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The Profit-Structure Relationship and Mergers in the European Banking Industry: An Empirical Assessment

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I. Introduction

In recent years, the banking sector has seen many mergers and acquisitions. This urge for expansion is attended by rapid changes in the market structure of the banking industry and raises questions about the desirability of these developments from the customer's point of view. Empirical studies often find a positive relationship between concentration or market share on the one hand and profitability on the other. Several explanations for the existence of this profit-structure relationship have been brought up in the literature. Broadly speaking, an increase in profitability is attributed to efficiency improvements or to a rise of market power. The implications for merger and antitrust policy, however, are radically different under efficient-structure hypotheses vis-à-vis market-power theories. Under the former hypotheses market concentration is motivated by an increase in efficiency – which would yield an increase in total surplus – while under the latter mergers are motivated by increasing market power – yielding a reduction in total surplus. Mergers should be encouraged in the first case, while in the second situation they should not be sustained.

The profit-structure relationship is a frequently explored topic within industrial as well as financial economics. However, most studies that examine the profit-structure relationship for the banking sector use American data. The studies of Berger (1995) and Berger & Hannan (1997, 1998) are standard in this field. Studies on the European banking market are

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limited in number. Examples are Molyneux & Thornton (1992), Altunbas & Molyneux (1994) and Goldberg & Rai (1996). For a recent overview of theory and empirical work, we refer to Goddard, Molyneux & Wilson (2001). In this study we focus on Europe and examine the validity of different explanations for the profit-structure relationship. Furthermore, the effects of mergers on bank performance are assessed empirically and combined with the empirical evidence on the profit-structure relationship to provide further insight in the economic rationale for banks to merge.

The effect of mergers on bank performance has been studied in literature along different lines. Early studies concentrated on the comparison of simple financial ratios before and after a merger. Berger & Humphrey (1992) contains a review. Vander Vennet (1996) provides a more recent example for the European banking industry. In the same study, he employs estimates for cost efficiency based on a stochastic cost frontier approach and concludes that domestic mergers of equal size and cross-border acquisitions lead to a significant improvement of operational cost efficiency. Some efficiency studies have simulated hypothetical mergers. Shaffer (1993) and Altunbas, Molyneux & Thornton (1997) provide examples for the US and Europe, respectively. The challenge in these studies is to incorporate the (hypothetical) post merger behaviour to improve performance, such as branch closures. A number of studies have investigated bank mergers by studying the shareholder valuation of merging banks around the announcement of the merger. Siems (1996) for example analyses US bank mergers and concludes that stockholders of target firms gain and that stock prices of bidding firms fall. Piloff & Santomero (1998) also found this result in their review of the literature on value effects of bank mergers and acquisitions. They conclude that the general result emerging from US studies is a transfer of value from acquirers to targets without a significant value creation overall. Cybo-Ottone & Murgia (2000) provide a recent example for European financial services firms and conclude that shareholders of target firms gain, whereas shareholders of acquiring banks at least break even. The results of Cybo-Ottone & Murgia thus suggest that shareholders have a positive attitude with respect to European bank mergers. This, however, is not evidence of actual merger benefits in the operational sense. Our approach is to use our profit efficiency estimates to compare the actual performance of banks before and some years after the merger, taking into account the market developments.

The paper is organised as follows: section II. discusses hypotheses that may explain the existence of the profit-structure relationship. These

hypotheses are tested in section III. using data from the European commercial banking industry. This section also discusses measurement techniques and efficiency estimates for individual banks. Section IV. studies the implications of bank mergers for profitability and the economic rationale of mergers against the background of the profit-structure relationship and its explanations. Finally, section V. concludes with a summary and a discussion of the results.

II. Possible Explanations of the Profit-Structure Relationship

Within the existing literature on the profit-structure relationship, most studies find empirical support for a positive relationship between bank profitability and a measure of market structure, although this evidence is weak at times. Studies that do find evidence for this relationship are, for example, Altunbas & Molyneux (1994) for Europe, and Berger (1995) for the US, whereas e.g. Berger & Hannan (1998) provide no empirical support for the US. Correlation and regression analyses based on the dataset used in this study, documented in section III.2, both show a highly significant positive relationship between market-structure variables and profitability supporting the existence of the profit-structure relationship for the European commercial banking industry. Several theoretical hypotheses have been brought forward to explain the phenomena found. These explanations of the profit-structure relationship can be divided into two categories: market-power hypotheses and efficient-structure hypotheses.

Market-power Hypotheses

In explaining a profit-structure relationship, market-power (MP) hypotheses state that market power is the main variable that causes profitability to change. Concentrated markets often entail market imperfections that may result from collusion, facilitated by high concentration, or by (legislative) entry and exit barriers (often present in banking as a result of strict regulation). Because of these imperfections, firms operate in a market that deviates from perfect competition, which enables them to exert influence on prices charged and/or paid. These firms achieve higher profits at the expense of their customers through their price setting. The difference between the two main types of market-power hypotheses, the structure-conduct-performance hypothesis and the rela-

tive-market-power hypothesis, is based on the market structure variable that gives the best proxy for market power. The *structure-conduct-performance* (SCP) hypothesis assumes that market concentration is the best proxy for market power because more concentrated markets show larger market imperfections enabling all firms to set prices at levels less favourable to customers. Through market-wide price setting, each individual firm is able to improve its profitability. The *relative-market-power* (RMP) hypothesis asserts that only firms with large market shares and well-differentiated products have the power to set prices for their products and thus to earn supernormal profits. In this case there is no market-wide price setting, but only price setting by dominant firms. Firms with smaller market shares are forced to operate as if under perfect competition and are unable to earn the same supernormal profits. This implies that the firm-specific market share is the better proxy for market power and market imperfections. An additional hypothesis, mainly used to explain the possible absence of a profit-structure relationship, is the so-termed *quiet life* (QL) hypothesis. This special case of the market-power hypotheses argues that as firms have more market power, either through market share or concentration, the management becomes less focussed on efficiency, since setting prices at more favourable levels can increase revenues. The quiet life hypothesis states that firms do increase revenues as a result of increased market power but, as a result of higher inefficiencies, do not show a superior profitability.

Efficient-structure Hypotheses

Efficient-structure (ES) hypotheses explain the positive relationship between profitability and either concentration or market share with reference to efficiency measures. Efficiency of individual banks causes both high profitability and a high market share. Hence, these hypotheses state that by controlling for efficiency, the relationship between profitability and market structure variables becomes insignificant and thus economically meaningless. The ES hypotheses can be divided into the efficient-structure-X-efficiency and efficient-structure-scale-efficiency hypotheses. The *efficient-structure-X-efficiency* (ESX) hypothesis states that firms are able to realise higher profits as a result of higher X-efficiency. X-efficiency measures to what extent (the management of) the firm is successful in earning maximum profits given input and output prices, or in minimising costs given input prices and output quantities. Hence, it is often interpreted as an indication of the level of managerial efficiency. In addition to increasing profitability, higher X-efficiency

levels also enable firms to increase their market share, at the expense of less efficient firms, which may result in a higher level of concentration. The profit-structure relationship is found because of the positive effect of X-efficiency on both profitability and market shares, and possibly on market concentration. Because of these simultaneous linkages, a significant but economically meaningless relationship between profitability and market structure is found, when no correction for X-efficiency is made. Under the *efficient-structure-scale efficiency* (ESS) hypothesis, the difference in profitability between firms is not caused by differences in the quality of management, but by differences in the level of scale efficiency at which a firm is operating. Firms that operate below their efficient scale, given input prices and product mix, may realise lower costs and higher profits per unit of output, higher market shares and possibly higher levels of market concentration by moving towards a more efficient scale[1]. The effects of scale efficiency on both profitability and market structure variables may lead a spurious profit-structure relationship.

III. Testing Explanations for the Profit-Structure Relationship

Various possible explanations for the existence of a profit-structure relationship have been discussed in the previous section. The present section will test these explanations using data on the European banking sector. Section III.1 provides a short description of the dataset used. Section III.2 shows empirical evidence on the existence of the profit-structure relationship in the European banking industry. Estimates of individual bank efficiency are crucial to distinguish between the several theories on the profit-structure relationship, since its existence is attributed to either market power or efficiency. Because these estimates are not straightforward, section III.3 goes into the techniques of efficiency measurement employed. Section III.4 discusses the methodology of testing the various explanations and section III.5 reports the empirical test results for European commercial banks. Section III.6 concludes with a short discussion of the empirical results in relation to some other empirical studies.

[1] Firms may also operate above their efficient scale and thus moving to this efficient scale goes hand in hand with a negative relationship between profitability and market share. Our estimates, though, show that less than twenty-five percent of all banks operate above their efficient scale level.

1. Data Description and Sources

The present study uses an unbalanced set of panel data on commercial banks, running from 1992 to 1997. A summary of key variables is given in table 1. The reported values are average values for the whole sample period. The dataset is based on information from balance sheets and income statements, obtained from the BankScope database[2]. The sample contains annual data of commercial banks in eight European countries, namely Belgium, Germany, Spain, France, Great Britain, Italy, Luxembourg and the Netherlands. The reason to study only commercial banks instead of all European banks is twofold: homogeneity and importance. Using one type of banks makes the group of observations more homogeneous, allowing for better efficiency estimates (see e.g. Bikker (2001)). Except for Germany and Italy, commercial banks are largest in number in each of the selected countries. The total number of observations equals 4175, with a minimum of 530 banks and a maximum of 797 banks for individual years. Based on the return on equity (ROE) and return on assets (ROA) as measures of profitability, Great Britain and Luxembourg perform best on average and Italy and France clearly perform poorly. Prices of loans (P_{loans}), securities ($P_{securities}$) and deposits ($P_{deposits}$) are calculated by dividing the income or expense flow associated with the particular input or output by the average outstanding dollar amount[3]. Because of the lack of data on numbers of employees for most banks in the data set, the price of labour (P_{labour}) is defined as the ratio of personnel expenses to total assets.

In describing the market structure we face the problem that there is not one well-defined market for bank products. Typically, banks employ a wide variety of activities, operate at a national and an international level and compete not only with banks but also with other financial institutions. Notwithstanding the increasing internationalisation of bank activities, we focus on national markets because most banks earn a large share of their revenues in their home market. In calculating the market structure variables we have not only included commercial banks but also

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2 The BankScope database is compiled by FitchIBCA and Bureau van Dijk.

3 A hypothetical division is used to allocate interest income and commission income over loans and securities. This allocation is based on an estimated ratio, calculated using the coefficients from a regression of income on the average balances of loans and securities. Since the prices are measured indirectly, an outlier correction is used to remove the most extreme values. As any choice of cut-off points is arbitrary we have removed the upper and lower 2.5 percentile of the prices of deposits and loans to eliminate the most extreme values.

Table 1

Summary of Key Variables

Country	Number of banks	ROE	ROA	P_{loans}	$P_{securities}$	P_{labour}	$P_{deposits}$	MS	Herf	Conc5
Belgium	37	0.1286	0.0039	0.0973	0.0748	0.0095	0.0619	0.0157	0.094	0.6138
Germany	183	0.0802	0.0027	0.0895	0.0636	0.0102	0.0897	0.0017	0.006	0.2646
Spain	64	0.1055	0.0069	0.1287	0.0970	0.0159	0.0724	0.0078	0.056	0.4615
France	166	0.0129	0.0008	0.1093	0.0871	0.0112	0.0967	0.0019	0.034	0.3328
Great Britain	63	0.1650	0.0077	0.1062	0.0737	0.0145	0.0614	0.0069	0.040	0.3699
Italy	58	–0.0115	0.0010	0.1198	0.0940	0.0158	0.1021	0.0081	0.038	0.3429
Luxembourg	95	0.1519	0.0048	0.1058	0.0760	0.0031	0.0779	0.0079	0.028	0.2673
Netherlands	30	0.1157	0.0051	0.0974	0.0690	0.0122	0.0672	0.0169	0.159	0.7884
All	696	0.0823	0.0037	0.1049	0.0780	0.0121	0.0818	0.0056	0.037	0.3561

other types of banks and some non-banks to take account of competition with other institutions. The market share (MS) of a bank is defined as the ratio of total assets of the individual commercial bank divided by the total assets of all banking institutions in the bank's national market (including other types of banks such as co-operative banks, savings banks, mortgage banks and some non-banking institutions). The Herfindahl index (Herf) is a measure of concentration in a national market and is calculated by summing the squared market shares of all banking institutions within this market. In principle the Herfindahl index captures all movements of consolidation or concentration because it includes all banks present in the market. All estimations in this paper have also been made with the five-bank concentration ratio (Conc5, defined as the sum of the market shares of the five largest banks within the national market) as a measure of concentration, with qualitatively the same results.

2. *The Existence of a Profit-Structure Relationship for European Banks*

The existence of the profit-structure relationship has been evaluated on the basis of correlation and regression analyses. The data for the European banking sector show a strongly significant correlation between the market structure variables and ROE, whereas the results for ROA are mixed (table 2). A regression analysis corroborates the bilateral correlation results (table 3). Control variables like GDP-growth (GDP), a dummy representing whether banks are consolidated or not (D_{Cons}) and a time trend (T) are added. Notice the low value of the adjusted R^2. Although the influence of market structure variables (and control variables) on profits is statistically significant, a larger part of the return

Table 2

The Profit-Structure Relationship: A Correlation Analysis

	Correlation coefficient	
Market structure variable	ROE	ROA
MS	0.0999 (6.488)**	0.0197 (1.275)
Herf	0.0436 (2.820)**	0.0648 (4.192)**

Note: Correlations significant at the 5 % level are marked by **
Pearson correlation test statistics are reported in parentheses.

fluctuations yet remains unexplained. Although the correlation and regression analyses support the existence of the profit-structure relationship for the European commercial banking industry, they do not reveal whether market power or efficiency are the dominant factors explaining this relationship. Efficiency estimates are necessary to discriminate between the various theories.

Table 3

The Profit-structure Relationship: A Regression Analysis

	Dependent variable	
Independent variables	ROE	ROA
Constant	0.0001 (0.018)	0.0015 (3.489) **
MS	0.7517 (7.58)**	–0.003 (–0.708)
Herf	0.0853 (2.055)**	0.0153 (4.542)**
GDP	0.8845 (7.038)**	0.0189 (2.639)**
D_{Cons}	0.0002 (0.033)	0.001 (2.463)**
T	0.0064 (4.467)**	0.0003 (2.96)**
Adj. R^2	0.0263	0.0086

Note: Coefficients significant at the 5 % level are marked by **.
T-values are reported in parentheses.

3. Efficiency Measurement

Efficiency estimates for individual banks are needed to test the validity of the different hypotheses explaining the profit-structure relationship. To this end X-efficiency and scale efficiency estimates are obtained using efficiency frontier techniques[4]. The estimation of these efficiency levels requires several decisions, such as the choice of a profit or cost

[4] *Berger & Humphrey* (1997) survey 130 studies that analyse financial institutions with the use of efficiency frontier techniques. Their paper gives an overview of approaches used and the differences in average efficiency levels found. *Berger & Mester* (1997) examine possible sources of differences in measured efficiency. Most efficiency studies concentrate on US banks. Exceptions are, for example, *Schure & Wagenvoort* (1999) who examine the fifteen EU-countries and Pastor, *Pérez & Quesada* (1997) who provide an international comparison between the major European countries and the United States.

function approach, the selection of bank inputs and outputs and the choice of the efficiency frontier technique.

Cost or Profit Function Approach

This study uses a profit specification to estimate efficiencies. The advantage of profit efficiency is that it considers both the cost side and the revenue side of bank operations. Taking only the cost side into account may create a bias against banks with high quality service as their competitive strategy. These banks will show relatively high costs per unit of output as a result of high quality service, but it might very well be that because of this service the revenue per unit of output is relatively high as well. Efficiency estimates based on a cost function approach would concentrate on the higher costs, resulting in a lower level of efficiency. Besides, banks are usually considered to be profit-maximising entities and, hence, an efficiency estimate based on profits will be more consistent with actual bank behaviour. Moreover, previous studies on bank efficiency and bank mergers have shown that most inefficiencies are found on the output (revenue) side (see e.g. Berger, Hancock & Humphrey (1993) or Akhavein, Berger & Humphrey (1997)). Hence, these revenue inefficiencies provide a source for potential gains from mergers. Profit efficiency takes output efficiency into account, and is therefore better suited to analyse the efficiency benefits of bank mergers (see section IV.). Indeed, Berger (1998) reported for US bank mergers a relative improvement of profit efficiency with very little change in cost efficiency.

Bank Inputs and Outputs

Labour and deposits are considered as bank inputs, with output consisting of loans and securities. This corresponds to the intermediation approach, which, as suggested by Berger & Humphrey (1997), is appropriate for the analysis of entire banks. Fixed capital, off-balance-sheet items and financial equity are included as fixed netputs, i.e. as fixed inputs or outputs. The second fixed netput, off-balance-sheet items, is used as such for two reasons. First, previous studies have shown that this item may have a relatively large influence on the performance of banks. Since the early 1990's, off-balance-sheet activities have increased strongly and, hence, have gained importance. Second, it is virtually impossible to construct a price per unit for these off-balance-sheet items from available data. Thus, in order to avoid estimating unreliable prices,

and yet to be able to use off-balance-sheet items for the estimation of the profit efficiency frontier, this variable is treated as a fixed output.

Efficiency Frontier Technique

The efficiency frontier technique employed to obtain annual estimates of individual bank efficiencies is the stochastic frontier approach, in which the composite error term follows an asymmetric distribution. Although this approach has the drawback of imposing a distribution on the error term (we have applied a truncated normal distribution), it is preferred over nonparametric approaches because they do not allow for random error at all. For each bank, estimates of scale and X-inefficiency have been derived. The X-inefficiency estimates (XE) measure to what extent the bank succeeds in maximising its profitability given the input prices and its output level. Scale efficiency (SE) indicates whether banks operate on, below or above efficient scale. If the scale efficiency estimate is positive, there are economies of scale (SE^E) i.e. the bank can increase its profitability by operating on a larger scale. There are diseconomies of scale (SE^D) if a bank can increase efficiency by decreasing the scale of its operations, i.e. the scale inefficiency estimate is negative. Per definition SE^E is always positive and SE^D is always negative and the further away from zero, the higher the scale inefficiency. Annex A provides a more detailed description of the estimation procedures.

4. *Testing Explanations for the Profit-Structure Relationship: Methodology*

The theoretical explanations for the profit-structure relationship discussed in section II. are classified into efficient-structure hypotheses and market-power hypotheses. We test their validity using a mathematical formulation based on Berger & Hannan (1997).

Testing the Efficient-Structure Hypotheses

Under the efficient-structure hypotheses, differences in efficiencies explain profitability differences. Once a correction is made for these efficiency differences, market structure variables should have no influence on profitability. Moreover, banks with higher market shares or operating in more concentrated markets should show no superior profitability through price setting, since the use of market power is no source of

higher profitability. When a bank becomes more efficient, it may pass through part of the efficiency gains by changing its prices in favour of its customers. However, the bank is not obliged to do so and prices may also remain unchanged. Higher efficiency should therefore have either no impact or a downward (upward) effect on output (input) prices. These predictions are summarised in equations (1) and (2)[5]. The sub indices i, m and t refer to individual banks, countries and years. Price variables are denoted by P and ϑ represents a white noise error term, added for estimation purposes. Z is a vector of control variables, such as a dummy variable indicating whether a bank is consolidated or not, the loans-to-assets-ratio of banks, gdp growth per country, interest rates and a trend variable.

$$(1) \qquad ROE_{i,t} = f_1(\overset{<0}{XE_{i,t}}, \overset{<0}{SE^E_{i,t}}, \overset{>0}{SE^D_{i,t}}, \overset{0}{Herf_{m,t}}, \overset{0}{MS_{i,t}}, Z_{i,t}) + \vartheta_{1i,t}$$

$$(2) \qquad P_{i,t} = f_2(\overset{\geq 0}{XE_{i,t}}, \overset{\geq 0}{SE^E_{i,t}}, \overset{\leq 0}{SE^D_{i,t}}, \overset{\leq 0}{Herf_{m,t}}, \overset{\leq 0}{MS_{i,t}}, Z_{i,t}) + \vartheta_{2i,t}$$

Besides the influence on profitability and possibly on prices, efficiencies are also expected to have an impact on the market structure variables: market share and concentration (equations (3) and (4)). This is essential to the efficient-structure hypotheses, because it is efficiency that is supposed to drive both market structure and profitability.

$$(3) \qquad MS_{i,t} = f_3(\overset{\leq 0}{XE_{i,t}}, \overset{\leq 0}{SE^E_{i,t}}, \overset{\geq 0}{SE^D_{i,t}}, Z_{i,t}) + \vartheta_{3i,t}$$

$$(4) \qquad Herf_{m,t} = f_4(\overset{\leq 0}{XE_{i,t}}, \overset{\leq 0}{SE^E_{i,t}}, \overset{\geq 0}{SE^D_{i,t}}, Z_{i,t}) + \vartheta_{4i,t}$$

Testing the Market-Power Hypotheses

Market-power hypotheses claim that there is a direct causal relationship between market structure and profitability, even after controlling for other variables. If the market structure variables have an impact on profitability, these other variables (including efficiency) may also influence profitability. The profitability and price equations used to test these hypotheses (equations (1*) and (2*)) are the same as in the tests of the

[5] The signs in equations (2) and (2*) are based on output prices. For the price of deposits, which is an input price in the intermediation approach, the signs should be reversed.

efficient-structure hypotheses above, but with different coefficient predictions.

$$(1^*) \qquad ROE_{i,t} = f_{1*}(\overset{\leq 0}{XE}_{i,t}, \overset{\leq 0}{SE}^{E}_{i,t}, \overset{\geq 0}{SE}^{D}_{i,t}, \overset{>0}{Herf}_{m,t}, \overset{>0}{MS}_{i,t}, Z_{i,t}) + \vartheta_{1*i,t}$$

$$(2^*) \qquad P_{i,t} = f_{2*}(\overset{\geq 0}{XE}_{i,t}, \overset{\geq 0}{SE}^{E}_{i,t}, \overset{\leq 0}{SE}^{D}_{i,t}, \overset{>0}{Herf}_{m,t}, \overset{>0}{MS}_{i,t}, Z_{i,t}) + \vartheta_{2*i,t}$$

In addition to these relations, the strictest versions of market-power hypotheses claim that there is no causal relation from efficiency to market structure. The reverse, no causal relationship from market structure to efficiency might also be true. In fact, these reversed relationships can be used to test the quiet life hypothesis, being a special case of the market-power hypotheses. This theory claims that because of more market power, management becomes less focused on efficiency, resulting in a negative relationship between market power and efficiency, as stated in equations (5), (6) and (7).

$$(5) \qquad XE_{i,t} = f_{3*}(\overset{\geq 0}{Herf}_{m,t}, \overset{\geq 0}{MS}_{i,t}, Z_{i,t}) + \vartheta_{3*i,t}$$

$$(6) \qquad SE^{E}_{i,t} = f_{4*}(\overset{\geq 0}{Herf}_{m,t}, \overset{\geq 0}{MS}_{i,t}, Z_{i,t}) + \vartheta_{4*i,t}$$

$$(7) \qquad SE^{D}_{i,t} = f_{4**}(\overset{\leq 0}{Herf}_{m,t}, \overset{\leq 0}{MS}_{i,t}, Z_{i,t}) + \vartheta_{4**i,t}$$

5. *Testing Explanations for the Profit-Structure Relationship: Empirical Results*

Table 4 reports the estimation results for equations (1) to (7) in order to test the efficient-structure and market-power hypotheses[6]. Equation (1) provides evidence for a negative relationship between X-inefficiency and ROE, supporting the efficient-structure-X-efficiency hypothesis. The fact that market structure variables are insignificant when included simultaneously with efficiency variables corroborates that the efficient-structure-X-efficiency hypothesis serves as an explanation of the profit-structure relationship. These results provide no empirical support for a positive relationship between ROE and market structure variables. However, using ROA as a measure of profitability, a significant positive rela-

[6] The equations are estimated by ordinary least squares regressions, assuming linearity for the functions f_1 to f_{4**}. For clarity of exposition, table 4 only reports coefficients relevant for the hypotheses tests.

tionship between profitability and the Herfindahl index is found as well as a significant negative coefficient for X-inefficiency. These results are in line with the findings of Goddard, Molyneux & Wilson (2001). The explanatory power of the ROA equation, though, is low compared to the ROE equation. Moreover, the difference with the estimation results without controlling for efficiency in section III.2 supports the importance of X-efficiency in the profit-structure relationship. The magnitude and significance of the Herfindahl index has diminished considerably as a result of the inclusion of efficiency variables. The estimates of equation (1) fail to support the efficient-structure-scale efficiency hypothesis and the relative-market-power hypothesis and therefore these hypotheses are rejected.

The estimates for the price relations generally support the efficiency hypotheses. Both output prices are positively related to the level of X-inefficiency, providing further support for the efficient-structure-X-efficiency hypothesis, whereas the positive coefficient on deposit prices is not in line with this hypothesis. The negative coefficient for MS in the output price equations contradicts price-setting behaviour, but leaves the validity of the efficient-structure-X-efficiency hypothesis unchanged[7]. The structure-conduct-performance hypothesis is not supported by the estimates of the output price equations, as the Herfindahl index has no influence on output prices, but does receive support from the input price equation. So, the empirical results indicate that market power is only exercised through the price of deposits, if exercised at all. Concerning the estimates of equations (3) and (4), they broadly correspond to the expectations formulated for the efficient-structure-X-efficiency hypothesis. With regard to the quiet life hypothesis, the equations (5) to (7) do not support this theory. The estimated relationships between the different types of inefficiency and the market structure variables mainly result in significant coefficients that have a sign contradicting the supposed positive influence of increased market power on inefficiency. In addition, the price equations fail to convincingly support price setting, as most of the estimated coefficients are either insignificant or have the wrong sign. All in all, the estimates reveal enough conflicting evidence to reject the quiet life hypothesis.

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[7] The significant finding of MS in the output price equations is not an artefact of the correlation between market share and the efficiency variables. Estimating the same equations without the efficiency variables yields qualitatively the same results.

Table 4

Estimation Results for Equations (1) to (7)

Independent variable	Dependent variable									
	ROE (1)/(1*)	ROA (1)/(1*)	P_{loans} (2)/(2*)	$P_{securities}$ (2)/(2*)	$P_{deposits}$ (2)/(2*)	MS (3)	Herf (4)	XE (5)	SE^E (6)	SE^D (7)
XE	–0.7662**	–0.0371**	0.0642**	0.0499**	0.0835**	–0.0095**	–0.0028			
	(–22.344)	(–19.195)	(9.048)	(8.978)	(12.105)	(–6.579)	(–1.44)			
SE^E	5800.86	62.6005	51363.11**	36649.28**	1849.757	–3750.137**	4653.879**			
	(0.835)	(0.085)	(15.096)	(16.085)	(0.744)	(–7.945)	(2.432)			
SE^D	–87689.17**	–6470.852**	–65341.7**	–51187.56**	–75642.22**	7265.152**	10855.88**			
	(–1.984)	(–2.814)	(–6.558)	(–5.981)	(–5.162)	(3.786)	(2.683)			
Herf	–0.0233	0.009**	–0.0214	0.0061	–0.0258**			–0.0309	3.93E–7**	6.15E–8**
	(–0.746)	(2.846)	(–1.293)	(0.525)	(–2.152)			(–0.629)	(3.012)	(2.959)
MS	0.0909	–0.0341**	–0.1063**	–0.088**	0.0035			–0.8208**	–8.57E–7**	1.30E–7**
	(1.813)	(–7.289)	(–4.762)	(–5.253)	(0.205)			(–8.45)	(–8.647)	(5.172)
Adj. R^2	0.6471	0.3955	0.4243	0.4551	0.4200	0.1152	0.1156	0.0731	0.0686	0.0447

Note: Coefficients significant at the 5% level are marked by **; T-values are reported in parentheses.

6. Discussion

Our empirical results support the efficient-structure-X-efficiency hypothesis. Some support, though less convincing, is also found for the structure-conduct-performance hypothesis. No empirical evidence is found for the remaining hypotheses. Table 5 summarises our results together with findings of a selection of recent other studies, which explored the profit-structure relationship. All results are based on regressions using profit and efficiency measures and market structure variables. The studies in which Berger was involved focus on the US, whereas the other studies analyse European banks. Moreover, the analyses of Molyneux & Thornton (1992) and Altunbas & Molyneux (1994) do regress bank profitability on market structure variables without including specific calculated efficiency measures. In fact, Altunbas & Molyneux interpret market share as a measure of efficiency and conclude that both market concentration and bank efficiency are determinants of bank profitability. This illustrates that a fair discrimination between the several theories is not possible without the use of efficiency measures other than market structure variables.

Only one study shows empirical support for the efficient-structure-scale efficiency hypothesis. This may, however, also interrelate with difficulties in the measurement of scale efficiencies. Based on our results the quiet-life hypothesis seems not to be supported by European data, whereas two studies using American data do report empirical support for this hypothesis. With regard to the other market-power hypotheses the results are mixed. Summarising, the balance between support and lack of support, if tested, is most favourable for the efficient-structure-X-efficiency hypothesis.

IV. Bank Mergers and the Profit-Structure Relationship

The present section examines the effects of bank mergers on profitability, efficiency and prices (section IV.1.), discusses whether these effects comply with the profit-structure hypotheses (section IV.2.) and ends with a summary of the results on bank mergers (section IV.3.).

1. Merger Effects on Bank Performance

The effects of bank mergers are assessed using data from the year prior to and the two years following the year of a merger. Pre-merger

Table 5

Recent Studies on Hypotheses Explaining the Profit-Structure Relationship

Study	Sample countries and period	SCP	RMP	QL	ESX	ESS
Berger (1995)	US, 1980–1989	–	+	NT	+	–
Berger & Hannan (1997)	US, 1980–1989	+	–	+	–	–
Berger & Hannan (1998)	US, 1980–1989	NT	NT	+	NT	NT
Molyneux & Thornton (1992)	18 European countries, 1986–1989	+	NT	NT	NT	NT
Altunbas & Molyneux (1994)	19 European countries, 1988	+	+	NT	NT	NT
Goldberg & Rai (1996)	11 European countries, 1988–1991	–	+	NT	+	–
Goddard, Molyneux & Wilson (2001)	15 European countries, 1989–1996	+	–	NT	+	+
This study	8 European countries, 1992–1997	+/–	–	–	+	–

Note: a '+' marks empirical support for the hypothesis in question, a '–' marks lack of support, and 'NT' means the hypothesis was not tested for.

data of a merged bank are constructed by combining the income statements and balance sheets of the merging banks. The year of the merger itself is not included in the analysis, because this is often a turbulent year, which might give a misrepresentation of the bank's general performance[8]. As the sample period runs from 1992 to 1997, the analysis will concentrate on mergers that took place in 1993, 1994 and 1995. Per merger year two datasets are constructed; one containing banks involved in merger activity in this year and one containing banks that are not involved in mergers[9]. Methodology and empirical results are discussed successively.

Methodology

Pooled observations of merged banks are used to calculate the asset-weighted change in performance variables before and after the merger[10]. Two absolute measures for the change in bank performance are used. The first measure is the performance change from the year prior to the merger to the first year after the merger, and the second is measured as the change from the year prior to the merger to the second year after the merger. Absolute changes in performance do, however, not differentiate between changes in performance due to the merger and changes that are the result of other, e.g. market-wide, factors. Hence, the relative change in performance is calculated to determine changes that can be attributed to mergers by taking the difference between the two- and three-year change of merged banks and non-merged banks.

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8 It is sometimes argued that it is better to analyse mergers by using years even further after the year of the merger, in order to avoid using data containing restructuring noise. Due to limitations of the data set used, we restrict ourselves to the first two years following the merger.

9 To be selected as a merged bank, both the pre-merger banks as well as the post-merger bank have to be present in the data set. As a consequence, mergers in this analysis only involve banks that operate in countries included in the data set. From the subset of non-merged banks, banks involved in a merger during the two years prior to or two years after the year of observation are removed from the set. This results in a separate peer group for each merger year, which represents a balanced panel of non-merged banks.

10 As, from a welfare point of view, banks with a large market share have a larger impact, the performance changes have been asset-weighted.

Empirical Results

Table 6 reports absolute and relative changes for a number of variables, using the year before and the two consecutive years after the merger. The variables considered are return on equity, X-efficiency, scale-efficiency, prices of loans, securities and deposits[11] and the loans-to-assets ratio. The loans-to-assets ratio (L/A) is included because changes in this variable may explain possible changes in profitability. As a bank becomes larger (through a merger), it may be better capable of diversifying its portfolio. This allows the bank to issue relatively more loans, which are considered riskier but also more profitable than securities. The table reports the change in the absolute value of the scale efficiency measure, i.e. scale economies and diseconomies are not treated separately. This change reflects the movement towards or away from zero, which represents an improvement respectively a deterioration of scale efficiency. In fact, SE is then a measure of scale inefficiency.

It appears from table 6 that merged banks have significantly improved their profitability: both in absolute terms as relative to the peer group. The X-efficiency of merged banks has also improved, as X-inefficiency shows a significant decrease over the years surrounding the merger. For merged banks, the X-inefficiency decreased at a higher rate than for the peer group, indicating that by merging, banks succeeded in improving their X-efficiency more than they would have done without merging. Scale efficiency seems to have improved for merged banks (absolutely and relative to non-merged banks), as the average value of the measure moves closer to zero, but these changes are statistically insignificant. All prices, output as well as input, seem to have decreased over the period, but again none of the changes differ significantly from zero. Output prices show a pattern that does not differ from that of the peer group, which indicates that merged banks neither use increased market power, nor pass through any gains realised by the merger to their customers through the setting of output prices. However, on a 10% significance level, the price of deposits does show a significant relative increase for the two-year change, which disappears over the next year as indicated by the insignificant three-year relative change. Thus, there are some indications that merged banks lowered their deposit rates by less than non-merged banks did in the year following the merger. This represents

11 The price of labour is not included, as it is not a price charged or paid to a bank's customers. Hence, there is no theoretical link between market power and the price of labour.

Table 6

Absolute and Relative Changes as a Result of Bank Mergers

	Absolute two-year change	Absolute three-year change	Relative two-year change	Relative three-year change
ROE	0.3135**	0.3313**	0.3036**	0.3282**
	(2.868)	(2.799)	(6.747)	(6.792)
ROA	0.0110**	0.0115**	0.0098**	0.0106**
	(2.737)	(2.200)	(6.013)	(4.999)
XE	–0.1052**	–0.1259**	–0.0877**	–0.1089**
	(–2.390)	(–2.522)	(–4.878)	(–5.349)
SE	–1.3496E-9	–1.3993E-9	–6.739E-8	–1.4907E-8
	(–0.129)	(–0.136)	(–0.14)	(–0.031)
P_{loans}	–0.0024	–0.01488	0.0041	0.0018
	(–0.136)	(–1.204)	(0.825)	(0.358)
$P_{securities}$	–0.005	–0.0132	0.0008	–0.0003
	(–0.499)	(–1.445)	(0.195)	(–0.109)
$P_{deposits}$	–0.0023	–0.0105	0.0101*	0.0065
	(–0.191)	(–0.747)	(2.065)	(1.145)
L/A	0.5589	–0.5570	4.4762**	2.9887*
	(0.195)	(–0.156)	(3.775)	(2.045)

Note: Significant differences are marked by * and ** for 10 % and 5 % significance levels, respectively; T-values are reported in parentheses.

a benefit for suppliers of cash funds, who receive a relatively higher award for bringing their funds to merged banks. This may point to an aggressive strategy to hold and attract depositors after the merger but it may also indicate the need for funds after a merger. The loans-to-assets ratio, which is a measure for the change in the composition of the bank portfolio, shows no significant absolute change for merged banks, but it does show a significant increase relative to non-merged banks. While the overall market tendency apparently has been a decrease in the relative amount of loans in their portfolio, merged banks have succeeded in keeping this ratio stable over the merger process. Thus, the data support the theory that merged banks are able to issue more loans relative to

securities aiming for a better-diversified portfolio with an improved profitability.

2. *Merger Effects and Profit-Structure Hypotheses*

The previous section established that bank mergers appear to be profitable, already in the first year after the merger. This section assesses whether any of the hypotheses explaining the profit-structure relationship can serve as the economic rationale for bank mergers. To this end, the effects of bank mergers on the variables in the previous section are confronted with predictions of the different hypotheses. Methodology and empirical results are discussed successively.

Methodology

Each hypothesis entails its own expectations about the development of key variables after a bank merger. To be accepted as a valid motivation for bank mergers, the changes in the variables considered should comply with the predictions of the hypothesis. Predictions for the qualitative effects of bank mergers on performance are formulated for each of the hypotheses described in section II.

If the efficient-structure-X-efficiency theory is true, mergers should lead to an improvement of X-efficiency, thus providing an economic motivation for bank mergers. This improvement is supposed to cause an increase in profitability. In addition, the hypothesis predicts possible changes in prices. If a bank decides to pass through part of the efficiency gains of the merger to its customers, output prices should decrease and the rate of deposits, which is regarded as an input price, should increase. However, a bank is not obliged to pass through any gains, so prices can also remain unchanged, without conflicting with the theory of the efficient-structure-X-efficiency hypothesis. The predicted effects of bank mergers conform the implications of the efficient-structure-scale efficiency theory are the same as in the efficient-structure-X-efficiency theory, only with scale efficiencies as the determinant of improved profitability instead of X-efficiency.

Under the structure-conduct-performance hypothesis, concentration resembles market power. More market power enables price setting, which causes output prices to be higher and input prices (i.e. deposit rates) to be lower. Because of these price changes, banks will become

more profitable. As mergers increase market share and thus concentration, they should lead to higher output prices, lower input prices and higher profitability in order to accept the structure-conduct-performance hypothesis as the motivation for mergers. The relative-market-power hypothesis follows the same line of reasoning as the structure-conduct-performance hypothesis, with the difference that market share is the explanatory variable instead of concentration. Hence, the predictions based on these hypotheses are qualitatively the same and it is hard to determine which of the two is dominating the other, if these expectations are met. However, in this case, it is clear that the mechanisms through which mergers improve profitability have to be sought within the market power explanations.

The quiet life hypothesis entails somewhat different expectations than the main market-power hypotheses, though the prices are expected to show the same development as under the other market-power hypotheses. However, as it is assumed that management becomes lax with regard to efficiency, either one or both efficiencies are expected to deteriorate. The effect of mergers under the quiet life hypothesis on profitability may be positive, zero and negative as the profitability change depends upon the development of both prices and efficiencies.

Table 7 summarises the predictions for qualitative effects of bank mergers under the different hypotheses. It should be emphasised that the predicted changes in X-efficiency and scale-efficiency are changes in the inefficiency measure, so that the 'minus' for the efficient-structure hypotheses indicates efficiency improvements and the 'plus' for the quiet life hypothesis points to a deterioration of efficiency.

Table 7

Qualitative Effects of Bank Mergers on Performance: Predictions

	ROE/ROA	XE	SE	P_{output}	P_{input}
ESX	+	–		0/–	0/+
ESS	+		–	0/–	0/+
SCP	+			+	–
RMP	+			+	–
QL	?	+	+	+	–

Empirical Results

Table 8 presents the qualitative empirical effects of mergers on bank performance – presented in section IV.1. – for merged banks relative to the peer group of non-merged banks. Comparison of these results with the hypotheses' predictions summarised in table 7 reveals that the empirical results correspond quite well with the predictions of the efficient-structure-X-efficiency hypothesis; both profitability and X-efficiency change in the right direction. The efficient-structure-scale efficiency hypothesis is not supported by the data, as scale efficiency fails to improve because of a merger. The two general market-power hypotheses predict the same changes, as the basic assumption of these hypotheses is that merged banks use gained market power to set prices, with the intention to increase profitability. The prices, however, do not show any significant changes, except for the two-year relative change of the price of deposits, which has the wrong sign. With the absence of price setting by merged banks, the causality that is supposed to run from increased market power through price setting to higher profitability is rejected and therefore both market-power hypotheses are rejected as possible explanations of mergers. The acceptance of the quiet life hypothesis, being a special case of the market-power hypothesis, requires the existence of the same relationship between market power and price setting, only allowing for profitability to show no improvement. Moreover, a deterioration of efficiency is expected. Since neither price setting nor a deterioration of efficiencies is supported by the data, the quiet life hypothesis is rejected as well.

Table 8

Qualitative Effects of Bank Mergers on Performance: Empirical Results

	ROE/ROA	XE	SE	P_{loans}	$P_{securities}$	$P_{deposits}$
Absolute change	+	–	0	0	0	0
Relative change	+	–	0	0	0	+/0

3. Summary

Mergers prove to have significant effects on bank performance. They lead to higher profitability and also to a significant improvement of a bank's level of X-efficiency. In general, scale efficiency and prices

charged and paid by banks seem to be unaffected by mergers. Hence, the empirical evidence corroborates the efficient-structure-X-efficiency hypothesis as a valid theory providing an economic rationale for bank mergers, as this theory predicts that bank mergers lead to improved profitability through higher X-efficiency.

V. Summary and Conclusions

In recent years, there has been a strong, ongoing tendency in the banking sector towards consolidation. In Europe this trend of restructuring is boosted by monetary unification. The rapid changes in the financial services industry bring about questions about the consequences of these developments for customers and the relationship between the structure of the banking industry and bank profitability. Empirical evidence generally points to the existence of a profit-structure relationship in the European commercial banking sector. This study has addressed two important related issues. We test whether possible explanations of the profit-structure relationship in Europe are supported by the data and we discuss whether these explanations give rise to an economic motivation for bank mergers. Our analysis is based on a sample of commercial banks in eight European countries, using an unbalanced panel data set over the period 1992–1997.

Several theories explaining the profit-structure relationship in the European banking sector are tested. The tests are categorised into efficient-structure and market-power hypotheses. The main distinction between these hypotheses concerns the role of efficiency. Efficient-structure hypotheses state that efficient banks are able both to operate more profitably and to increase their market share. This then underlies the profit-structure relationship. On the other hand, market-power hypotheses claim that increased market power enables banks to raise profitability through price setting. To test the hypotheses, X-efficiencies and scale efficiencies of individual banks have been estimated employing a profit function approach. The empirical evidence documented in the present study provides strongest support for the efficient-structure-X-efficiency hypothesis. This suggests that X-efficiency, often interpreted as a measure of management quality, is the dominant factor underlying the profit-structure relationship.

The second part of our analysis concerns the effects of mergers on bank performance. The empirical evidence reveals that merged banks

significantly improve their profitability as well as their X-efficiency, both absolutely and compared to a peer group of non-merged banks. Scale efficiency does not improve and price levels generally do not change relative to non-merged banks. Confrontation of the qualitative effects of mergers on bank performance with the expected effects based on the different efficient-structure and market-power hypotheses reveals that predicted and actual effects match best for the efficient-structure-X-efficiency hypothesis, since merged banks significantly improve their level of both X-efficiency and profitability. This suggests that the efficient-structure-X-efficiency theory may provide an economic rationale for bank mergers.

The existence of the profit-structure relationship, its explanation and the motivation of bank mergers also have implications for antitrust legislation. Antitrust legislation aims at protecting consumer interests by controlling concentration movements. Increasing market shares and market concentration enlarge the market power of banks, which they might use to increase profitability. According to this study there is at best weak evidence of abuse of market power through unfavourable price setting behaviour by banks and there is no empirical evidence of this behaviour after bank mergers. On the other hand, there is also no evidence of merged banks passing through part of the gains in X-efficiency they realise. All in all, the findings suggest that antitrust legislators should be careful when considering a merger proposal, since disapproving mergers can leave potential social gains unrealised. It seems plausible, though, that there is a level of concentration beyond which a further increase will limit competitive forces in such a way that it becomes a threat to social welfare. It is hard to determine at what level this might happen, especially because it does not seem to have been reached yet in any of the countries investigated. A complication in determining this critical level is the fact that antitrust legislation has already been active over the period considered. Therefore, it is possible that proposed mergers between large banks that would have had a large impact on market concentration and possibly would make customer's worse off have been prohibited or that existing antitrust legislation discouraged large banks from attempting to merge. Furthermore, issues beyond the scope of our investigation such as the supervision of large international financial institutions and effects of bank mergers on financial stability must be taken into account in considering the merits of bank mergers. Moreover, since the field of the profit-structure relationship in the European banking sector is relatively unexplored, our empirical findings on

the relevance of X-efficiency for the profit-structure relationship may gain weight if the results are corroborated by other studies investigating different data sets[12].

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[12] This is especially the case because the availability and quality of European bank data lags behind American bank data, as the standard regulatory demands on listed companies are weaker in Europe than in the US.

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Annex A: Efficiency Estimation

Estimates for scale efficiency and X-efficiency are obtained using the stochastic frontier approach with a truncated normal distribution (see Aigner, Lovell & Schmidt (1977)). Since profits may be negative, we use a specification without logarithms. The functional specification is based on the Fuss quadratic flexible form function (also used by e.g. Akhavein, Berger & Humphrey (1997), Berger, Hancock & Humphrey (1993)). Input and output prices used are the prices of loans, securities, labour and deposits. The fixed inputs and outputs used are fixed assets, off-balance-sheet items and financial equity. To improve the fit of the estimated profit function we have added several control variables: a dummy variable for consolidated banks, the loans-to-assets ratio, annual GDP-growth, short-term and long-term interest rates, and a trend variable. Estimations are performed using 'Frontier 4.1', an estimation program developed by T. Coelli of the University of New England (Coelli (1996)).

X-efficiency

Estimation of the profit function by maximising its likelihood function gives an estimate of the composite error term for every individual bank and every year in the sample. The efficiency error term can be extracted

from the composite error term by using the conditional expectation of the efficiency error component (see Stevenson (1980) and Greene (1993)). This conditional expectation of the efficiency error component, measured in after-tax profit per price of deposits per equity is multiplied by the price of deposits, resulting in an inefficiency measure that is denominated in after-tax profit per equity. This gives a direct, intuitively interpretable measure of inefficiency. The measure of X-efficiency, employed in this study has to our best knowledge not been used in combination with profit efficiency yet. Allen & Rai (1996) use a similar measure of X-inefficiency, based on a translog cost function.

Scale Efficiency

To estimate bank-specific scale efficiency levels prices are replaced by quantities in the profit function. The scale efficiency is derived from the partial derivatives of the profit function with respect to output quantities. The derivatives are multiplied by the price of deposits. This measure gives the marginal profitability of each output, reflecting the change in return per dollar equity as a result of a one-dollar increase in this output. To estimate the combined scale efficiency for a bank, the weighted average of the two marginal profitability measures is calculated, using the output quantities as weights, keeping the output mix constant. This measure for scale efficiency gives the local marginal profitability of a bank, which resembles the potential gain or loss in return on equity per one-dollar increase in output.

Summary

The Profit-Structure Relationship and Mergers in the European Banking Industry: An Empirical Assessment

Empirical research provides evidence of a relationship between market structure and profitability in the European banking sector. This paper tests several market-power and efficient-structure theories, which might explain the profit-structure relationship. These tests reveal that X-efficiency is the crucial factor underlying the profit-structure relationship because it enables banks to improve both profitability and market share. Bank mergers in recent years appear to have been successful because, on average, X-efficiency and profitability have improved after the consolidation. Moreover, there are no indications of unfavourable price setting behaviour as a result of increased market power. (JEL G14, G21, G34, L11)

Zusammenfassung

Gewinnstrukturbeziehungen und Fusionen im europäischen Bankensektor: Eine empirische Untersuchung

Die empirische Forschung liefert den Beweis für eine Beziehung zwischen Marktstrukturen und Rentabilität im europäischen Bankensektor. In diesem Beitrag werden diverse Marktmacht- und Effizienzstrukturtheorien untersucht, mit denen sich Gewinnstrukturbeziehungen erklären lassen. Aus diesen Untersuchungen geht hervor, dass die X-Effizienz der den Gewinnstrukturbeziehungen zugrunde liegende ausschlaggebende Faktor ist, durch die die Banken in die Lage versetzt werden, sowohl ihre Rentabilität als auch ihre Marktanteile zu vergrößern. In den letzten Jahren scheinen Bankenfusionen deshalb erfolgreich gewesen zu sein, weil sich X-Effizienz und Rentabilität nach der Konsolidierung im Durchschnitt verbessert haben. Ferner gibt es keine Anzeichen für ein ungünstiges Preissetzungsverhalten aufgrund erhöhter Marktmacht.

Résumé

La relation entre le rendement et la structure de marché et les fusions dans l'industrie bancaire européenne: une évaluation empirique

Des recherches empiriques montrent l'évidence de la relation entre la structure de marché et la rentabilité dans le secteur bancaire européen. Cet article teste plusieurs théories du pouvoir du marché et de la structure de l'efficience; celles-ci pourraient expliquer la relation entre le rendement et la structure. Ces tests révèlent que l'efficience X est le facteur crucial à la base de la relation entre le rendement et la structure. En effet, celle-ci permet aux banques d'améliorer autant leur rentabilité que leur part de marché. Les fusions bancaires des dernières années semblent réussies car, en moyenne, l'efficience X et la rentabilité se sont améliorées après la consolidation. De plus, il n'y a aucune indication de comportement défavorable à la fixation des prix comme résultat du pouvoir accru du marché.