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Market Structure, Scale Efficiency, and Risk as Determinants of German Banking Profitability

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Market Structure, Scale Efficiency, and Risk as Determinants of German Banking Profitability

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Abstract

The Scale-Efficiency version of the Efficient-Structure Hypothesis and the Structure-Conduct-Performance Hypothesis find empirical support in German banking data from 1998 to 2002. Due to the acceptance of the two hypotheses and the existence of overall economies of scale, we conclude that German banks may improve their profitability by increasing their asset size and/or by consolidation. The increased banking profitability will not only come from monopolistic power (higher concentration rate) but also from the scale efficiency benefit. We also find that portfolio risk is a key factor in determining the profit-structure relationship.

Keywords: Profit-structure relationship, Market Structure, Scale efficiency, Portfolio Risk

JEL Classification: C33, G21, G14, L11

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1. Introduction

In a recent paper published by the IMF, Decressin et al. (2003) propose that recent weak bank profitability in Germany appears to be related with *structural factors* rather than the macro-economic cycle. Some anecdotal evidence and financial ratio analyses are also presented to support this claim. The motivation of this paper is to study the issue of bank profitability in a coherent and rigorous econometric framework with a large panel data set of the German banking industry. Another main motivation is to go beyond the factors explored in the IMF paper in explaining why the profitability of the German banking system has been relatively low and trended downwards over recent years. For example, over 20 percent of Germany's commercial banks in the Fitch IBCA database did not earn a rate of return for their owners that exceeded the rate of a risk-free treasury bill[3]. This immediately leads to the question of how the structure and the organization of the German banking system can be changed to safeguard banks' profitability and the sector's stability.

First, we would like to give a brief overview of the German banking system. As shown in Table 1 below, the German banking system is composed of the three following pillars: commercial banks, cooperatives, and public sector banks[4].

[Please insert Table 1]

These three pillars are all different with respect to ownership and objectives. For example, most of ***the public sector banks*** are effectively owned by state and local governments, which operate commercially but also have a public mandate and currently benefit from a government guarantee. The group of public sector banks comprises regional and national development banks, savings banks (Sparkassen), and their state banks (Landesbanken). Since these public sector banks are governed by public law, the mandate of the savings banks (Sparkassen) and state banks (Landesbanken) is to foster the economic development of their regions by following viable business plans. Moreover, public sector banks enjoy the benefits of state guarantees[5] which ensure that public sector banks are able to meet their obligations at any time. Because of these guarantees, public sector banks have the advantage of access to lower-cost funds relative to their lower-rated competitors. Although now the public sector guarantees are

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[3] Decressin et al. (2003) find that this is the case in any of the three years 1997, 1999, and 2001. Another indicator from the OECD suggests that Germany's banking system pre-tax ROA reached about 1/4 percent in 2000-2001, having declined noticeably in the 1990s.

[4] In addition, mortgage banks and building and loan societies (Realkreditinstitute and Bausparkassen) operate in all three sectors. Moreover, the continued operation of the state banks (Landesbanken) is guaranteed by the saving banks (Sparkassen) through the institutional protection scheme.

[5] These guarantees are the "Anstaltslast" (maintenance obligation) and "Gewaehrtraegerhaftung" (liability obligation).

being phased out[6], the removal of state guarantees does not mean that there will be no public support for public sector banks. Particularly the state banks (Landesbanken) are considered *too big to fail*[7]. Moreover, the phase-out of the guarantees will only have a limited impact on the savings banks (Sparkassen), because only few savings banks (Sparkassen) raise funds in capital markets. Savings banks (Sparkassen) predominantly rely on customer deposits and interbank loans for the bulk of their funding needs[8].

The second group in the German banking industry is ***the cooperatives*** (Volksbanken, Raiffeisenbanken, Spar- and Darlehenskassen). This group of banks was founded as self-help organizations for craftsmen, workers and farmers. Cooperative banks concentrate on their respective local markets and do not compete with one another[9]. Since cooperatives concentrate on a specific local clientele, this group of banks have an informational advantage in evaluating the creditworthiness of their local borrowers, and the fact that depositors and borrowers are also mostly owners can reduce moral hazard. However, the disadvantage of this ownership structure and customer base has limited diversification in the cooperative banks' loan portfolios.

Finally, the major part of ***private sector banks*** are commercial banks. Commercial banks comprise the big four banks, which account for roughly two thirds of this sector's business. The private sector banks also include the Postbank[10], foreign banks, and numerous smaller banks. The biggest four commercial banks comprise Deutsche Bank, HypoVereinsbank, Dresdner Bank, and Commerzbank. Like the cooperative banks, they do not benefit from a public sector guarantee, and thus are at a disadvantage relative to the state banks (Landesbanken) in tapping capital markets. Also, the commercial banks run a generous voluntary deposit protection scheme instead of an institution protection scheme. This generous voluntary deposit protection scheme is administered by the commercial bankers' association to enable competition with public banks and cooperatives in deposit-taking. Moreover, commercial banks (including those that do not elect to be members of the voluntary deposit guarantee scheme) have to participate in the less generous statutory deposit protection scheme. Neglect-

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6 On July 18, 2001, the European Commission and the German authorities came to an agreement to abolish the public sector guarantees for the savings banks (Sparkassen) and state banks (Landesbanken). The termination of government guarantees for public sector banks will start in mid-2005

7 Another reason is that the savings banks (Sparkassen) will still have to stand behind the state banks (Landesbanken), because of their institutional protection scheme.

8 The situation for the state banks (Landesbanken) is different, since nearly one third of their liabilities take the form of securities. Because of state guarantee, state banks (Landesbanken) can have better rating from the rating companies.

9 Although some used to focus on certain groups of the population, they are now offering services to everyone across the country.

10 The Postbank, which ranks among the country's postal service, is a joint stock corporation under private law that. The majority of Postbank shares is still held by the Federal Republic of Germany.

ing the different ownership structure, co-operations and public banks exhibit a quite similar behavior.

Generally speaking, from the Fitch IBCA database, we can observe that savings banks (Sparkassen) and cooperatives currently have higher returns on equity than commercial banks.

After reviewing the German banking system, we come back to the argument of how *structural factors* affect German banking profitability. Many propose that the relatively low profitability of the German banking system could possibly reflect that profit maximization is not always the paramount objective of public sector banks and cooperatives. Furthermore, a high number of banks per capita leads to intense competition. For instance, Decressin et al. (2003) point out that competition in Germany appears to be more intense than in the United Kingdom and France. In the following part, we will attempt to find out how the market structure affects banks' profitability by examining a model that can distinguish between three competing profit-structure hypotheses.

Three profit-structure hypotheses have emerged in the banking literature to explain the profit-structure relationship. They are the Structure-Conduct-Performance Hypothesis, the Relative-Market-Power Hypothesis, and the Scale-Efficiency version of the Efficient-Structure Hypothesis. The Structure-Conduct-Performance Hypothesis states that banks set prices that are less favorable to consumers in more concentrated markets because of an imperfect competition. The Relative-Market-Power Hypothesis suggests that only banks with large market shares and well-differentiated products can exercise market power in pricing these products and earn supernormal profits (Shepherd, 1982). Finally, under the Scale-Efficiency version of the Efficient-Structure Hypothesis, all banks have equally good management and technology (the same X-efficiency), but some banks simply produce at more efficient scales than others. Under the scale efficiency version of the Efficient-Structure Hypothesis, since these banks which locate on more efficient scale are also assumed to gain large market shares that may result in high concentration, the positive profit-structure relationship is spurious (Lambson, 1987).

In addition to market structure and scale efficiency, we also consider risk-taking as determinant of banks' profitability. The management of risks has recently been identified as a main rationale for industry consolidation. For instance, Benston, Hunter and Wall (1995) point out that banks mergers and acquisitions may be motivated by a desire to obtain the risk-reducing effects of diversification. Acharva, Hasan and Saunders (2002) find empirical support that geographical diversification results in an improvement in the risk-return tradeoff for banks with low levels of risk. In this study, our consideration is that the risk-taking behavior of financial institutions has in recent years come to the forefront of the debate on the stability of

the banking system (Edwards and Mishkin, 1995)[11]. Our measurement of *risk* is based on the theory of the trade-off relationship between risks and profits. Koch and MacDonald (2003) show that for banks higher returns are generally indicative of above average risks, while lower returns should indicate a lower risk position. At the end of this paper we will discuss the relationship of the profit-structure relationship and risk-taking in greater detail.

The remainder of this paper is structured as follows. Section 2 outlines the functional form and measurement methodologies adopted in this study. Section 3 contains the data description and sources. The following section shows the estimation and results. In a final section, we summarize our findings and give suggestions for the future industrial organization of the German banking sector.

2. Specifications of Models

2.1 Methodology: Scale Economies and the Profit-Structure Relationship

Most previous contributions to the banking literature have tested the profit-structure hypotheses alone by examining the price-concentration relationship without the benefit of efficiency. However, a potential drawback is present because the excluded efficiency variables may be correlated with both prices and market structure. For example, if an efficient bank has lower marginal cost (since this bank locates on the scale efficiency region of the average cost curve), this bank is usually bigger and has larger market share. In such cases, findings will incorrectly support the Structure-Conduct-Performance Hypothesis and the Market-Power Hypothesis. To argue with this point, we modify a model specification from Berger (1995) that nests the three profit-structure hypotheses, including a direct measure of scale efficiency and risk factors. In the following part, we first obtain scale efficiency by estimating the translog cost function.

Scale Economies

Banks' multi-outputs in this paper are measured by the intermediation approach. In our view, the nature of banks is more accurately described as intermediaries of financial services rather than producers of loan and deposit account services, a view taken by the production approach[12]. We assume that domestic banks in Germany aim to minimize costs with profit-maximizing behavior. The translog cost function has the form below:

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[11] Edwards and Mishkin (1995) argue that the erosion of profits due to competition from financial markets can be held responsible for the excessive risk-taking observed in the 1980s in the US.

[12] The production approach usually defines banks' output as the number of deposit of loan accounts or on the number of transactions performed on these accounts.

$$\begin{aligned}\ln TC = {} & \alpha_0 + \sum_{i=1}^{4} \alpha_i \ln Q_i + \sum_{i=1}^{3} \beta_i \ln P_i + \lambda_B \ln B \\ & + \frac{1}{2}\left(\sum_{i=1}^{4}\sum_{j=1}^{4} \delta_{ij} \ln Q_i \ln Q_j + \sum_{i=1}^{3}\sum_{j=1}^{3} \gamma_{ij} \ln P_i \ln P_j + \lambda_{BB} \ln B \ln B \right) \\ & + \sum_{i=1}^{3}\sum_{j=1}^{4} \rho_{ij} \ln P_i \ln Q_j + \sum_{i=1}^{4} \lambda_{bi} \ln B \ln Q_i + \sum_{i=1}^{3} \tau_{Bi} \ln B \ln P_i \\ & + \sum_{i=1}^{3} h_{it} \ln P_i \, t + \sum_{i=1}^{4} k_{it} \ln Q_i \, t + k_{Bt} \ln B \, t + k_t \, t + k_{tt} \, t^2 + \varepsilon \end{aligned} \tag{1}$$

where

ln *TC*	the natural logarithm of the total costs for interest costs, labour cost and capital cost,
Q_i	*i*-th output,
Q_1	total loans which include all class of loans,
Q_2	interbank assets,
Q_3	equity investments,
Q_4	other investments including liquidity investments and other investments,
P_i	*i*-th input prices,
P_1	interest rate = (interest paid / interest-baring total deposits),
P_2	labor expense = (overheads expense / total output),
P_3	capital price = (operating cost / fixed assets),
ln *B*	the natural logarithm of the number of branches,
$\alpha, \beta, \gamma, \delta, \lambda, \rho, \tau, h, k$	coefficients to be estimated.

According to Shephard's Lemma (Christensen, Jorgenson and Lau, 1973), the derived demand for an input can be inferred by partially differentiating the cost function with respect to the input price, P_i. Thus, cost share equations can be generated from the translog cost function (1) as follows:

$$\sum_{i=1}^{3} s_i = \sum_{i=1}^{3} \beta_i + \sum_{i=1}^{3}\sum_{j=1}^{3} \gamma_{ij} \ln P_i + \sum_{i=1}^{3}\sum_{j=1}^{4} \rho_{ij} \ln Q_j + \sum_{i=1}^{3} \tau_{Bi} \ln B + \sum_{i=1}^{3} h_{it} \, t + u_i \, . \tag{2}$$

Since the duality theorem requires the cost function to be linearly homogeneous in input prices, the following restrictions have to be imposed on the parameters of the translog cost function (1):

$$\begin{aligned} & \sum_{i=1}^{3} \beta_i = 1 \, , \\ & \sum_{i=1}^{3} \gamma_{ij} = 0 \qquad \text{for all j,} \\ & \sum_{i=1}^{3} \rho_{ij} = 0 \qquad \text{for all j,} \\ & \sum_{i=1}^{3} \tau_{Bi} = 0 \, . \end{aligned} \tag{3}$$

Further, the second order parameters of the translog cost function (1) must satisfy the symmetry condition.

$$\delta_{ij} = \delta_{ji} \quad \text{and} \quad \gamma_{ij} = \gamma_{ji} \quad \text{for all i, j.} \tag{4}$$

The translog cost function (1) is estimated jointly with the cost share equation (2) using the seemingly unrelated regression estimation (SURE) technique. Since the input cost share equations will sum to unity, one cost share equation should be omitted from the estimated system of equations to avoid the problem of a singular contemporary covariance matrix of disturbances (Berndt, Hall and Hansman, 1974).

The concept of scale economies is based on the shape of the average cost curve. For instance, economies of scale are present up to the level where the long-run marginal cost (LMC) curve lies below the long-run average cost (LAC) curve. By following Molyneux et al. (1997) and Noulas et al. (1990), we estimate overall economies of scale for each bank by evaluating equation (5) to examine how changes in scale affect total cost.

$$OES = \sum_{i=1}^{4} \frac{\partial \ln TC}{\partial \ln Q_i} \tag{5}$$

If $OES < 1$, there are increasing returns to scale, i.e. economies of scale exist. If $OES = 1$, constant returns to scale exist. If $OES > 1$, there are decreasing returns to scale. The existence of scale economies means that the average cost of producing a product, in the long run, decreases as more of the output is produced.

The Profit-Structure Relationship

The relationship between market structure and the profitability of banks is of concern to bank managers and to banking regulators. Particularly, the banking regulators have to weigh the potentially beneficial effects of mergers on the combined banks' profitability and viability against the possible detrimental impact on consumer welfare. For example, increased competition from financial deregulation in the banking sector may force banks to invest into higher yielding assets by increasing their risk exposure beyond a reasonable level. Based on this consideration, we will pay particular attention to the delicate balance between profitability and risk. We incorporate aspects of banks' ex-post risk-taking behavior into a framework developed by Berger (1995) to evaluate alternative theories of the profit-structure relationship. Our modified model is described as follows:

Return on Equity (or Return on Assets)

$$ROE \text{ (or } ROA) = f_1 \text{ (concentration rate, market share, scale efficiency, portfolio risk)} + \varepsilon, \quad (6)$$

Concentration rate

$$CONC = f_2 \text{ (scale efficiency)} + \varepsilon, \quad (7)$$

Market share

$$MS = f_3 \text{ (scale efficiency)} + \varepsilon. \quad (8)$$

All three hypotheses, the Structure-Conduct-Performance Hypothesis, the Market-Power Hypothesis and the Scale-Efficiency version of Efficient-Structure Hypothesis, are represented by different variables. The major equation (6) is shown to be a valid reduced form for all of the hypotheses and any or all of them may be found to be consistent with the data. For instance, if the Structure-Conduct-Performance Hypothesis holds, the coefficient of concentration is significant and positive, but the coefficient of market share is not in this case. This result indicates that the positive profit-concentration relationship occurs because concentration affects price and price affects profit. On the other hand, if the coefficient of market share is positive and significant, but the other coefficients are not, the Relative-Market-Power Hypothesis holds. Under the Relative-Market-Power Hypothesis, market share becomes the key exogenous variable since banks with large market shares have well-differentiated products and are able to exercise market power in pricing these products.

By contrast, if the Scale-Efficiency version of Efficient-Structure Hypothesis is accepted, the coefficient of the scale efficiency variable will be positive and significant. An important limitation of the reduced-form profit equation in (6) is that it tests only one of the three necessary conditions of the Efficient-Structure hypotheses. In order to explain the profit-structure relationship spuriously, two more conditions (eq. 7 and eq. 8) should be met, since both profits and the market structure variables (concentration rate and market share) must be positively related to the variable of scale efficiency. For instance, equation (8) means that more efficient firms have greater market shares. This can be explained by the fact that more efficient banks obtain greater market share through price competition or through acquisition of less efficient banks.

Finally, because of the assumed trade-off relationship between risks and returns, the impact of the risk factors on the profit-structure relationship will be studied by incorporating portfolio risk. In this study, our portfolio risk is measured by earnings variability which is the same method as used by Kwan (2004). Modern Portfolio Theory can be applied to banks, which hold different portfolios of assets by time. For example, banks can obtain a combination of risk and return that is better than can be obtained by holding assets that have a high positive correlation.

3. Data Description and Sources

3.1 The Data Resources

The data resources were individual banks' balance sheets and income statements obtained from the Fitch IBCA database from 1998 to 2002. The data on branch numbers for German banks were gathered from Deutsche Bundesbank's "Verzeichnis der Kreditinstitute". Our sample includes the 288 biggest German banks (by asset size), which represent at least 90% of the total loan market in Germany. The sample banks are listed in Appendix 1. Given the chosen intermediation approach, we use four categories of outputs, three kinds of input variables and one control variable in our models. All variables in this study are measured in Euro million dollars. Data from income statements are gathered from 1st of January to 31st of December for each year. Data from balance sheets and the other official reports are obtained on 31st of December for each year. All variables in this paper are defined in the following section.

3.2 Definitions of Variables

Profitability (*ROE or ROA*)

In this study, we employ the pre-tax return on equity and the pre-tax return on total assets as our two profitability indicators. The rate of return on equity is the most appropriate measure of profitability as it is more consistent with the notion that ownership will seek to maximize profits. However, to eliminate the financial leverage effect, we also use the rate of return on total assets as an alternative.

Market share (*MS*) and Concentration (*CONC*) variables

We measure the degree of concentration in the banking sector by using *the size of bank loans,* and rely upon the Herfindahl index (*HERF*) for our econometric analysis. The Herfindahl index[13] of market concentration is calculated as follows:

$$HERF = \sum_{i=1}^{N} \left(\frac{TD_i}{TD} \right)^2 , \qquad (9)$$

where
TD_i bank i's total loans
TD all sample banks' total loans.

[13] When an industry is occupied by only one firm (a pure monopolist), the index attains its maximum value of 1.0. The value declines with increases in the number of firms N and increases with rising inequality among any given number of firms. By squaring market shares, the *HERF* index weights more heavily the values for large firms than for small.

The following Table describes the change of loan market share for the major groups of German banks, and Herfindahl index of market concentration of the German industry from 1998-2001.

[Please insert Table 2]

Not only that Germany has much higher number of banks than France, Italy and Spain[14], but also we can observe from Table 1 that concentration rate in Germany is also much lower than the concentration rate in the US, which is around 20 % (Berger, 1995). Moreover, the extent of consolidation in Germany is lower than that in the global banking industry (Balino et al., 2000; Belaish et al., 2001). However, the concentration rate in Germany has still slightly decreased over time.

Scale efficiency: *S-EFF*^{e} and *S-EFF*^{d}

We obtain scale efficiencies from the major *translog cost function* in the previous case of scale economies. For each bank's output mix and input prices, a U-shaped multi-product average cost curve is traced out and the scale-efficient output vector Y^{se} at the bottom of the U-curve can also be determined. We distinguish between *scale economy efficiency* for banks that are below efficient scale, and *scale diseconomy efficiency* for banks that are above efficient scale.

Thus, we include the scale economy efficiency (*S-EFF*^{e}) variable and the scale diseconomies efficiency (*S-EFF*^{d}) variable to replace the scale efficiency (*S-EFF*) variable, because they may have different implications under the Scale-Efficiency version of the Efficient-Structure Hypothesis. Advocates of the Scale-Efficiency version of the Efficient-Structure Hypothesis argue that banks *in the scale economy region* grow larger and more profitable and at the same time increase their market share and their market's concentration rate rises, creating the spurious *positive* profit-structure relationship. In contrast, banks in the scale diseconomy region *shrink* to increase scale efficiency and profits. If dominant firms shrink, it would reduce the concentration rate. These relationships can be written as follows:

$$S\text{-}EFF^e = \begin{cases} S\text{-}EFF & \text{if} \quad Y < Y^{se} \\ 1 & \text{if} \quad Y \geq Y^{se} \end{cases}, \tag{10}$$

[14] The data source is OECD Bank Profitability (2002). In 2001, Germany had 2,370 banks, while France, Italy, and Spain had 1,067, 821 and 281 banks, respectively.

$$S\text{-}EFF^{d} = \begin{cases} 1 & if \quad Y < Y^{se} \\ S\text{-}EFF & if \quad Y \geq Y^{se} \end{cases}. \tag{11}$$

Indicator of portfolio risk

In Kwan's (2004) study about risk and returns of publicly held versus privately owned banks, risk is measured by loan portfolio quality or earnings variability. The author finds that the results for the two measurements are statistically indistinguishable. Because of data availability, we use a simple measure of banks' portfolio risk to shed light on the risk-return tradeoff relationship and our portfolio risk is defined as earnings variability.

In our study, portfolio risk for the *k*-th period is obtained from the standard error of return of asset for *k*, *k*–1, and *k*–2 period. In portfolio theory, portfolio risk is usually defined as the standard deviation of the probability distribution of asset returns.

Finally, we summarize the definitions and statistics of all variables in the following Table 3 and Appendix 2.

[Please insert Table 3]

4. Estimation and Results

Different from most of previous studies, we use a panel data set instead of single year data to investigate scale economies and the profit-structure relationship of the German banking industry. Although positive serial correlation and heteroscedasticity will still exist, using panel data enables us to investigate the relationships between *temporal changes* and *cross-sectional differences*. We employ the seemingly unrelated regression estimation (SURE) technique, which is particularly useful with large panel data sets (Avery, 1977) to estimate several equations simultaneously. In this specific error components model, the regression errors in each equation are assumed to be composed of three independent components – one component associated with time, another with cross-sectional units, and a third with each observation.

$$u_{jnt} = \mu_{jn} + v_{jt} + \varepsilon_{jnt} \tag{12}$$

The model developed above makes the assumptions that both within and between equation error covariances are composed of independent individual, time period, and observation components, and the covariances of all three components are non-zero. Mahajan, Rangan, Zard-

koohi (1996) and Hunter and Timme (1986) also use seemingly unrelated regression estimation (SURE) to analyze the panel data for the translog cost function system of banks.

4.1 Results of the scale economies

Since we will include the direct measure of scale economies in the specification model of the profit-structure relationship model, we summarize all empirical results from our translog cost function system here.

Translog Cost Function System

From the following Table 4, we find that the coefficient of branch number (B) is positive and significant. According to the coefficients of all outputs, we may infer that, producing one more unit of interbank assets (Q_2) will cost German banks much more than producing the other three outputs: total loans (Q_1), equity investment (Q_3) and other investments (Q_4). Since the coefficient of time (t) is significantly negative, this may imply that *technology* (e.g. computer, software of exchange system, information system and so on) has helped German banks to reduce their total costs over time.

[Please insert Table 4]

Overall Economies of Scale

We obtain an average value of overall economies of scale for the German banking industry of 0.5812 (refer to Table 5). This empirical result means that from *a cost standpoint*, German banks can obtain the benefit from overall economies of scale by increasing their bank asset size. This conclusion is the same as the results from studies cited in the literature review of Molyneux et al. (1997), although the value is smaller[15]. However, this difference can be explained by the choice of a completely different data set, sample period, number of outputs and definitions of outputs and inputs[16]. For example, based on the choice of our sample set, there is a wide range of asset sizes within the 298 biggest German banks and until the 298th banks, quite a lot of small asset size banks are included. This will also affect the shape of the translog cost function.

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[15] For example, the average value of overall economies of scale from Molyneux et al. (1997) is 0.70.

[16] For example, our labour cost is defined as overheads expense / total outputs. Molyneux et al. (1997) define labor cost as the average annual wage per employee.

[Please insert Table 5]

Furthermore, we make use of separate samples to provide us with a comprehensive treatment of the banking industry and determine whether the results are stable across environments. From Table 5, we can see the average values of overall economies of scale of public sector banks, private sector banks and cooperative sector banks are 0.5493, 0.7484 and 0.5741 respectively. The values of overall economies of scale are all significantly different from one and our results show that all three groups are all able to obtain the benefit from overall economies of scale.

4.2 Results for the Profit-Structure Relationship

In this section, we investigate the three profit-structure hypotheses as competing explanations of the observed variation in bank profitability. Our specification model includes the equations (6), (7) and (8) where return on equity/ return on assets are used as profitability indicators. In contrast to previous banking studies, we add portfolio risk into major equation (6). We note that the adjusted R^2 of the major equation (6) is considerably raised from 3.56% to 33.08%. (Please refer to Table 6 and Appendix 3.) Since the previous banking literature have obtained adjusted R^2 for the major equation ranging from 3% to 21% (Berger, 1995) without considering portfolio risk in the profit-structure relationship, our empirical evidence may support the notion that portfolio risk plays an important role in determining German banking profitability.

[Please insert Table 6]

After we add portfolio risk into the major equation (6), the market share coefficient in the major equation (6) is still negative and significant at the 10 % critical level which, again, suggests that the Relative-Market-Power Hypothesis is rejected. However, we have several new findings. First, the coefficient of the concentration rate is positively related to return on equity and becomes significant at the 5% critical level in the major equation (6). This result means that there is a positive profit-structure relationship in the German banking industry. The implication is that German banks could achieve a higher profitability (return on equity) if the German banking market was more concentrated. However, the drawbacks of such a hypothesis should not be neglected. Banking regulators also need to pay attention to protect consumers' benefit, because the acceptance of the Structure-Conduct-Performance Hypothesis indicates that adverse effects of higher concentration on consumer welfare are likely. The Struc-

ture-Conduct-Performance Hypothesis states that banks can set prices that are less favorable to consumers in more concentrated markets because of competitive imperfections.

Since the coefficients of scale efficiency are all positive in equations (6), (7), and (8), the Scale-Efficiency version of Efficient-Structure Hypothesis is still significant after portfolio risk is added. Higher profitability is thus not only derived from monopoly power (a higher concentration rate) but also from the greater scale efficiency. The accepted Scale-Efficiency version of Efficient-Structure Hypothesis shows that German banks can improve their banking profitability by increasing their asset size. In addition, banks would obtain the benefit from scale efficiency by bank mergers or by opening more bank branches.

One more new result is that the coefficient of portfolio risk is significant at the 1% critical level and has the "right" (positive) sign. Lower returns indicate a lower risk position, while high returns are generally indicative of higher average risk. Thus, we can say if a German bank is very conservative and exhibits low ex-post portfolio risk; its profit may be negatively affected. However, portfolio risk should be maintained within in a certain level to assure banks' safety. Furthermore, if we use return on asset as our profitability indicator instead of return on equity, our empirical results in table 7 are similar.

[Please insert Table 7]

Finally we summarize all empirical results on profit-structure relationships in the following Table:

[Please insert Table 8]

5. Conclusions

To answer the questions posed in our introduction, the empirical evidence gathered in this paper shows that *market structure* plays a significant role in determining German banks' profitability. Analysis on a panel of 288 German banks from 1998 to 2002 supports the Structure-Conduct-Performance Hypothesis and the Scale-Efficiency version of the Efficient-Structure Hypothesis. Since the Structure-Conduct-Performance Hypothesis is accepted, we may conclude that a higher concentration rate is likely to bring about a positive effect on German banking industry profitability. However, German banking regulators also need to pay attention to protecting consumers' benefit as further concentration may give banks the ability to set less favourable price for customers. Fortunately, due to the acceptance of the Scale-Efficiency version of Efficient-Structure Hypothesis and the existence of overall economies of scale, the

increased profitability after any consolidation will not only come from the monopolistic power (higher concentration rate) but also from greater scale efficiency.

Another important finding in this paper is that portfolio risk is also a key factor in determining the profit-structure relationship. Incorporating portfolio risk can significantly increase the adjusted R^2 of our specification model. This empirical result indicates that German banks could achieve a higher yield on their assets by taking appropriate portfolio risks. Certainly, appropriate risk management systems still need to be in place. If the latter is not the case and competition becomes too intense, increased risk-taking by banks may even threaten the stability of a country's financial system.

Tables

Table 1: Overview of the German Banking System

(1) Private-sector (non-cooperative) banks

- Commercial banks
- Private sector mortgage banks

(2) Cooperative banks (Genossenschaftsbanken)

- Central institutions
- Credit cooperatives
  (Volksbanken, Raiffeisenbanken, Spar- and Darlehenskassen)

(3) All public sector credit institutions

- Savings banks (Sparkassen)
- State banks (Landesbanken) / Girozentralen
- Public sector mortgage banks
- Special public sector credit institutions

Table 2:

Concentration Rate and Market Shares of the Different Groups of German Banks

	Groups	Composition of Groups	1998	1999	2000	2001	2002
Concentration	German Banking Industry	Sample Banks	0.0428	0.0359	0.0373	0.0354	0.0356
Market Shares in the Loan Market	Saving Banks	Sparkassen	0.1384	0.1284	0.1060	0.1076	0.1078
	State Banks	Landesbanken	0.1957	0.1773	0.1529	0.1580	0.1583
	Cooperative Banks	Volksbanken	0.0314	0.0301	0.0597	0.0585	0.0587
	Private Banks	Commercial Banks	0.6105	0.6106	0.6347	0.6293	0.6296

Source: Calculated by the authors and the data collected from the Fitch IBCA database.

Table 3:

Definitions for All Variables in the Model of Profit-Structure Relationship

Symbol	Definitions
ROA	Ratio of net before-tax income to assets.
ROE	Ratio of net before-tax income to equity.
CONC	Herfindahl index of concentration of loan market
MS	Bank *i* 's share of total market loan.
S-EFF	Scale efficiency can be obtained from the previous case of scale economies.
$S\text{-}EFF^{e}$	Scale economy efficiency: equals *S-EFF* if bank is below efficient scale; equals 1 otherwise.
$S\text{-}EFF^{d}$	Scale diseconomies efficiency; equals *S-EFF* if bank is above efficient scale; equals 1 otherwise.
Portfolio Risk	The portfolio risk is defined as the standard error of the return of assets.

Source: This table is made by the authors.

Table 4:

Empirical Results of the Translog Cost Function System

Coefficient	1998-2001	
Constant	4.9294	(5.6419)
ln Q_1	2.2493*	(1.3106)
ln Q_2	5.9193***	(1.0551)
ln Q_3	2.9771***	(0.5443)
ln Q_4	2.2616***	(0.7793)
ln P_1	0.4128	(0.4703)
ln P_2	0.4080	(0.3643)
ln B	6.0686***	(0.8442)
$(\ln Q_1)^2$	0.4812**	(0.2320)
$(\ln Q_2)^2$	0.1766***	(0.0273)
$(\ln Q_3)^2$	−0.0341*	(0.0193)
$(\ln Q_4)^2$	0.0415	(0.0278)
ln Q_1 · ln Q_2	−0.4346***	(0.1385)
ln Q_1 · ln Q_3	−0.0946	(0.0699)
ln Q_1 · ln Q_4	0.2765***	(0.0934)
ln Q_2 · ln Q_3	0.2724***	(0.0481)
ln Q_2 · ln Q_4	−0.0684*	(0.0371)
ln Q_3 · ln Q_4	-0.0656***	(0.0145)
ln P_1 · ln P_2	−0.2297***	(0.0308)
ln P_1 · ln P_3	0.2114***	(0.0629)
ln P_2 · ln P_3	0.1736***	(0.0484)
$(\ln B)^2$	0.2300*	(0.1310)
ln P_1 · ln Q_1	0.4803***	(0.0706)
ln P_2 · ln Q_1	0.3560***	(0.0547)
ln P_1 · ln Q_2	0.2842***	(0.0443)
ln P_2 · ln Q_2	0.2240***	(0.0341)
ln P_1 · ln Q_3	0.4840***	(0.0165)
ln P_2 · ln Q_3	0.3645***	(0.0130)
ln P_1 · ln Q_4	0.4863***	(0.0224)
ln P_2 · ln Q_4	0.3712***	(0.0174)
ln B · ln Q_1	−0.5149***	(0.1460)
ln B · ln Q_2	0.1623	(0.1035)
ln B · ln Q_3	0.0587*	(0.0317)
ln B · ln Q_4	−0.2281***	(0.0647)
ln B · ln P_1	0.2946***	(0.0439)
ln B · ln P_2	0.2242***	(0.0343)
ln P_1 · t	−3.7326***	(0.0751)
ln P_2 · t	−2.8545***	(0.0578)
ln P_3 · t	−2.0249***	(0.1080)
ln Q_1 · t	0.2129	(0.1540)
ln Q_2 · t	−0.4298***	(0.0872)
ln Q_3 · t	−0.0545	(0.0454)
ln Q_4 · t	0.0253	(0.0531)
ln B · t	0.2819***	(0.1031)
t	−29..5422***	(1.2680)
t^2	−0.0562	(0.1521)
Private	1.3714***	(0.5115)
Cooperative	1.8949***	(0.5298)

Approximate standard error in parentheses;
* significantly different from zero at 10% level;
** significantly different from zero at 5% level;
*** significantly different from zero at 1% level.

Table 5:

Empirical Results of Overall Economies of Scale for German Banks from 1998 to 2002

Groups	Composition of the Group	Value of Overall Economies of Scale
Public Sector Banks	State Banks (Landesbanken), and Saving Banks (Sparkassen)	0.5493*** (0.3627)
Private Sector Banks	Commercial Banks	0.7484*** (0.3951)
Cooperative Sector Banks	Credit Cooperatives	0.5741*** (0.4319)
German Banking Industry	Whole Sample Banks	0.5812*** (0.3774)

Approximate standard error in parentheses;
* significantly different from one at 10% level;
** significantly different from one at 5% level;
*** significantly different from one at 1% level.

Table 6:

Empirical Results of the Profit-Structure Relationship with Cconsidering Portfolio Risk (*ROE* as Indicator of Profitability)

Variable	*ROE* (eq. 6)	*CONC* (eq. 7)	*MS* (eq. 8)
Constant	−0.4129 (3.5316)	0.0376*** (0.0001)	0.0012*** (0.0003)
Concentration Rate	122.6514** (45.5075)		
Market Share	−125.1559*** (30.4661)		
Scale economy Efficiency (*S-EFF*^{e})	0.3945* (0.2153)	0.0002*** (7.86 E-05)	0.0007*** (0.0002)
Portfolio Risk	20.4953*** (1.0959)		
Private Banks	1.9885*** (0.7423)	0.0003 (0.0002)	0.0062*** (0.0007)
Cooperative Banks	0.6942 (0.8022)	0.0006** (00002)	0.0005 (0.0008)
Adjusted R^2	33.08%	1.3%	7.43%

Approximate standard error in parentheses;
* significantly different from zero at 10% level;
** significantly different from zero at 5% level;
*** significantly different from zero at 1% level.

Table 7:

Empirical Results of the Profit-Structure Relationship with Considering Portfolio Risk (*ROA* as Indicator of Profitability)

Variable	*ROA* (eq. 6)	*CONC* (eq. 7)	*MS* (eq. 8)
Constant	−0.1254 (0.1773)	0.0376*** (0.0001)	0.0012*** (0.0003)
Concentration Rate	8.9761* (4.6920)		
Market Share	−3.2274** (1.5300)		
Scale Economy Efficiency ($S\text{-}EFF^e$)	0.0258** (0.0108)	0.0002*** (7.86 E-05)	0.0007*** (0.0002)
Portfolio Risk	1.0062*** (0.0716)		
Private Banks	0.0457 (0.0373)	0.0003 (0.0002)	0.0062*** (0.0007)
Cooperative Banks	−0.0269 (0.0403)	0.0006** (00002)	0.0005 (0.0008)
Adjusted R^2	21.42%	1.3%	7.43%

Approximate standard error in parentheses;
* significantly different from zero at 10% level;
** significantly different from zero at 5% level;
*** significantly different from zero at 1% level.

Table 8:

Summary of Results of Three Profit-Structure Relationship Hypotheses

Profitability Indicator	*ROE*	*ROA*
Structure-Conduct-Performance Hypothesis	Accepted	Accepted
Relative-Market-Power Hypothesis	Rejected	Rejected
Efficient-Structure Hypothesis under Scale-Efficiency Version	Accepted	Accepted
Portfolio Risk	Significant	Significant

Sources: This table is made by the authors.

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Appendix

Appendix 1:
The Sample Banks in this Study: 288 German Banks

1 Deutsche Bank AG
2 Bayerische Hypo
3 Commerzbank AG
4 Dresdner Bank
5 Bayerische Landesbank
6 LBBW
7 WestLB AG
8 Nord/LB
9 Bankgesellschaft Berlin AG
10 Depfa Deutsche Pfandbriefbank AG
11 Landesbank Schleswig-Holstein
12 Landesbank Hessen-Thüringen
13 Deutsche Postbank AG
14 Hamburgische Landesbank
15 Dekabank Deutsche Girozentrale
16 Landesbank Berlin
17 AHBR Allgemeine Hypothekenbank Rheinboden
18 HVB Real Estate Bank
19 Hypothekenbank in Essen
20 Landesbank Rheinland-Pfalz
21 Landwirtschaftliche Rentenbank
22 RHEINHYP Rheinische Hypothekenbank AG
23 DZ Bank AG-Deutsche Zentral-Genossenschaftsbank
24 Eurohypo Europäische Hypothekenbank der Deutschen Bank
25 Deutsche Genossenschafts-Hypothekenbank
26 Westdeutsche Genossenschafts-Zentralbank eG
27 ING BHF-BANK AG
28 Landesbank Sachsen Girozentrale
29 Berlin-Hannoversche Hypothekenbank
30 Westfälische Hypothekenbank AG
31 Deutsche Bank Privat-und Geschäftsbank
32 IKB Deutsche Industriebank
33 Bremer Landesbank Kreditanstalt Oldenburg
34 Bausparkasse Schwäbisch Hall AG
35 SEB
36 Dexia Hypothekenbank Berlin
37 Münchener Hypothekenbank

38 Württembergische Hypothekenbank
39 BHW Bausparkasse
40 Baden-Württembergische Bank
41 Deutsche Hypothekenbank
42 Deutsche Kreditbank
43 Deutsche Apotheker- und Arztebank
44 Stadtsparkasse Köln
45 Vereins-und Westbank
46 Allgemeine Deutsche Direktbank
47 WL-Bank - Westfälische Landschaft Bodenkreditbank
48 SEB-Hypothekenbank
49 Wüstenrot Bausparkasse
50 Frankfurter Kasse
51 Landesbank Saar-Saar
52 Westdeutsche Immobilienbank
53 Nassauische Sparkasse
54 Kreissparkasse Köln
55 Volkswagen Bank
56 Stadtsparkasse München
57 Maple Bank
58 HSBC Trinkaus & Burkhardt KGaA
59 Düsseldorfer Hypothekenbank
60 Berliner Volksbank
61 Die Sparkasse Bremen
62 Schleswig-Holsteinische Landschaft Hypothekenbank
63 Stadtsparkasse Düsseldorf
64 Wüstenrot Hypothekenbank
65 Sächsische Aufbaubank
66 DVB Bank Deutsche Verkehrsbank AG
67 Deutsche Schiffsbank
68 Wüstenrot Bank
69 Sparkasse Aach
70 Debeka Bausparkasse
71 LBS DeutscheWest
72 Stadtsparkasse Hannover
73 Sal. Oppenheim jr. & Cie. KGaA
74 Oldenburgische Landesbank
75 Sparkasse Nürnberg
76 Bayerische Landesbausparkasse
77 Sparkasse Münsterland
78 Sparkasse Essen
79 Kreissparkasse Ludwigsburg
80 Kreissparkasse Esslingen-Nürtingen

81 LBS Baden-Württemberg
82 Dresdner Bank Lateinamerika
83 Sparda-Bank Südwest
84 Landessparkasse zu Oldenburg
85 CC Bank
86 LBS Norddeutsche Landesbausparkasse Berlin-Hannover
87 Kreissparkasse Heilbronn
88 Sparkasse Leipzig
89 Sparkasse Krefeld
90 Sparkasse Pforzheim-Calw
91 Kreissparkasse Waiblingen
92 ABN Amro Bank (Deutschland)
93 Sparkasse Dortmund
94 Kreissparkasse Hannover
95 Kreissparkasse München-Starnberg
96 Sparkasse Mainfranken Würzburg
97 Kreissparkasse Böblingen
98 Lehman Brothers Bankhaus
99 BBBank
100 Sparkasse Bonn
101 Entrium
102 Sparkasse Bielefeld
103 M.M. Warburg & Co.
104 Mittelbrandenburgische Sparkasse
105 Stadtsparkasse Dresden
106 Kreissparkasse Göppingen
107 Citigroup Global Markets Deutschland
108 GEFA
109 Kölner Bank
110 Sparda-Bank Baden-Württemberg
111 Sparkasse Bochum
112 Sparkasse Neuß
113 VR-Leasing AG
114 Sparkasse Osnabrück
115 GMAC Bank GmbH
116 Deutsche Bausparkasse BADENIA
117 Kreissparkasse in Siegburg
118 Frankfurter Volksbank
119 Stadtsparkasse Duisburg
120 Hamburgische Wohnungsbaukreditanstalt
121 BMW Bank
122 Sparkasse Saarbrücken
123 Kasseler Sparkasse

124 Sparkasse Karlsruhe
125 Weberbank Privatbankiers
126 Evangelische Darlehensgenossenschaft
127 Sparkasse Herford
128 Schmidtbank
129 Sparkasse Freiburg-Nordlicher Breisgau
130 Stadtsparkasse Wuppertal
131 Kreissparkasse Biberach
132 Sparkasse Ulm
133 Stadtsparkasse Augsburg
134 Sparkasse Heidelberg
135 Kreissparkasse Tübingen
136 Sparkasse Koblenz
137 Sparkasse Rhein-Neckar Nord
138 Sparda-Bank Berlin
139 Deutsche Bank Bausparkasse
140 Taunus Sparkasse
141 Sparkasse Fürstenfeldbruck
142 Sparkasse Düren
143 Kreissparkasse Ostalb
144 Sparkasse Langen-Seligenstadt
145 Sparkasse Hanau
146 Sparkasse Memmingen-Lindau-Mindelheim
147 Bank für Sozialwirtschaft
148 LBS Ostdeutsche Landesbausparkasse
149 Stadtsparkasse Mönchengladbach
150 Sparkasse Chemnitz
151 Sparda-Bank München
152 Evangelische Kreditgenossenschaft
153 Südwestbank
154 Kreissparkasse Südholstein
155 Sparkasse Aschaffenburg-Alzenau
156 Kreissparkasse Ravensburg
157 Sparkasse Gelsenkirchen
158 Sparda-Bank Hannover
159 Bankhaus Lampe
160 Bankhaus Reuschel
161 Sparkasse Harburg-Buxtehude
162 Kreissparkasse Hildesheim
163 Sparkasse Landshut
164 Sparkasse Kiel
165 Allgemeine Privatkundenbank
166 Ostseesparkasse Rostock

167 Norisbank
168 Sparkasse Offenburg/Ortenau
169 Sparkasse Bamberg
170 Kreissparkasse Reutlingen
171 National Bank
172 Kreissparkasse Saarlouis
173 BHW Bank
174 Deutsche Bank Lübeck
175 Sparkasse Leverkusen
176 Sparkasse Fürth
177 Sparkasse Paderborn
178 Sparkasse Marburg-Biedenkopf
179 Stadt- und Kreissparkasse Erlangen
180 Sparkasse Regensburg
181 Sparkasse Darmstadt
182 Sparkasse Steinfurt
183 Liga Bank
184 Sparkasse Ingolstadt
185 Sparkasse Göttingen
186 Sparkasse Südliche Weinstraße
187 Sparkasse Elbtal-Westlausitz
188 AKB Privat-und Handelsbank
189 PSA Finance Deutschland
190 Sparkasse Ostholstein
191 Sparkasse Trier
192 Mainzer Volksbank
193 Sparkasse Rhein-Nahe
194 Kreissparkasse Borken
195 Sparkasse Vogtland
196 Sparda-Bank Nürnberg
197 Sparkasse Stormarn
198 Landes Bausparkasse Rheinland Pfalz
199 Sparkasse Wetterau
200 Sparkasse Recklinghausen
201 Sparkasse Zollernalb
202 Kreissparkasse Syke
203 Sparkasse Kraichgau-Bruchsal-Bretten-Sinsheim
204 Volksbank Paderborn-Höxter
205 Wiesbadener Volksbank
206 Kreissparkasse Calw
207 Bank im Bistum Essen
208 BHW Allgemeine Bausparkasse
209 Sparkasse Mittelhaardt-Deutsche Weinstraße

210 Sparkasse Mülheim
211 Sparkasse Fulda
212 Bausparkasse Mainz
213 Kreissparkasse Kaiserslautern
214 Nord-Ostsee Sparkasse
215 Sparkasse Lübeck
216 Sparkasse Lüneburg
217 Sparkasse Gifhorn-Wolfsburg
218 Kreissparkasse Herzogtum Lauenburg
219 Sparkasse Celle
220 Sparkasse Lemgo
221 Kreissparkasse Groß-Gerau
222 Sparkasse Siegen
223 Sparkasse Coesfeld
224 Vereinigte Sparkasse Stadt und Landkreis Ansbach
225 Kreissparkasse Augsburg
226 Kreissparkasse Heinsberg
227 Sparkasse Detmold
228 Sparkasse Minden-Lübbecke
229 Kreissparkasse Tuttlingen
230 Volksbank Gießen
231 Sparkasse Hagen
232 Sparda-Bank Frankfurt (Main)
233 Dortmunder Volksbank
234 Stadtsparkasse Magdeburg
235 Sparkasse Schaumburg
236 Westfalenbank
237 Vereinigte Volksbanken eG Böblingen-Calw-Sindel
238 Kreissparkasse Düsseldorf
239 Sparkasse Wetzlar
240 Kreissparkasse Verden
241 Sparkasse Roth-Schwabach
242 Stadtsparkasse Oberhausen
243 Flensburger Sparkasse
244 Sparkasse Passau
245 Falk Bank
246 Volksbank Rhein-Neckar eG
247 Sparkasse Rosenheim
248 Allianz Bausparkasse
249 Sparkasse Bayreuth
250 Volksbank in Stuttgart AG
251 Sparda-Bank Hamburg
252 Kreissparkasse Segeberg

253 Sparkasse Villingen-Schwenningen
254 AKA Ausfuhrkreditanstalt
255 Sparkasse Dieburg
256 Volksbank Bonn-Rhein-Sieg
257 Sparkasse im Landkreis Schwandorf
258 Landesbausparkasse Schleswig-Holstein
259 Stadt und Kreissparkasse Hof
260 Kreissparkasse Wesermünde-Hadeln
261 Berenberg Bank - Joh. Berenberg, Gossler & Co.
262 Stadtsparkasse Solingen
263 Volksbank Pforzheim
264 Sparkasse Neumarkt
265 Sparda-Bank Essen
266 Städtische Sparkasse Bremerhaven
267 Sparkasse Hochrhein
268 Sparkasse Worms
269 Sparkasse Miltenberg-Obernburg
270 Westerwald Bank
271 Sparda-Bank Köln
272 Kreissparkasse Bad Tölz-Wolfratshausen
273 Sparkasse Neu-Ulm lllertissen
274 Sparkasse Amberg-Sulzbach
275 Sparkasse Nienburg
276 Kreissparkasse Euskirchen
277 Sparkasse Neckartal-Odenwald
278 Sparkasse Moers
279 Sparkasse Gütersloh
280 Sparkasse Neuwied
281 Volksbank Hannover
282 Ulmer Volksbank
283 Sparkasse Stade-Altesland
284 Volksbank Freiburg
285 Sparkasse Rotenburg-Bremervoerde
286 Volksbank Göppingen
287 Sparkasse Starkenburg
288 Sparkasse Markgräflerland

Appendix 2:

Descriptive Satistics of Al Vriables from 1998 - 2002[17]

	ROA	*ROE*	*CONC*	*MS*	*Portfolio Risk*	*Capital Risk*
Mean	0.2395	5.6827	0.0378	0.0035	0.0988	4.3384
Median	0.2200	5.4200	0.0360	0.0006	0.0404	4.0900
Maximum	2.7000	81.5300	0.0428	0.1309	2.7062	83.3400
Minimum	-0.5000	-110.0400	0.0355	0.0001	0.0000	0.0081
Std. Dev.	0.2116	7.4201	0.0029	0.0109	0.2064	5.3952
Skewness	4.5742	-5.0515	1.0355	6.7618	5.5260	11.3916
Kurtosis	43.5831	115.1510	2.3042	58.1997	44.5330	157.5438
Jarque-Bera	77808.7300	602824.000	226.9251	53554.9	82813.50	1160153
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	1345	1393	1393	1393	1327	1393

	Q_1	Q_2	Q_3	Q_4	P_1	P_2
Mean	10811.1900	4899.1080	4899.1080	4716.7940	0.0397	0.0174
Median	1961.2000	331.6000	331.6000	741.9000	0.0372	0.0193
Maximum	419300	120259.0	120259.0	415100.0	0.2055	0.0871
Minimum	312.5000	1.00E-06	1.00E-06	1.00E-06	0.0012	3.63E-05
Std. Dev.	34261.1900	16153.8700	16153.8700	20868.7600	0.0140	0.0084
Skewness	6.8475	4.8285	4.8286	13.1717	5.9600	0.3257
Kurtosis	60.5655	27.9954	27.9954	232.3926	61.9586	7.5356
Jarque-Bera	166459.400	34136.2700	34136.27	2534680	172015.6	998.23
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	1393	1393	1393	1393	1393	1393

	P_3	*B*
Mean	0.2949	106.2340
Median	0.0647	43.0000
Maximum	22.2000	14726.0000
Minimum	0.0018	1.0000
Std. Dev.	1.4202	734.8709
Skewness	10.4646	18.5515
Kurtosis	128.8952	355.7600
Jarque-Bera	774341.700	5981513
Probability	0.0000	0.0000
Observations	1393	1393

[17] Skewness is a measure of asymmetry of the distribution of the series around its mean. Positive skewness means that the distribution has a long right tail and negative skewness implies that the distribution has a long left tail.
Kurtosis measures the peakedness or flatness of the distribution of the series. The kurtosis of the normal distribution is 3. If the kurtosis exceeds 3, the distribution is peaked relative to the normal; if the kurtosis is less than 3, the distribution is flat relative to the normal.
Jarque-Bera is a test statistic for testing whether the series is normally distributed. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed as χ^2 with 2 degrees of freedom.
The reported probability is the probability that a Jarque-Bera statistic exceeds the observed value under the null – small probability value leads to the rejection of the null hypothesis of a normal distribution.

Appendix 3:

Empirical Results of the Profit-Structure Relationship without Considering the Portfolio Risk

Variable	*ROE* (eq. 6)	*CONC* (eq. 7)	*MS* (eq. 8)
Constant	3.4921 (4.0356)	0.0376*** (0.0001)	0.0012*** (0.0003)
Concentration Rte	56.9392 (106.8981)		
Market Share	−138.4691*** (35.9735)		
Scale Economy Efficiency (*S-EFF*^{e})	0.6024** (0.2513)	0.0002*** (7.86 E-05)	0.0007*** (0.0002)
Private Banks	4.1190*** (0.8380)	0.0003 (0.0002)	0.0062*** (0.0007)
Cooperative Banks	0.7479 (0.8937)	0.0006** (00002)	0.0005 (0.0008)
Adjusted R^2	3.56%	1.3%	7.43%

Approximate standard error in parentheses;
* significantly different from zero at 10% level;
** significantly different from zero at 5% level;
*** significantly different from zero at 1% level.

In Appendix 3, our result indicates that the Relative-Market-Power Hypothesis is rejected as an explanation of the profit-structure relationship in the German banking market. The Structure-Conduct-Performance Hypothesis does not contribute to illuminating the profit-structure relationship. The Scale-Efficiency version of Efficient-Structure Hypothesis is accepted since the coefficients of scale efficiency are positive and significant in three equations. However, the adjusted R^2 of the equation are very low.