eleven banks in operation.⁴ This number fell to nine at the beginning of the crisis period and subsequently to six at the end of the crisis.⁵

During the crisis, almost all of the indigenous banks were *defacto* insolvent. These banks were subsequently closed following the Government's formation of the Financial Sector Adjustment Company (FINSAC) in 1997 to resolve the severe problems in the financial system. FINSAC later spearheaded the merger of the four failed indigenous banks, bringing the number of banks in the market to six at the end of 1999. After the merged bank was sold to a foreign bank by FINSAC in 2000, the sector finally settled in 2002 with the sale of another bank by FINSAC to another foreign company. See Table 1 for details on the changes in the banking sector between 1989 and 2002.

An important observation of the period under review is that the major player in the banking sector during the crisis period was the Government through the operations of FINSAC. This influential involvement of the Government instead of pure market forces is consistent with earlier studies, which reported that authorities in emerging markets typically played a greater role in the resolution of financial crises.⁶

The issues outlined above raise important policy questions. For instance, did the increased concentration in the Jamaican banking sector lead to a reduction in competition, and thus negatively affect consumer welfare? Alternatively, did the increased bank concentration result in greater efficiency in the sector? For example, according to recent theoretical research on competition in financial systems, incumbents with large market shares may be forced to behave competitively in order to prevent potential market entry. Also, what was the precise impact of the Government intervention in the sector on competition during and after the crisis? This paper attempts to answer these questions by conducting an extensive empirical examination of the sample period March 1989 to March 2002.

Although studies have been carried out on the profitability and efficiency of the Jamaican banking sector for the 1990s,⁷ the possible impact of liberalization or the financial crisis on the

⁴ This included eight domestic and four foreign banks. The eight domestic banks included: National Commercial Bank (NCB), Workers Savings and Loans (WSL), Trafalgar Commercial Bank (TCB), Eagle Commercial Bank (ECB), Mutual Security Bank (MSB), Century National Bank (CNB), Citizens Bank (CBL). The four foreign banks included: Bank of Nova Scotia (BNS), Canadian Imperial bank of Commerce (CIBC), Bank of Credit and Commerce International (BCCI) and Citibank (CBNA).

⁵ Five foreign-owned and one domestically-owned.

⁶ Such as Gelos and Roldos (2002).

⁷ See Stennet, Bachelor and Foga (1999), Green (1999), and Panton (1998).

level of market power in the banking sector has remained unexplored. This paper seeks to examine this impact by using two competing methodologies. First, the Herfindahl-Hirschman Index (*HHI*), which is the most common measure of concentration, is calculated over the sample period. Then, as a result of the shortcomings of the *HHI*, this study utilizes a more robust methodology put forward by Panzar and Rosse (1982 and 1987). The Panzar and Rosse methodology is applied using a panel data set including the *entire* population of commercial banks throughout the sample period, which allows the banking sector to be analyzed for any changes in competitive behaviour over time.

Following this introduction section, section 2 gives an overview of the issues involved in the literature. The *HHI* is discussed in section 3. The Panzar-Rosse methodology is examined in section 4. A description of the data set is done in section 5. Empirical results are presented in section 6 and section 7 concludes.

2.0 Summary of the Relevant Literature

There is a vast academic literature on the measurement of competition in the banking sector. This field is not without debate at both the theoretical as well as the empirical levels. Currently, there are two major approaches that may be used to evaluate the level of market power within a particular sector. These approaches differ according to whether the underlying model of the sector is structural or non-structural.⁸

The structural approach uses concentration ratios, such as the Herfindahl-Hirschman Index, to form hypotheses about the relationship between concentration and market structure.⁹ In the case of a monopoly, when one firm has 100 per cent of the market share, the *HHI* will be equal to 10,000, which is the upper bound. The lower bound of zero is attained when the market is perfectly competitive. Therefore, the larger the *HHI*, the more concentrated the market becomes, since fewer firms control more of the market. However, the relationship between concentration and market structure has been an area of considerable debate among the

⁸ See Bikker and Haaf (2001)

⁹ The *HHI* is calculated as the sum of the squared market shares of all the banks in the sector. That is $HHI = \sum_{i=1}^k MS_i^2$, where MS_i is the bank's market share and k represents the number of banks in the sector. As an example, if the banking sector included 4 banks with market shares of 60, 20, 15 and 5 per cent, then $HHI = 60^2 + 20^2 + 15^2 + 5^2 = 4250$. If the latter 3 banks merged, then $HHI = 60^2 + 40^2 = 5200$, indicating an increase in concentration.

Structuralists. The discourse is centred on two competing hypotheses: the “structure-conduct performance” (SCP) hypothesis and the “contestability” hypothesis.

The SCP hypothesis asserts that there exists a non-linear increasing relationship between concentration and market power.¹⁰ That is, as the market becomes more concentrated, the banks tend to collude and act as a monopoly in setting prices above the competitive level. This implies that there is an inverse relationship between concentration and consumer welfare.

Alternatively, the contestability hypothesis suggests that even in the face of increased concentration, incumbent banks may still behave competitively once there exists a potential free entrant who can offer similar services at lower costs.¹¹ It has further been argued that the positive relationship between concentration and market power may be the result of the incumbent banks being forced by a hypothetical entrant to increase their market share by lowering the price of their products (to equal cost, in the case of ‘perfect contestability’) rather than exploit their efficiency advantages. This view implies that greater concentration may lead to a higher level of consumer welfare.

As a result of the present ambiguity, efforts have been made to test the relationship empirically. However, the findings are still ambiguous. While Berger and Hannan (1989) found evidence to support the SCP paradigm, Jackson (1992) found the relationship to be non-monotonic and even negative for high levels of concentration, which contradicts the SCP.¹² Furthermore, other studies have been inconclusive and have also been refuted on technical grounds.¹³

Apart from the ambiguity surrounding the *HHI* theory, there are additional areas of concern. One important shortcoming is that while the index accounts for the number of banks and their market share, it does not consider the distribution of the shares as well as the geographical location of the banks. This makes comparisons with other countries difficult, as two countries could have the same *HHI* but different market structures due to the distribution of market shares.¹⁴

The inability of the structuralists to clearly define the relationship between concentration and market power has prompted the search for non-structural models by the ‘New Empirical

¹⁰ See Cetorelli (1999) for further discussion.

¹¹ See Baumol (1982).

¹² See Cetorelli (1999).

¹³ See Shaffer (1993).

¹⁴ See Cetorelli (1999) for a discussion.

Industrial Organization' (NEIO). These models, which include those of Bresnahan (1982) and Panzar and Rosse (P-R) (1982 and 1987), do not rely on explicit information about market structure in order to determine the level of competition.¹⁵

The Bresnahan methodology is executed by using a simultaneous equation model to estimate a system of equations involving the supply and demand functions as well as a price equation. From the estimation, an index, measuring the extent of the firms' market power, is developed. Using this methodology, Shaffer (1993) rejected the hypothesis of monopoly/collusion in favour of perfect competition in the Canadian banking sector, while Nakane (2001) found the Brazilian banking sector to be highly, though not perfectly, competitive.

The P-R model provides a very simple approach to test the market structure of an industry for competitiveness. Inferences are made based on the "H-statistic", which is calculated as the sum of the factor price elasticities estimated from a reduced-form revenue function. Use of the reduced-form revenue equation eliminates the problems usually encountered when trying to obtain supply side information. This is due to the fact that revenues are more likely to be recorded than the cost data necessary to execute the Bresnahan approach. Additionally, the Bresnahan approach relies on aggregated data, and thus, does not account for bank heterogeneity. Alternatively, when individual bank data are available, the P-R approach may be preferred.

An important advantage of the non-structuralist models is that they usually yield similar results when applied.¹⁶ This is due primarily to the fact that they have clearly defined hypotheses with specific interpretations. Therefore, there is little or no room for ambiguity as is the case with the structuralists that have three potential explanations for the one relationship.

3.0 The *Herfindahl-Hirschman* Index

The Herfindahl – Hirschman Index is a simple but useful tool for the measurement of concentration within an industry. It is calculated as the sum of all the banks' squared market shares, where market share may be based on either deposits or assets. Although the relationship between the *HHI* and concentration is clear, the link between concentration and market power remains an issue of much debate. As such, this paper considers all the relevant arguments as

¹⁵ See Bikker and Haaf (2001).

¹⁶ See Shaffer (1993) and Nathan and Neave (1989).

outlined in section 2 in order to explain the *HHI* empirical results using the Jamaican banking data.

A quarterly *HHI* was calculated for both deposits and assets over the period January 1989 to March 2002. Both indices displayed very similar movements over the sample period as shown in Figures 1 to 3. A slow decline in each index was observed for the 1992 to 1995 post-liberalisation period when the sector was expanding rapidly. Specifically, both indices declined below the 2000 mark during the liberalization period and the beginning of the post liberalization period, before moving above this threshold in 1995. According to the SCP approach, the decline implies increased competition among the banks following financial liberalization.

The year 1996 ended with the exit of two banks that had a combined market share of approximately 16 per cent. One of the exiting banks merged with a large bank in 1996, resulting in an increase in the latter's market share by approximately 32 per cent. The market share of the other exiting bank was distributed across the market. These developments resulted in an unprecedented increase in the indices by approximately 40 percent,¹⁷ indicating that the market became more concentrated and possibly less competitive. Subsequently, the *HHI* mildly fluctuated around the value of 3000 for assets, and 3250 for deposits as consolidation in the sector continued through the crisis and post crisis periods.

An important observation of the analysis is that the merger of four failed banks in 1999 did not have a significant impact on the indices. A possible explanation comes from an analysis of the market shares owned by these banks. Together the four banks owned only 15 percent of the total market share. Thus, after their merger, there was a relatively small change in bank concentration. As a result, it is possible to conclude using the *HHI* that the Jamaican banking industry declined in competitiveness throughout the sample period mainly as a result of the large merger in 1996.

Another important observation from the structural indices revealed that the market shares of the two most dominant players drove its pattern and movement over the entire sample period.¹⁸ This means that some form of oligopolistic behaviour may characterize the market. For example, it could be the case that the two most dominant players are price setters and the others are followers, i.e., the market may be one of price leadership.

¹⁷ The index moved from 2100 to 3250 between June 1996 and December 1996.

¹⁸ See Figures 1 to 3.

It must be noted that the above analysis was based on the conventional SCP paradigm, which narrowly assumes that the relationship between concentration and market power is positive. However, as outlined in section 2, the nature of this relationship is inconclusive using the structural approach. To overcome this problem, an empirical analysis was carried out using the Panzar-Rosse methodology described in the following section. The use of the P-R model should clarify this uncertainty, since the P-R model has clearly defined hypotheses to distinguish one market structure from another.

4.0 Empirical Methodology

This section outlines the model developed by Panzar and Rosse (1982 and 1987). Their model uses individual bank data to estimate a reduced-form revenue equation. The nature of competition in the sector is evaluated using the H-statistic – the sum of the factor price elasticities obtained from the estimation.

Two critical implications exist for this equilibrium model. First, at the bank level, profit is maximized where marginal revenue is equal to marginal cost:

$$R'_i(y_i, \kappa, v_i) - C'_i(y_i, f_i, q_i) = 0 \quad (1)$$

R'_i is the marginal revenue function, C'_i is marginal cost function, y_i is the output of bank i , κ is the number of banks, v_i and q_i consists of exogenous variables that shift the bank's revenue and cost functions, respectively, and f_i is a vector of bank i 's factor input prices.

The second implication is that the zero profit constraint holds at the industry level:¹⁹

$$R_i^*(y^*, \kappa^*, v) - C_i^*(y^*, f, q) = 0 \quad (2)$$

From these conditions, the H-statistic is formulated as:²⁰

¹⁹ “*” indicates equilibrium values.

²⁰ See Panzar and Rosse (1987) for further discussion.

$$H = \sum_{x=1}^I \frac{\partial R_i^*}{\partial f_{x_i}} \frac{f_{x_i}}{R_i^*} \quad (3)$$

This is the sum of the factor price elasticities, which indicates how responsive revenue is to a percentage change in factor prices.

Before outlining the estimation procedure it is necessary to discuss the various testable implications of the model. The H-statistic can be used to identify the three major market structures, namely, monopoly/perfect collusion, monopolistic competition and perfect competition/contestable market. Conclusions about the type of market structure are made based on the size and sign of the H-statistic. That is, both the size and sign are used to differentiate between the different market structures. The intuition behind the H-statistic rests solely on microeconomic theory, which outlines how revenues react to changes in input prices for the different market structures. Essentially, an increase in these costs will reduce revenues for a firm enjoying monopoly power, but increase that of a firm in a perfectly competitive market, proportionately. Therefore, it is expected that a perfectly competitive market will have an H-statistic equal to one, while the monopolist will have a negative H-statistic. The monopolistically competitive market should have an H-statistic that is somewhere between zero and one. Each of these hypotheses is discussed in greater detail in the following section.

A summary of the testable hypotheses of the different market structures is presented below.

H-statistic	Hypotheses
$H = 1$	Perfect competition or monopoly in a contestable market
$0 < H < 1$	Monopolistic competition
$H \leq 0$	Monopoly or collusion

Using a simple, single product monopoly model with the assumptions of constant price elasticity and a constant returns to scale Cobb-Douglas technology, P-R further showed that not only is the sign of the H-statistic important, but so too is its size. That is, a larger H-statistic means that the market is more competitive implying that the H-statistic is a continuous measure of competition.

In applying the P-R model, it is important to clearly define the production activity of the banks since they are not exactly comparable to other types of firms. The current literature presents two alternative approaches - the “production approach” and the “intermediation approach” – that can be taken in empirical work. Although there is some amount of debate as to which approach should be taken in empirical work, this paper will follow the intermediation approach, which classifies deposits and loans as inputs and outputs, respectively.²¹

4.1 Description of the Model

The marginal cost (C') and marginal revenue (R') functions of the P-R model are as follows:

$$\ln C' = \phi_0 + \phi_1 \ln y + \sum_{k=1}^t \rho_k \ln f_k + \sum_{j=1}^p \tau_j q_j \quad (4)$$

$$\ln R' = \omega_0 + \omega_1 \ln y + \sum_{d=1}^n \psi v_d \quad (5)$$

where, “ln” denotes the natural logarithm, y is the output of the bank, f is the factor input prices, q and v are exogenous variables that shift the bank’s cost and revenue functions respectively. Setting marginal revenue equal to marginal cost – the equilibrium profit-maximizing condition – yields the following equation:

$$\ln y = (\phi_0 - \omega_0 + \sum_{k=1}^t \rho_k \ln f_k + \sum_{j=1}^p \tau_j q_j - \sum_{d=1}^n \psi v_d) / (\phi_1 - \omega_1) \quad (6)$$

Multiplying equation (6), by the common price level²² yields the reduced-form revenue equation for bank i . As such, to estimate the H-statistic for the Jamaican banking sector the following equation was used:

$$\begin{aligned} \ln IR/A &= \beta + \rho_1 \ln IP_{i,t} + \rho_2 \ln LP_{i,t} + \rho_3 \ln KP_{i,t} \\ &+ \chi_1 DL_{i,t} + \chi_2 NLA_{i,t} + \lambda_1 LA_{i,t} + \lambda_2 LK_{i,t} + \lambda_3 KA_{i,t} \\ &+ \lambda_4 LQA_{i,t} + d_1 t + \delta_i + \varepsilon_{i,t} \end{aligned} \quad (7)$$

²¹ However, this is not without some amount of debate. For further discussions, see Hancock (1991), Huges and Mester (1993a, b) and Huges, Mester and Moon (2001).

²² The common price level may be expressed as: $\ln p = \sigma + \phi \ln (y^*)$. See Bikker and Haaf (2001).

Where IR/A is the ratio of total interest revenue (or interest income) to total assets, IP (or the price of deposits), is the ratio of interest expenses to total deposits, LP (or the price of labour), is the ratio of personnel expenses to total deposits plus loans plus investment and, KP (or the price of capital), is the ratio of fixed asset expenses to total fixed assets. Note that IP , LP and KP are all proxies used for the factor prices since the actual prices are not available. The sum of the coefficients on these variables, $(\rho_1 + \rho_2 + \rho_3)$, forms the H-statistic.

Other control variables were also included in equation (7). These variables include LK (loans to capital), LA (loans to total assets), DL (deposits to loans), KA (capital to assets), LNA (non performing loans to total assets) and LQA (liquid funds to assets) ratios.

Equation (7) was estimated using a panel data set with fixed effects to account for any heterogeneity among the banks as well as to avoid specification problems. The individual effects are represented by δ_i . A time dummy, t , was also included to account for the macroeconomic changes that occurred over the sample period.

5.0 Data

A quarterly panel data set, covering all of the thirteen (13) commercial banks that operated between the first quarter of 1989 and the first quarter of 2002, was constructed for use in estimation. The data obtained from BOJ included the balance sheets and the profit and loss accounts of the commercial banks. The number of banks fell from eleven in 1989:1 to six in 2002:1. While two banks had competitively merged, others were forcibly merged or permanently closed by the Government. The data set treats merged banks as separate institutions before the merger and then subsequently as one bank. The specified treatment of mergers suggests that the business mix and competitive behaviour of the banks does not change.²³

As stated in the introduction, the Jamaican banking sector experienced significant changes over the sample period. Table 2 shows that interest income to assets increased, on average, during the liberalisation and post-liberalisation period, but declined over the remaining sample period. The rapid expansion and contraction of the post liberalisation and crisis periods respectively, suggest that these changes are in line with expectations. Of the three factor costs, only capital price declined during the crisis period, while all three fell during the post-crisis

²³ See Hempell (2002) for further discussion.

period. The fact that there was no change in interest and labour prices, between the post liberalisation and crisis periods, comes as a surprise since these two periods were intrinsically different.²⁴ On the other hand, the bank specific factors showed significant variation in their pattern of movement over the period. The most notable of the group was loans to capital, which fell dramatically during the post liberalisation and post crisis periods. Furthermore, the two liquidity indicators gave conflicting reports of the industry's liquidity status over the sample range. While deposits to loans indicate that liquidity increased steadily over the sample period, liquid funds to assets suggest that liquidity fell during the crisis and post crisis periods.²⁵ The latter result is in line with *a priori* expectations. In addition, loans to assets fell in all periods subsequent to the liberalisation period as the high interest rate reduced the banks' loan portfolios. Also in line with expectations, non-performing loans to assets increased significantly during the crisis and then fell to very low levels as the industry recovered.

To capture the existence of structural breaks in the banking sector, the data were separated into four (unequal) sub-periods representing the 1989 to 1991 liberalization, the 1992 to 1995 post-liberalization, the 1996 to 1999 crisis, and the 2000 to 2002 post-crisis sub-periods. The factor prices were then interacted with dummies representing each of these sub-periods, excluding the liberalization period, and then estimated within one regression. Any statistically significant interaction term would indicate a change in competitive behaviour (and thus, the H-statistic). The direction of the change is determined by the sign of the interaction term. An F-test is used to determine the significance of any reported changes in the H-statistic.

5.0 Empirical Results

The third column in Table 3 presents the results from the estimation of equation (7). Using interest income as the dependent variable allows for a complete analysis of market power in the banking sector. The interaction terms, for the post liberalisation, crisis and post crisis sub-periods, should give an indication of whether or not competition changed over the period and the direction of any such change.

These empirical results suggest that the banking sector may be characterized by monopolistic competition (albeit declining competition) over the sample period, since the

²⁴ Recall that the industry expanded rapidly during the post liberalisation period before collapsing in the mid-90s.

²⁵ Liquid funds to assets is a more comprehensive measure of liquidity.

estimated H-statistic is always below one and above zero. This is verified by the fact that the hypotheses of perfect collusion and perfect competition/contestable market are both rejected at the one percent level of significance. This means that the H-statistic for the overall sample period (0.63) is significantly different from zero and one, thus fulfilling the requirement to be characterized as a monopolistic market.

Interest price is the factor that contributed the most to the H -statistic across the sub-periods, reporting a significant and positive coefficient value of 0.550 for the overall sample period. The coefficient on the capital price also reported a significant positive value. However, this was consistently lower than the coefficient on the interest price and was significant for the overall sample period only. This suggests that this price remained proportional to output throughout this period. The coefficient on labour price, on the other hand, reported an insignificant value for the overall sample period, indicating that it was an unimportant factor price.

Of the bank-specific factors (BSF), loans to assets and deposits to loans were the only significant ratios. The positive sign on the loans to assets coefficient is in line with expectations since the accumulation of loans means that banks would be accumulating more interest revenue. The coefficient on the deposit to loans ratio, measuring business mix, was also positive. This indicated that banks with higher levels of liquid funds, in the form of deposits, to fund their loan portfolio had greater levels of interest income.

As outlined earlier in the methodology, interaction terms were introduced for the sub-periods 1992 to 1995, 1996 to 1999 and 2000 to 2002. Estimating equation (7) with all the interaction terms allowed for the testing of changes in the H-statistic over the sample period. This was achieved by using the significant interaction terms to adjust the H-statistic for the respective sub-periods. The significance of this test for structural change was computed by using the Wald Coefficient Test (F -test).

Importantly, according to *a priori* expectations, competition in the banking sector should increase with the onset of financial liberalization. That is, prior to the removal of ceilings on interest rates, banks are generally unable to take full advantage of the risk-return trade-off in their portfolios, making it unprofitable to fund excessively risky ventures. This creates significant economic rents from relationship banking. However, liberalization should increase the pool of welfare enhancing projects increasing the number of higher profit opportunities

associated with higher levels risk. This will reduce banks' franchise values and lead to entry and competition in the financial system.

Table 3 shows that during the post-liberalisation period, there was a significant reduction in the H-statistic for interest income implying that the industry became less competitive during this period. This contrasts with the expectation that financial liberalization would significantly increase competition in the banking sector. The crisis and post crisis periods also saw further reductions in the H-statistic. However, this result is consistent with expectations given the consolidation in the sector. The low and declining H-statistic may be explained by the fact that the two dominant banks' average share of interest income increased from 61 percent before the crisis to 72 percent after.²⁶ Although the results imply that competition deteriorated following the crisis sub-period, the hypothesis of perfect collusion was rejected at each stage, suggesting that the industry remained monopolistically competitive over the period.

An important point that must be established here is that the results of the P-R model are more robust than that for the Herfindahl-Hirschman Index. The *HHI*, which only provides a measure of concentration, may be explained by three alternative theories to make the link between concentration and market power. For example, according to the *HHI* discussed earlier, concentration fell slightly during the pre crisis sub-period, rose significantly during the crisis sub-period and then remained constant during the post crisis sub-period. Making the link between these observed changes in concentration and market power would lead to three different dynamic paths for competitive behaviour.²⁷ It is this subjective nature of the *HHI* that has led to it being an unreliable measure of market power. The P-R model, however, measures market power directly and thus leaves little room for subjectivity. As such, the result from the P-R model is generally more robust and reliable, than the *HHI*, and thus gives a better measure of market power over a specified period. The robustness of the P-R model is further verified by the fact that variations in model specification had an insignificant impact on the H-statistic.

Table 3 also displays the results from the estimation of equation (7) with total income as the dependent variable. The purpose of this analysis is to examine the effect that non-interest income had on the H-statistic given that the share of non-interest income in total income averaged, more or less, between 10 and 20 percent²⁸ over the sample period. Further more, the

²⁶ See Figure 4.

²⁷ Recall that there are three different theories, the Structure Conduct Performance, Efficiency and Contestability paradigms.

²⁸ This implies that interest income averaged above 80 percent of total income for the said period. See Figures 5 and 6.

intermediation approach used in the application of the P-R model does not incorporate the activities generating non-interest income. The results in Table 3 show that the total income variant of the model yielded a lower adjusted R-squared (0.59) than that for interest income (0.69) suggesting, as expected, that interest income gave the better fit. In addition, the H-statistic reported for total income (0.46) was significantly lower than that for interest income (0.63). This is due primarily to the fact that non-interest income activities do not depend, significantly, on interest price. Therefore, estimating equation (7) with total income, introduced a downward bias in the estimated H-statistic. This suggests that the sector is less competitive with the inclusion of non-interest income. Figure 5 indicates that the distribution of market shares for non-interest income was mostly concentrated in only two institutions. This provides the intuition for the downward bias (towards a lower level competitiveness) in the H-statistic. Notwithstanding, both dependent variables led to the same conclusion about the market structure of the commercial banking sector. That is, they both suggest that the sector is monopolistically competitive.

7.0 Conclusion

The macroeconomic policies implemented during the early 1990s to adjust the structure of the Jamaican economy brought about significant changes in the banking industry. The objective of this paper was to examine the effect of such changes on the market structure of the banking industry. The Herfindahl –Hirschman Index, along with the accompanying structural theories, was used to analyse changes in the level of concentration and competition in the industry over the period. Results from this analysis revealed that there was a slight increase in competition following financial liberalization. However, the industry became more concentrated after the financial crisis in the mid-1990s, which might suggest that there was a decline in competition among the banks.

However, the ambiguous nature of the *HHI* necessitated the use of the more robust Panzar and Rosse methodology to measure the market power of the industry. Based on the results from this alternative methodology, competition actually fell slightly immediately following the liberalization period. Furthermore, the hypotheses of monopoly/perfect collusion and perfect competition/contestable market were both rejected in favour of monopolistic competition for the entire sample period. Interaction terms used to track changes in market power over time also indicated that there was a steady decline in competition throughout the

specified sample period. The continual reduction in competition over the sample period casts doubt on the welfare benefits to consumers with regard to increased competition from financial liberalization in the Jamaican case.

It is clear that the events of the mid-1990s led to significant changes in the concentration of the commercial banking sector. Although the specific relationship between concentration and market power remains unclear when using the *HHI*, it still provides a fairly accurate measure of industry concentration. The P-R model, however, is preferred in testing for possible changes in market power when adjustments in concentration are signalled by the *HHI*. The results of the P-R model indicated that competition deteriorated over the sample period. This suggests that the increased concentration during the period did, in fact, affect competition negatively.

References

- Baumol, W., J. Panzar, and R. Willig, 1982, *Contestable Markets and the Theory of Industry Structure* (New York: Harcourt Brace Jovanovich).
- Berger, A. and T. Hannan, 1989, 'The Price Concentration Relationship in Banking.' *The Review of Economics and Statistics*, Vol. 71, pp 291 – 299.
- Bikker, J. and K. Haaf, 2001, 'Competition, Concentration and Their Relationship: An Empirical Analysis of the Banking Industry.' Working Paper De Nederlandsche Bank.
- Burdisso, T. and L. D'Amato, 1999, 'Prudential Regulations, Restructuring and Competition: The Case of the Argentine Banking Industry.' Research Department, Banco Central de la Republica Argentina, Working Paper No.10.
- Chamberlin, E., 1962, *The Theory of Monopolistic Competition*, Harvard University Press, Cambridge Mass, 8th edition.
- Cetorelli, N., 1999, 'Competitive analysis in the Banking: Appraisal of the Methodologies.' *Economic Perspectives*, Federal Reserve Bank of Chicago.
- Gelos, G., 2002, 'Consolidation and Market Structure in Emerging Markets Banking Systems,' Working Paper, International Monetary Fund.
- Green, P., 1999, 'Preserving the Integrity of the Jamaican System: The Challenges,' Mimeo, Research Services Department, Bank of Jamaica.
- Hancock, D., 1991, *A Theory of Production of the Financial Firm*, Norwell, Mass.: Kluwer Academic Publishers.
- Hempell, H., 2002, 'Testing for Competition Among German Banks,' Discussion Paper 04/02, Economic Research Centre of the Deutsche Bundesbank.
- Huges, J.P., and L. J. Mester, 1993a, 'A Quality and Risk-Adjusted Cost Function for Banks: Evidence on the Too-Big-to-Fail Doctrine,' *Journal of Productivity Analysis*, Vol. 4, No. 3, pp. 293-315.
- _____, 1993b, 'Accounting for the Demand for Financial Capital and Risk-Taking in Bank Cost Functions,' Working Paper No. 93-7, Federal Reserve Bank of Philadelphia, Economic Research Division.
- Huges, J., Mester, L. and Moon, 2001, 'Are Scale Economies in Banking Elusive or Illusive? Evidence Obtained by Incorporating Capital Structure and Risk-Taking into Models of Bank Production,' *Journal of Banking and Finance*, Vol. 25, 2169-2208.

Jackson, W., 1997, 'The Price-Concentration Relationship in Banking: A Comment,' *Review of Economics and Statistics*, Vol. 74, 373-376.

Nakane, M., 2001, 'A Test of Competition in Brazilian Banking,' Working Paper No. 12, Research Department, Banco Central Do Brasil.

Nathan, A. and E. Neave, 1989, 'Competition and Contestability in Canada's Financial System: Empirical Results,' *The Canadian Journal of Economics*, Vol. 22, pp. 576-594.

Panton, N., 1996, 'The Commercial Banking Industry In Jamaica: Some Issues of Efficiency,' Financial Sector Unit, Research Services Department, Bank of Jamaica.

Panzar, J. and J. Rosse, 1987, 'Testing for "Monopoly" Equilibrium,' *Journal of Industrial Economics*, Vol.35, pp. 443-456.

Shaffer, S., 1993, 'A Test of Competition in Canadian Banking,' *Journal of Money, Credit, and Banking*, Vol. 25, pp. 49-61.

Stennet, R., P. Batchelor and C. Foga, 1999, 'Stabilisation and the Jamaican Commercial Banking Sector (1991-1997),' *Social and Economic Studies*, pp. 345-377.

Vesala, 1995, 'Testing Competition in Banking: Behavioural Evidence from Finland,' Bank of Finland Studies, Working Paper No. E: 1.

Table 1. Dynamics of the Commercial Banking Sector (1989-2002)

Year	No. of Banks at end-year	Total Assets \$JA('000)	Annual Growth Rate of Assets (%)	Entrants	Exits	Change of ownership/ merger	Adjustments in Liquid Assets Requirements for Commercial Banks
1989	11	\$15,114,226.00	-	-	-	-	-
1990	11	\$17,088,608.00	13.1	-	-	-	20.5 to 25.0 25.0 to 27.5 27.5 to 32.5
1991	10	\$27,394,782.00	60.3	-	BCCI	-	32.5 to 33.5 33.5 to 20.0
1992	11	\$46,624,739.00	70.2	IVB	-	-	20.0 - 50.0
1993	11	\$61,716,860.00	32.4	-	-	-	-
1994	11	\$95,094,265.00	54.1	-	-	-	-
1995	11	\$119,475,970.00	25.6	-	-	-	50.0 to 47.0
1996	9	\$128,089,301.00	7.2	-	CNB, MSB	NCB acquired ownership of MSB	-
1997	9	\$142,433,094.00	11.2	-	-	-	-
1998	9	\$165,039,652.00	15.9	-	-	-	47.0 to 45.0 45.0 to 43.0
1999	6	\$190,895,027.00	15.7	UB	IVB, ECB, WSL, CBL	IVB, ECB, WSL, CBL merged to form UB	43.0 to 41.0 41.0 to 39.0 39.0 to 35.0 35.0 to 34.0
2000	6	\$216,479,457.00	13.4	RBTT	UB	UB sold to RBTT.	34.0 to 33.0 33.0 to 32.0 32.0 to 31.0
2001	6	\$234,628,213.00	8.4	-	-	-	31.0 to 30.0 30.0 to 29.0 29.0 to 28.0
2002	6	\$248,581,188.00	-	-	-	NCB sold to AIC	-

Table 2. Descriptive Statistics²⁹

Sub-Periods	1989-1991	1992-1995	1996-1999	2000-2002
Total Income /Assets	0.06 <i>0.03</i>	0.06 <i>0.02</i>	0.05 <i>0.02</i>	0.03 <i>0.03</i>
Interest Income / Assets	0.05 <i>0.03</i>	0.05 <i>0.02</i>	0.04 <i>0.02</i>	0.03 <i>0.03</i>
Non. Interest Income/Assets	0.01 <i>0.01</i>	0.01 <i>0.01</i>	0.01 <i>0.00</i>	0.00 <i>0.01</i>
Interest cost/Assets	0.06 <i>0.06</i>	0.42 <i>4.97</i>	0.05 <i>0.05</i>	0.16 <i>2.85</i>
Personnel costs/ (deposits+loans+ investments)	0.01 <i>0.00</i>	0.01 <i>0.04</i>	0.01 <i>0.00</i>	0.01 <i>0.02</i>
Capital costs/ Fixed Assets	0.12 <i>0.16</i>	0.17 <i>0.17</i>	0.11 <i>0.07</i>	0.07 <i>0.08</i>
Loans/ Assets	0.44 <i>0.13</i>	0.32 <i>0.08</i>	0.34 <i>0.16</i>	0.20 <i>0.19</i>
Capital/ Assets	0.07 <i>0.04</i>	0.09 <i>0.10</i>	0.01 <i>0.34</i>	0.03 <i>0.18</i>
Non. Performing Loans/Assets	0.01 <i>0.03</i>	0.02 <i>0.03</i>	0.03 <i>0.11</i>	0.01 <i>0.06</i>
Loans/ Capital	27.42 <i>189.79</i>	5.00 <i>3.52</i>	3.69 <i>7.44</i>	8.08 <i>94.00</i>
Liquid Funds/Assets	0.40 <i>0.13</i>	0.38 <i>0.09</i>	0.27 <i>0.14</i>	0.23 <i>0.20</i>
Deposits/ Loans	1.50 <i>0.47</i>	2.16 <i>0.47</i>	2.46 <i>0.47</i>	1.63 <i>0.47</i>

²⁹ Means with standard deviations in italics.

Table 3. Empirical Results

	Factor Prices	Interest Income/ Assets	Total Income/ Assets
<i>Entire Sample Period</i>	Interest Price	0.55** (8.461)	0.367** (4.829)
	Labour Price	-0.040 (-0.792)	0.093 (1.727)
	Capital Price	0.076* (2.747)	0.0956* (2.609)
	H statistic P(F test)^ P(F test)^^^	0.63 0.00** 0.00**	0.46 0.00** 0.00**
<i>Post- Liber. Period</i>	Interest Price	-0.233** (-4.808)	-0.156* (-2.473)
	Labour Price	0.123** (3.808)	0.09* (2.627)
	Capital Price	-0.037 (-1.116)	-0.029 (-0.600)
	H statistic P(F test)~	0.52 0.00**	0.40 0.00**
<i>Crisis Period</i>	Interest Price	-0.365** (-3.384)	-0.172 (-1.559)
	Labour Price	0.205* (2.634)	0.132 (1.813)
	Capital Price	0.015 (0.322)	-0.050 (-0.925)
	H statistic P(F test)~	0.47 0.00**	0.46 0.05
<i>Post- Crisis Period</i>	Interest Price	-0.458** (-5.066)	-0.217* (-2.198)
	Labour Price	0.274** (4.443)	0.159* (2.616)
	Capital Price	0.049 (1.008)	-0.015 (-0.266)
	H statistic P(F test)~	0.44 0.00**	0.40 0.08
<i>Other Variables</i>	Deposit/ Loans	0.097** (5.322)	0.088** (4.310)
	Loans/ Assets	1.011** (4.132)	0.946** (3.831)
	Time	-0.004 (-1.755)	-0.003 (-1.250)
	Non-performing Loans/Assets	0.266 (0.988)	0.306 (1.283)
	Loans/ Capital*100	0.000 (-0.12)	-0.006* (-2.514)
	Capital/ Assets	0.112 (0.791)	0.163 (1.323)
	Liquid Funds/ Assets	0.104 (0.654)	0.374* (2.346)
	(F-value)fe	4.57**	2.37*
	Adj. R	0.69	0.59
	Max. No. of Banks	13	13
	Max. No. of Obs.	497	497

- Note: 1. "A" and "^^" indicate P values for the hypotheses H=1 and H=0 respectively.
 2. "~" gives the P values for the test for changes in the H statistic over time.
 3. T- values for the different variables, calculated from robust standard errors, are given in parentheses.
 4. "*" Significance at 5% level.
 5. "**" Significant at the 1% level.

Figure 1. Herfindahl-Hirschman Index (Deposits)

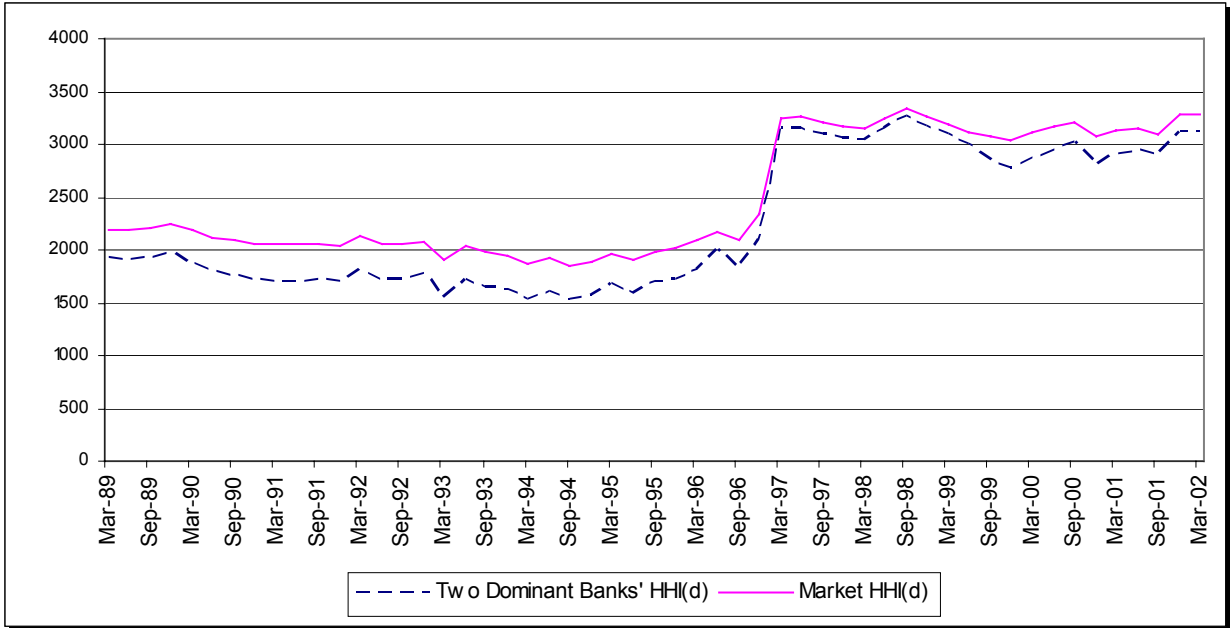


Figure 2. Herfindahl-Hirschman Index (Assets)

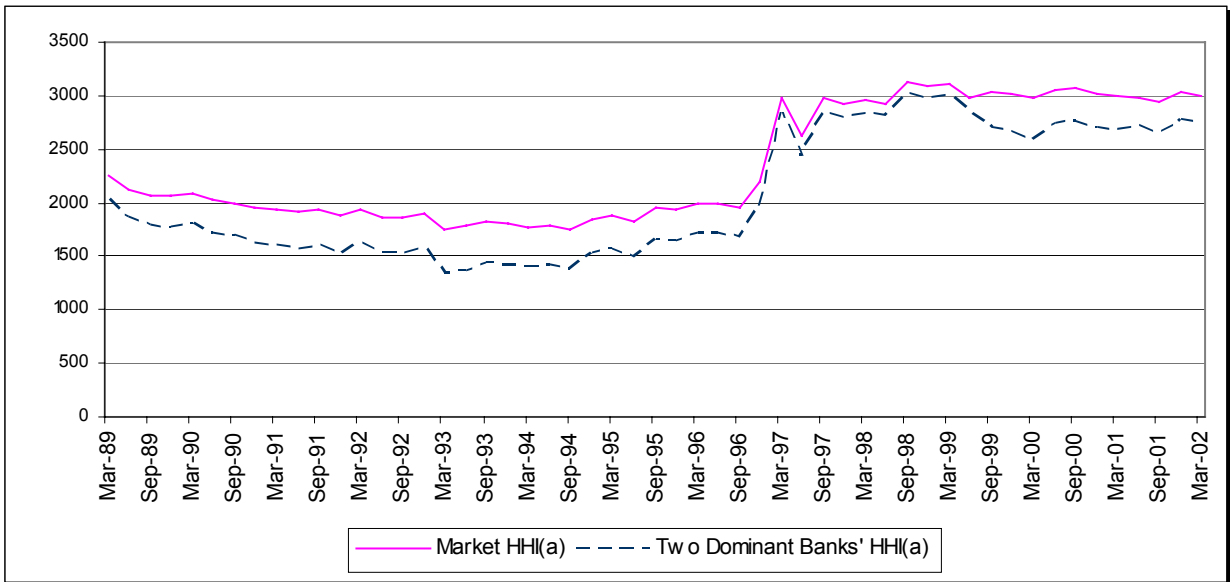


Figure 3. Herfindahl-Hirschman Index (Deposits and Assets)

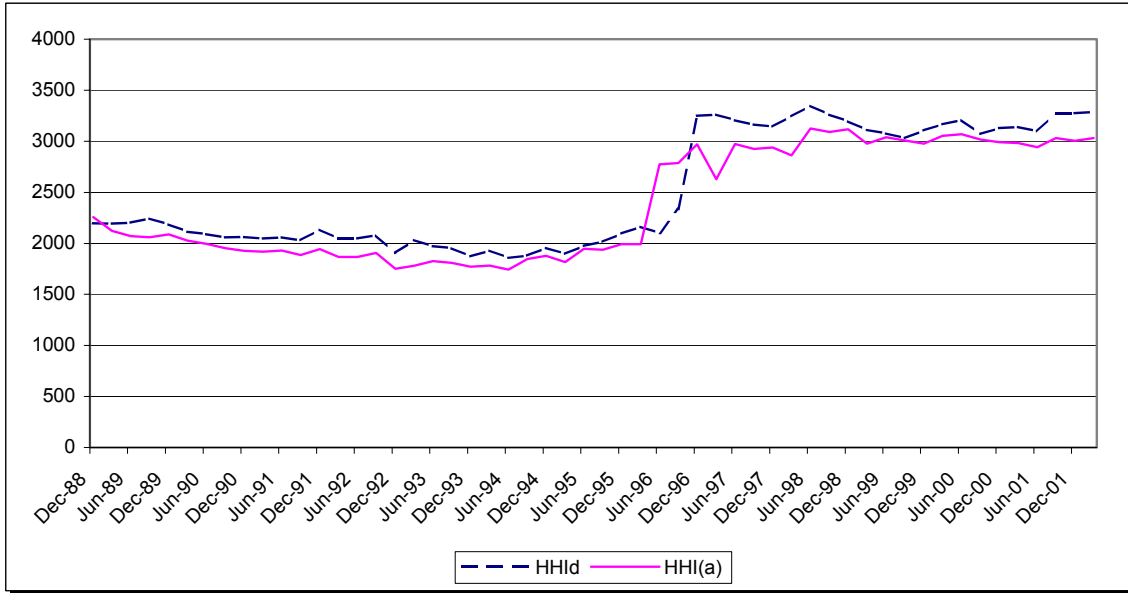


Figure 4. Market Share of Interest Income of the Two Dominant Banks

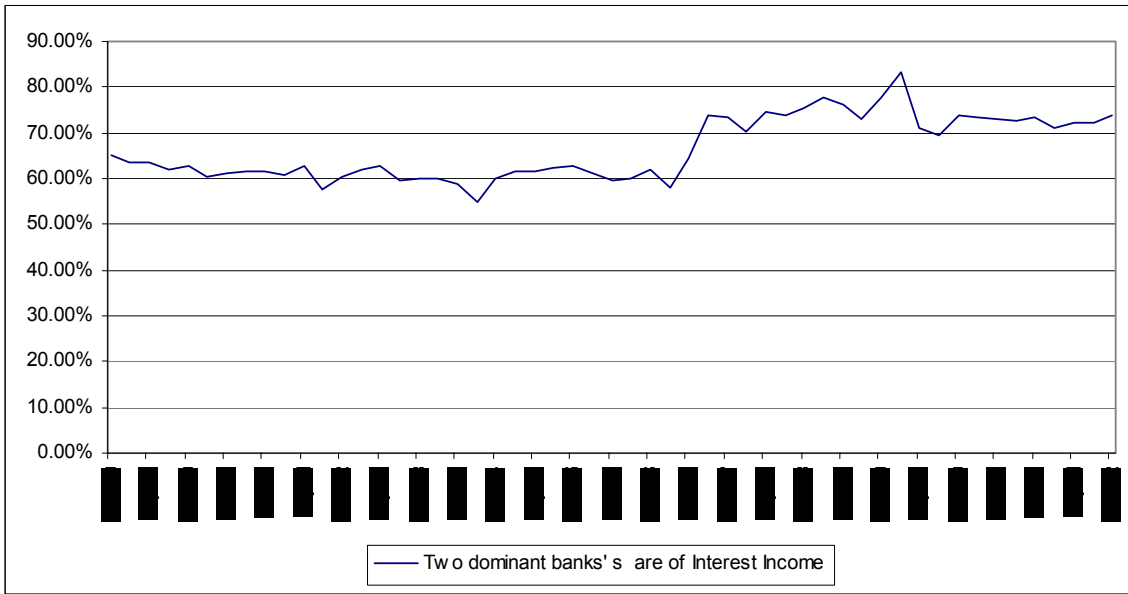


Figure 5. Interest and Non-Interest Income as a Percentage of Total Income

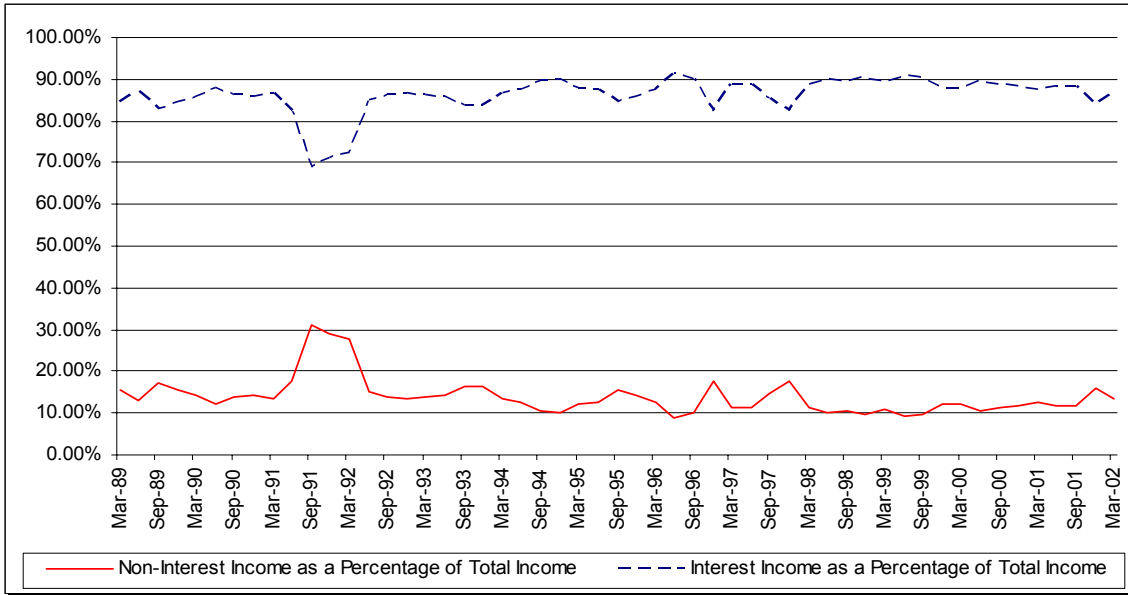


Figure 6. Market Share of Non-interest Income of the Two Dominant Banks

