# Competition Structures of the Banking and Securities Industries in Korea

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**Abstract**: The objective of this paper is to provide a comparative analysis of the competition structures of the two main types of financial intermediation in Korea, the banking and securities industries. The competition structure of each collectively determines that of the industry as a whole. Two approaches are adopted: quantitative market concentration measures and a qualitative Panzar-Rosse statistic. Using the former approach, the Korean financial industry appears heavily bank-centered and the banking industry is highly concentrated relative to the securities industry. This has created concerns over possible monopolistic power. Yet market concentration itself is not a sufficient condition for monopoly or monopolistic competition. In fact, in the latter approach, which focuses on players' behaviors as profit maximizers rather than on market concentration itself, the banking industry is found to be more competitive than the securities industry, consistent with Bikker and Haaf (2002). Noteworthy in this regard is that, following the Asian financial crisis, the banking industry was reformed and consolidated to meet international accounting and supervisory codes based on well-defined efficiency and market competition principles while securities industry was

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not. Therefore, the two seemingly contradictory results are not incompatible and, importantly, they hint at the directions that the securities industry may pursue.

## Ⅰ. Introduction

The objective of the paper is to provide a comparative analysis of the competition structures of the two main financial industries in Korea, banking and securities industry. Each sector's competition structure determines the competition structure of overall financial industries. Especially recently financial convergence between different financial areas such banking and securities industries is becoming an obvious trend in Korea as well as in other countries. To achieve financial convergence, it is necessary to perceive competition structures of interested sectors. In Korea, it has been often said that the banking industry is highly concentrated compared to the securities industry. Currently there are nine banks, less than a fifth of the number of securities firms. Asset size of the securities industry, meanwhile, is less than a tenth of that of the banking industry. At end-2008, the total asset size of the banking industry was 171.5 trillion KR Won, while that of the securities industry stood at 14.1 trillion KR Won. Since the Asian crisis in 1997-1998, the number of banks has been slashed from 32 to 8 -including regional banks as well as national banks- while the number of securities firms went from 38 to 42 by end-2008.

As a result, it has been argued that the financial system is too bank-centered and that the government should adopt policies that mitigate the monopolistic aspects of the banking industry to help achieve balanced development between the banking and securities sectors.

Yet it is well known that market share itself is not a sufficient condition for monopoly or monopolistic competition. In order to judge market structures correctly, careful investigation should be taken using rigorous methods that go beyond market concentration measures. We choose to adopt the Panzar- Rosse statistic, which focuses on players' behaviors as profit maximizers rather than on market concentration itself.

In this paper, two types of investigative approaches are suggested: one is a quantitative index, such as the Herfindahl and CR5 (concentration ratio of top 5 firms by market share) and, the other is a qualitative statistic, such as the Panzar-Rosse statistic proposed by Panzar and Rosse (1987).

If a market is competitive, the Herfindahl and CR5 indices approach zero while the Panzar-Rosse statistic approaches one. If a market is not competitive, the former approaches one while the latter statistic is zero. If a market has a higher value of both indices and of the statistic, however, then any firm behaves as a competitive firms, even though it may have higher market concentration.[1]

Before going further, we shall briefly review previous studies. Kim (2002) measures the market concentration of the banking industry from 1995 to 2001, finding that it increased through the Asian crisis, creating some concerns regarding the monopolistic powers of banks in the financial market. He suggests that policies to mitigate the high concentration ratio are necessary.

Shin (2007) investigates the market competition structure of the banking industry from 1997 to 2006, adopting the Panzar-Rosse approach. He finds that the market structure of the industry does not have serious monopolistic problems, even though market shares rose following the Asian crisis. However, Shin only analyzes the banking industry. Lee (2003) found that market structure got more competitive between 1992 and 2002, citing the fact that banking business structures diversified into non-banking

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1. This is the case in the contestable market.

services as well.

According to Bikker and Haaf (2002), banking industry market structures are estimated as monopolistic competition in many countries, such as the U.S., Canada, France, Germany, Spain, the U.K., Switzerland, Italy, Japan and Korea. In particular, large banks behave more competitively than small banks, which is the same result found by De Bandt and Davis (2000). Bikker and Haaf (2002) implies that market competition structure is not proportionate to the size or market share of banks. Large banks are exposed to competition with foreign banks, as well as with domestic banks. Small banks, however, are not necessarily competing with foreign banks since they pursue domestic niche markets, exploiting, for example, regional characteristics.

As shown in <Table 1>, the mean estimate of the Panzar-Rosse statistic in Bikker and Haaf (2002) is 0.69, and the estimate for large banks is 0.85, which are very similar values to the 0.68~0.75 estimated in our study shown in <Table 5-1>~<Table 5-2>. The mean estimate for small banks in Bikker and Haaf is 0.64, far less than that of large banks.

This paper consists of five sections. Section Ⅱ presents estimates for the Herfindahl and CR5 indices. Section Ⅲ derives alternative simpler version of the Panzar-Rosse statistic based on profit maximizing objective functions, rather than the revealed preference theory used in Panzar and Rosse (1987). Section Ⅳ suggests estimation results for the Panzar- Rosse statistic. Lastly, section Ⅴ offers some concluding remarks.

***Table 1.*** International Comparison of Panzar-Rosse Statistic

| country | total banks | small banks | large banks |
|---|---|---|---|
| Australia | 0.50 | -0.14 | 0.63 |
| Austria | 0.87 | 0.93 | 0.91 |
| Belgium | 0.89 | 0.95 | 0.86 |
| Canada | 0.60 | 0.74 | 0.56 |
| Denmark | 0.32 | 0.31 | 1.16 |
| Finland | 0.78 | 0.67 | 0.70 |
| France | 0.70 | 0.54 | 0.89 |
| Germany | 0.60 | 0.56 | 1.05 |
| Greece | 0.76 | 0.41 | 1.01 |
| Ireland | 0.65 | 0.99 | 0.93 |
| Italy | 0.82 | 0.75 | 0.83 |
| Japan | 0.58 | 0.43 | 0.64 |
| Korea | 0.68 | - | 0.77 |
| Luxembourg | 0.93 | 0.94 | 0.90 |
| Netherlands | 0.75 | 0.74 | 0.91 |
| New Zealand | 0.86 | - | 0.86 |
| Norway | 0.74 | 0.80 | 0.66 |
| Portugal | 0.83 | 0.84 | 0.91 |
| Spain | 0.55 | 0.56 | 0.61 |
| Sweden | 0.80 | 0.84 | 0.95 |
| Switzerland | 0.55 | 0.51 | 1.01 |
| UK | 0.61 | 0.41 | 1.20 |
| US | 0.54 | 0.61 | 0.68 |
| mean | 0.69 | 0.64 | 0.85 |

Source: Bikker and Haaf (2002)

## Ⅱ. Market Concentration Ratios

The Herfindahl index is defined as

(1) $$\sum_{i=1}^{n} s_i^2$$

where $s_i$ is the market share of each institution given $n$ number of institutions. If $n$ number of firms have equal market share $1/n$, then $H = 1/n$. If there is only a single firm in the market, $H = 1$.

Since the index defines market competition structures based on a market concentration scale, a market with a small number of players is always perceived as non-competitive, even though it is actually a contestable market. Therefore, it should be noted, when interpreting estimation results, that a higher value Herfindahl index estimate does not itself necessarily imply monopolistic power.

As indicated in <Table 2>, the Herfindahl index for banks in 2000 was 0.077, but increased to 0.101 by 2007. However, the index for securities firms was 0.060 in 2000, but decreased to 0.057 in 2007. These results reflect the fact that the banking industry was restructured, with frequent M&A activity since the Asian crisis, so that the number of banks decreased sharply. The securities industry, meanwhile, has not been restructured through such an M&A, and the number of securities firms has been rather increased than decreased.

The CR5 index shows similar result as the Herfindahl index as indicated in <Table 3>. For the banking industry, the CR5 index was 0.51 in 2000 and increased to 0.62 in 2007. However, the CR5 index for securities industry was 0.32 in 2000 but increased to 0.51 in 2005 and 0.42 in 2007. It is apparent that the CR5 index for the banking industry is always higher than that of the securities in dustry, as are the Herfindahl indices of the two industries.

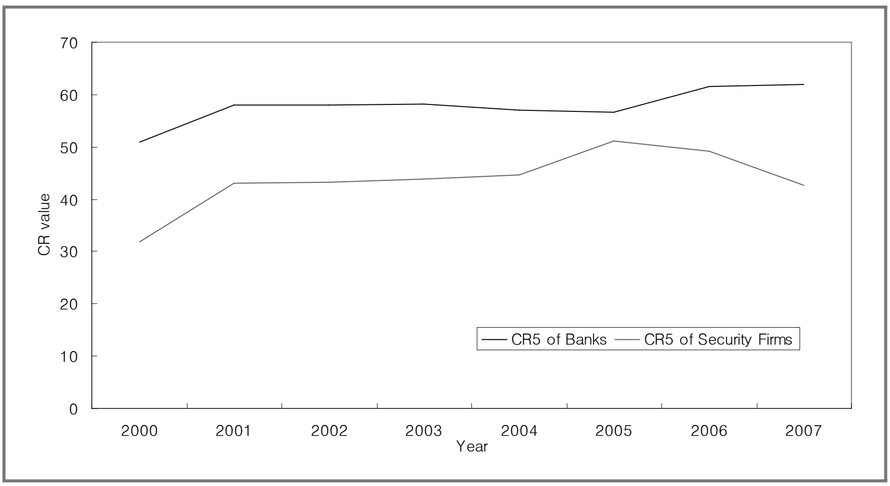
***Table 2.*** Herfindahl Index

| | banks | securities firms |
|---|---|---|
| 2000 | 0.0767 | 0.0600 |
| 2001 | 0.0968 | 0.0561 |
| 2002 | 0.0976 | 0.0542 |
| 2003 | 0.0967 | 0.0571 |
| 2004 | 0.0934 | 0.0558 |
| 2005 | 0.0914 | 0.0697 |
| 2006 | 0.0998 | 0.0662 |
| 2007 | 0.1010 | 0.0574 |

***Table 3.*** CR5 Index

| | banks | securities firms |
|---|---|---|
| 2000 | 0.509 | 0.318 |
| 2001 | 0.581 | 0.430 |
| 2002 | 0.580 | 0.432 |
| 2003 | 0.582 | 0.438 |
| 2004 | 0.570 | 0.447 |
| 2005 | 0.567 | 0.512 |
| 2006 | 0.616 | 0.492 |
| 2007 | 0.620 | 0.427 |

***Figure 1.*** CR5 of Banks and Securities firms




# Ⅲ. Panzar-Rosse Statistic

## 1. Critical Values

The Panzar-Rosse test analyzes the behavior of firms in the market by focusing on their profit maximizing behaviors. Rather than sticking to the market concentration ratio, the test investigates the elasticity of return structures to the changes of input factor prices that are uniquely defined and correspondent to each different market competition structure.

According to Panzar and Rosse (1987), the elasticity of return structures to the changes of input factor prices is one if the market is perfectly competitive, less than or equal to zero if the market is monopolistic, and less than one if the market is monopolistically competitive. If the competition structure of a monopolistically competitive market is close to perfect competition, the elasticity approaches one, while if it is close to monopoly, the elasticity is close to less than zero.

***Table 4.*** Critical Values of Panzar-Rosse Statistic

| critical values | market structures |
|---|---|
| $H^m \leq 0$ | monopoly |
| $H^{mc} < 1$ | monopolistic competition |
| $H^c = 1$ | perfect competition or contestable market |

Sources: Panzar and Rosse (1987), Bikker and Haaf (2002)

## 2. Alternative Derivation of Panzar-Rosse Statistic: Simpler Version

When the critical value of the Panzar-Rosse statistic is derived in Panzar and Rosse (1987), revealed preference theory is made use of for its simplicity. However, it cedes exact and clear implications of elasticity. This paper tries to derive alternative simpler version of Panzar-Rosse statistic based on an explicit objective function for the profit maximization problem, which produces clear-cut results for the implications of elasticity.

First, for perfect competition, the profit maximization objective function is:

(2) $$\max_y p \cdot y - c(y)$$

where $y$, $p$ and $c(y)$ are respectively output, price, and a cost function that is twice differentiable and convex. The first order condition for profit maximization is $p = MC$, where $MC$ is marginal cost. If $y$ is multiplied to both sides of the first-order condition, we get $p \cdot y = MC \cdot y$ which is $TR = MC \cdot y$, where $TR = p \cdot y$ is total revenue. Since $MC = \frac{\partial c}{\partial y}$ and $c = w \cdot L(w, r, y) + r \cdot K(w, r, y)$, then, $MC = w\frac{\partial L}{\partial y} + r\frac{\partial K}{\partial y}$.

Therefore, using $\frac{\partial TR}{\partial w} = \frac{\partial L}{\partial y}y$ and $\frac{\partial TR}{\partial r} = \frac{\partial K}{\partial y}y$, we get following Panzar-Rosse statistic $H^c$ as follows.

(3) $$H^c = 1$$

This unitary elasticity implies that market price changes exactly the same amount as input factor price changes. Therefore, total revenue does not change when input factor price changes. See Appendix for details.

Second is the monopoly case. The objective function is:

(4) $$\max_y \quad p(y) \cdot y - c(y)$$

The first order condition of profit maximization is $MR = p(y) + y \cdot p'(y) = MC$. If $y$ is multiplied to the both sides of the condition, $p(y) \cdot y + y^2 p'(y) = TR + y^2 p'(y) = MC \cdot y$, that is, $TR = MC \cdot y - y^2 p'(y)$where $p'(y) < 0$. Since $\frac{\partial TR}{\partial w} = \frac{\partial L}{\partial y}y - y^2\frac{\partial p'(y)}{\partial w}$, and $\frac{\partial TR}{\partial r} = \frac{\partial K}{\partial y}y - y^2\frac{\partial p'(y)}{\partial r}$, then Panzar-Rosse statistic is as follows.

(5) $$H^m \leq 0$$

This elasticity value implies that market price changes more than the amount as input factor price changes. Therefore, total revenue does change when input factor price changes. See Appendix for details.

Third is the monopolistic competition case. Since there are $n$ number of monopolistically competitive firms in the market, the profit function is:

(6) $$\max_{yi} \quad p(y_i;\ p_1,\ \cdots,\ p_{i-1},\ p_{i+1},\ \cdots,\ p_n) \cdot y_i - c_i(y_i), \quad i = 1,\ 2,\ \cdots,\ n$$

from which we can get the following result.

(7) $$H^{mc} < 1$$

This elasticity implies that market price changes more than the amount as input factor price changes, however, less than the amount of monopoly case. See Appendix for details.

## Ⅳ. Estimations of Panzar-Rosse Statistic

### 1. Test Equation

The test equation is proposed as follows. A Cobb-Douglas production function is assumed for the cost minimization problem, such as

(8) $$\min_{L,\ K} \quad wL + rK \quad s.t. \quad L^{\alpha}K^{\beta} = y$$

from which we can get a cost function as follows.

$$c(w, r, y) = Pw^{a_1} r^{a_2} y^{a_3} \tag{9}$$

Where $P$ is constant. The equilibrium condition for a competitive market is given as $TR = MC \cdot y$. Since $MC = Pw^{a_1} r^{a_2} a_3 y^{a_3 - 1}$, $TR = MC \cdot y = Pa_3 w^{a_1} r^{a_2} y^{a_3}$. Taking the logarithm, the test equation could be readily derived as follows.

$$\log(TR) = \log(Pa_3) + a_1 \log(w) + a_2 \log(r) + a_3 \log(y) \tag{10}$$

### 2. Data and Estimation Results

The data utilized in the paper is for 9 banks[2] and 40 securities companies[3] from Q1 1999 to Q1 2007. The data sources are Bank of Korea and Financial Supervisory Services of Korea. For the estimation, the variables are defined as follows. $TR$ is total revenue, $w$ is labor cost per unit of labor defined as Selling, General and Administrative Expenses (SGAE) divided by the number of employments, $r$ is capital cost per unit of capital defined in this paper as interest cost for borrowing divided by amount of borrowing. For the case of bank, $r$ is a sum of interest cost for deposits and yields on bonds divided by total borrowing, while for the case of securities companies, $r$ is a sum of interest costs for borrowing, call money and RP divided by total borrowing.

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2. IBK, KDB, Shinhan, Kookmin, Citi Korea, KEB, Hana, SC, Woori
3. Samsung, CJ, CLSA Korea, HMC Investment, NH Investment, SK, Kyobo, Goodmorning shinhan, Daishin, Daewoo, Daetoo, Deutsche, Dong Bu, Tong Yang, Leading, Macquarie, Meritz, Mirae Asset, Bookook, Bridge, Bng, BNP Paribas, Solomon, Shinyoung, Citigroup Global Markets Korea, Woori Investment, Eugene Investment, Yuhwa, E*trade Korea, KIDB, Korearb, Kiwoom, Prudential Investment, Hana, Korea Investment, Hannuri, Hanyang, Hanwha, Hyundai, Heungkuk

***Table 5.*** Variable Definition

| variable | definitions |
|---|---|
| $TR$ | total revenue |
| $w$ | labor cost per unit of labor: SGAE divided by the number of employments |
| $r$ | capital cost per unit of capital: interest cost divided by liabilities |
| $TA$ | total assets |
| $Lia$ | liabilities |

Total borrowing that is liability is defined differently for banks and securities firms. For banks, liability is the sum of deposits and bond issues while for securities firms it is the sum of borrowing, cally money and RP sales. $TA$ is total asset as a variable for output $y$ in equation (10). To compare the effects of relative sizes of banks and securities firms, liability is added as an explanatory variable together with total asset of each financial institution.

According to estimations, banking industry is more competitive than securities industry. As indicated in <Table 5-1>~ Table 5-3>, the estimates of the Panzar-Rosse statistic for banks range from 0.68~0.75 and Wald statistics under the null hypothesis $H-statistic=0$ are ranged from 45~54, implying that the competition structure of the banking industry is monopolistically

***Table 5-1.*** Panzar-Rosse Test Results for Banks: Least Squares

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(TA) | 1.739 | 0.151 | 11.52 | 0.000 |
| log(Lia) | -0.668 | 0.145 | -4.607 | 0.000 |
| log(w) | 0.348 | 0.061 | 5.701 | 0.000 |
| log(r) | 0.403 | 0.073 | 5.491 | 0.000 |
| constant | -4.622 | 0.607 | -7.609 | 0.000 |
| H-statistic | 0.751 | | | |
| Wald test-statistic (H-stat=0) | 45.313 | | | |
| R-squared | 0.813 | | | |
| Adjusted R-squared | 0.862 | | | |

note: TA=total assets, Lia=liabilities. 5% significance level of Chi-square critical value for Wald test is 5.99.

***Table 5-2.*** Panzar-Rosse Test Results for Banks: Panel Fixed Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(TA) | 3.195 | 0.260 | 12.30 | 0.000 |
| log(Lia) | -1.785 | 0.250 | -7.143 | 0.000 |
| log(w) | 0.156 | 0.061 | 2.544 | 0.012 |
| log(r) | 0.521 | 0.072 | 7.234 | 0.000 |
| constant | -9.922 | 0.944 | -10.51 | 0.000 |
| H-statistic | 0.678 | | | |
| Wald test-statistic (H-stat=0) | 54.251 | | | |
| R-squared | 0.867 | | | |
| Adjusted R-squared | 0.862 | | | |

***Table 5-3.*** Panzar-Rosse Test Results for Banks: Panel Random Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(TA) | 2.734 | 0.227 | 12.03 | 0.000 |
| log(Lia) | -1.438 | 0.219 | -6.575 | 0.000 |
| log(w) | 0.218 | 0.059 | 3.702 | 0.012 |
| log(r) | 0.487 | 0.070 | 6.976 | 0.000 |
| constant | -8.127 | 0.829 | -9.805 | 0.000 |
| H-statistic | 0.705 | | | |
| Wald test-statistic (H-stat=0) | 53.271 | | | |
| R-squared | 0.760 | | | |
| Adjusted R-squared | 0.757 | | | |

competitive. The estimates of H-statistic for securities firms range from 0.046~0.050, and Wald statistics under the null hypothesis $H-statistic=0$ are ranged from 5.10~10.9, as indicated in <Table 6-1>~<Table 6-3> implying that the competition structure of the securities industry is also monopolistically competitive. However, the absolute values of the estimates of the two industries are quite different. The estimates for the banking industry are relatively close to unity value, while those for the securities industry are essentially zero. In other words, the banking industry is monopolistically 'competitive' in a way more resembling perfect competition than monopoly, however, the securities industry is 'monopolistically' competitive in a way more resembling monopoly

***Table 6-1.*** Panzar-Rosse Test Results for securities firms: Least Squares

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(TA) | 0.763 | 0.021 | 35.98 | 0.000 |
| log(Lia) | 0.130 | 0.019 | 6.789 | 0.000 |
| log(w) | 0.042 | 0.054 | 0.789 | 0.430 |
| log(r) | 0.050 | 0.015 | 3.240 | 0.001 |
| constant | -1.224 | 0.244 | -5.010 | 0.000 |
| H-statistic | 0.092 | | | |
| Wald test-statistic (H-stat=0) | 10.953 | | | |
| R-squared | 0.851 | | | |
| Adjusted R-squared | 0.850 | | | |

***Table 6-2.*** Panzar-Rosse Test Results for securities firms: Panel Fixed Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(TA) | 0.589 | 0.037 | 15.46 | 0.000 |
| log(Lia) | 0.037 | 0.027 | 1.387 | 0.166 |
| log(w) | 0.108 | 0.070 | 1.532 | 0.126 |
| log(r) | 0.024 | 0.016 | 1.529 | 0.127 |
| constant | 2.201 | 0.527 | 4.174 | 0.000 |
| H-statistic | 0.132 | | | |
| Wald test-statistic (H-stat=0) | 5.105 | | | |
| R-squared | 0.886 | | | |
| Adjusted R-squared | 0.881 | | | |

***Table 6-3.*** Panzar-Rosse Test Results for securities firms: Panel Random Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(TA) | 0.711 | 0.029 | 24.56 | 0.000 |
| log(Lia) | 0.089 | 0.024 | 3.712 | 0.000 |
| log(w) | 0.065 | 0.065 | 1.001 | 0.012 |
| log(r) | 0.046 | 0.015 | 2.999 | 0.000 |
| constant | -0.098 | 0.370 | -0.265 | 0.000 |
| H-statistic | 0.101 | | | |
| Wald test-statistic (H-stat=0) | 10.273 | | | |
| R-squared | 0.496 | | | |
| Adjusted R-squared | 0.493 | | | |

than perfect competition.

In the <Table 7-1>~<Table 7-3> where total asset is excluded from explanatory variables, the estimates of the Panzar-Rosse H-statistic for banks range from 0.87~1.06 and Wald statistics

***Table 7-1.*** Panzar-Rosse Test Results for Banks: Least Squares

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(Lia) | 0.961 | 0.038 | 24.993 | 0.000 |
| log(w) | 0.422 | 0.073 | 5.762 | 0.000 |
| log(r) | 0.647 | 0.084 | 7.636 | 0.000 |
| constant | -1.193 | 0.638 | -1.871 | 0.062 |
| H-statistic | 1.089 | | | |
| Wald test-statistic (H-stat=0) | 68.257 | | | |
| R-squared | 0.727 | | | |
| Adjusted R-squared | 0.725 | | | |

***Table 7-2.*** Panzar-Rosse Test Results for Banks: Panel Fixed Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(Lia) | 0.627 | 0.078 | 7.962 | 0.000 |
| log(w) | 0.149 | 0.070 | 2.142 | 0.033 |
| log(r) | 0.914 | 0.132 | 6.894 | 0.000 |
| constant | 6.925 | 1.672 | 4.142 | 0.000 |
| H-statistic | 1.063 | | | |
| Wald test-statistic (H-stat=0) | 68.931 | | | |
| R-squared | 0.908 | | | |
| Adjusted R-squared | 0.892 | | | |

***Table 7-3.*** Panzar-Rosse Test Results for Banks: Panel Random Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(Lia) | 0.877 | 0.063 | 13.725 | 0.000 |
| log(w) | 0.279 | 0.064 | 4.325 | 0.000 |
| log(r) | 0.600 | 0.098 | 6.116 | 0.000 |
| constant | 0.602 | 1.113 | 0.541 | 0.589 |
| H-statistic | 0.879 | | | |
| Wald test-statistic (H-stat=0) | 58.607 | | | |
| R-squared | 0.476 | | | |
| Adjusted R-squared | 0.471 | | | |

under the null hypothesis $H-statistic=0$ are ranged from 58~68, implying that the competition structure of the banking industry is perfectly competitive or monopolistically competitive. The estimates of H-statistic for securities firms range from 0.094~0.279 and Wald statistics under the null hypothesis H - statistic = 0 are ranged from 7.3~63.4, as indicated in <Table 8-l>~<Table 8-3>, implying that the competition structure of the securities industry is monopolistically competitive. In the <Table 9-1>~<Table 9-3> where dummy variable for bank is included as an explanatory variable which takes 1 if the bank is subsidiary of financial holding company, the estimates of the Panzar-Rosse H-statistic for banks range from 0.878~1.094 and Wald statistics

***Table 8-1.*** Panzar-Rosse Test Results for securities firms: Least Squares

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(Lia) | 0.669 | 0.019 | 34.65 | 0.000 |
| log(w) | 0.256 | 0.086 | 2.970 | 0.003 |
| log(r) | -0.112 | 0.024 | -4.681 | 0.000 |
| constant | 2.130 | 0.364 | 5.851 | 0.000 |
| H-statistic | 0.368 | | | |
| Wald test-statistic (H-stat=0) | 32.920 | | | |
| R-squared | 0.611 | | | |
| Adjusted R-squared | 0.610 | | | |

***Table 8-2.*** Panzar-Rosse Test Results for securities firms: Panel Fixed Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(Lia) | 0.162 | 0.029 | 5.656 | 0.000 |
| log(w) | 0.134 | 0.082 | 1.629 | 0.104 |
| log(r) | -0.040 | 0.018 | -2.237 | 0.026 |
| constant | 8.559 | 0.454 | 18.85 | 0.000 |
| H-statistic | 0.094 | | | |
| Wald test-statistic (H-stat=0) | 7.338 | | | |
| R-squared | 0.877 | | | |
| Adjusted R-squared | 0.867 | | | |

***Table 8-3.*** Panzar-Rosse Test Results for securities firms: Panel Random Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| log(Lia) | 0.260 | 0.027 | 9.686 | 0.000 |
| log(w) | 0.347 | 0.077 | 4.490 | 0.000 |
| log(r) | -0.068 | 0.017 | -4.036 | 0.000 |
| constant | 6.604 | 0.425 | 15.520 | 0.000 |
| H-statistic | 0.279 | | | |
| Wald test-statistic (H-stat=0) | 36.477 | | | |
| R-squared | 0.767 | | | |
| Adjusted R-squared | 0.733 | | | |

***Table 9-1.*** Panzar-Rosse Test Results for Banks: Least Squares

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| Dummy | -0.119 | 0.041 | -2.896 | 0.004 |
| log(Lia) | 0.999 | 0.040 | 24.89 | 0.000 |
| log(w) | 0.426 | 0.072 | 5.898 | 0.000 |
| log(r) | 0.668 | 0.084 | 7.952 | 0.000 |
| constant | -1.710 | 0.654 | -2.613 | 0.009 |
| H-statistic | 1.094 | | | |
| Wald test-statistic (H-stat=0) | 73.292 | | | |
| R-squared | 0.735 | | | |
| Adjusted R-squared | 0.732 | | | |

***Table 9-2.*** Panzar-Rosse Test Results for Banks: Panel Fixed Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| Dummy | -0.051 | 0.035 | -1.479 | 0.140 |
| log(Lia) | 0.871 | 0.035 | 24.315 | 0.000 |
| log(w) | 0.178 | 0.080 | 2.209 | 0.028 |
| log(r) | 0.907 | 0.118 | 7.672 | 0.000 |
| constant | 2.504 | 0.971 | 2.578 | 0.011 |
| H-statistic | 1.078 | | | |
| Wald test-statistic (H-stat=0) | 73.338 | | | |
| R-squared | 1.085 | | | |
| Adjusted R-squared | 0.831 | | | |

***Table 9-3.*** Panzar-Rosse Test Results for Banks: Panel Random Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| Dummy | -0.068 | 0.153 | -0.443 | 0.658 |
| log(Lia) | 0.881 | 0.065 | 14.488 | 0.000 |
| log(w) | 0.278 | 0.065 | 4.315 | 0.000 |
| log(r) | 0.600 | 0.098 | 6.102 | 0.000 |
| constant | 0.567 | 1.126 | 0.504 | 0.615 |
| H-statistic | 0.878 | | | |
| Wald test-statistic (H-stat=0) | 58.422 | | | |
| R-squared | 0.474 | | | |
| Adjusted R-squared | 0.466 | | | |

under the null hypothesis $H-statistic=0$ are ranged from 58.4~73.3, implying that the competition structure of the banking industry is perfectly competitive or monopolistically competitive. The dummy variable represents structures of banks that may affect bank's revenue.

In the <Table 10-1>~<Table 10-3> where risk variable which is defined as the inverse of BIS ratio is additionally included as an explanatory variable, the estimates of the Panzar-Rosse H-sta

***Table 10-1.*** Panzar-Rosse Test Results for Banks: Least Squares

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| Dummy | -0.094 | 0.042 | -2.256 | 0.025 |
| risk | -0.332 | 0.119 | -2.786 | 0.006 |
| log(Lia) | 0.991 | 0.039 | 24.92 | 0.000 |
| log(w) | 0.385 | 0.073 | 5.270 | 0.000 |
| log(r) | 0.642 | 0.084 | 7.682 | 0.000 |
| constant | -2.383 | 0.691 | -3.447 | 0.001 |
| H-statistic | 1.027 | | | |
| Wald test-statistic (H-stat=0) | 65.317 | | | |
| R-squared | 0.472 | | | |
| Adjusted R-squared | 0.738 | | | |

note: dummy variable is 1 if bank is subsidiary of financial holding company, otherwise 0.
Variable 'risk' is defined as the inverse of BIS ratio.

***Table 10-2.*** Panzar-Rosse Test Results for Banks: Panel Fixed Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| Dummy | -0.042 | 0.034 | -1.204 | 0.229 |
| risk | -0.245 | 0.108 | -2.265 | 0.024 |
| log(Lia) | 0.877 | 0.035 | 24.609 | 0.000 |
| log(w) | 0.190 | 0.080 | 2.380 | 0.018 |
| log(r) | 0.799 | 0.127 | 6.310 | 0.000 |
| constant | 1.241 | 1.114 | 1.114 | 0.266 |
| H-statistic | 0.989 | | | |
| Wald test-statistic (H-stat=0) | 54.162 | | | |
| R-squared | 0.854 | | | |
| Adjusted R-squared | 0.833 | | | |

***Table 10-3.*** Panzar-Rosse Test Results for Banks: Panel Random Effects

| Variables | coefficients | std. error | t-statistic | p-value |
|---|---|---|---|---|
| Dummy | -0.068 | 0.146 | -0.465 | 0.642 |
| risk | 0.105 | 0.148 | 0.711 | 0.478 |
| log(Lia) | 0.862 | 0.068 | 12.658 | 0.000 |
| log(w) | 0.286 | 0.066 | 4.334 | 0.000 |
| log(r) | 0.581 | 0.104 | 5.597 | 0.000 |
| constant | 1.055 | 1.247 | 0.846 | 0.398 |
| H-statistic | 0.867 | | | |
| Wald test-statistic (H-stat=0) | 56.359 | | | |
| R-squared | 0.474 | | | |
| Adjusted R-squared | 0.465 | | | |

tistic for banks range from 0.867~1.027 and Wald statistics under the null hypothesis $H-statistic=0$ are ranged from 54.2~65.3, implying that the competition structure of the banking industry is perfectly competitive or monopolistically competitive.[4]

4. In the estimations, we did Wald test under the null of $H-statistic=1$, and got results that the null is not rejected for the banks when dummy variable as well as risk variable are included. This implies that banking industry is perfectly competitive even though the results are not reported because Wald test results under the null of $H-statistic=0$ imply such results.

Combining the Herfindahl and CR5 indices with the Panzar-Rosse statistic, a bank should behave as a competitive firm despite high market concentration, while securities firm should behave as a monopolistic firm even though it has a low market concentration. This seemingly puzzling result implies that high market concentration itself is not a sufficient, but merely a necessary condition for monopoly.[5] As noted earlier, Bikker and Haaf (2002) found similar results.

Following Shaffer (1982), we shall now determine whether the two industries are in long-run equilibrium. According to Shaffer, the risk-adjusted rate of return per unit of asset should be the same across financial institutions for each industry. In other words, cross-sectional ROA should be the same over time, even though input factor prices change over time and across individuals. By the way, to test the long-run equilibrium status, ROA values should be positive, since the logarithm is taken to utilize the test equation derived in Section IV. However, as pointed out by Shin (2007, p.29), ROA values for banks and securities firms for some periods right after the Asian crisis from 1997 to 2000 are negative, so Shaffer's methodology could not be applied for the test. <Table 11> and Figure 2 show time trends of ROA mean values.

However, a $\chi^2$-statistic could be an alternative way to test the long-run equilibrium status, and it is much simpler than Shaffer's methodology. $\chi^2$-statistic tells how ROA distribution of banks and securities firms are well focused around mean over time. $\chi^2$-test results are contained in <Table 12>. It is found that all of the $\chi^2$ -statistic for banks are less than the critical value, except for the year of 2000, implying that the banking industry is in long-run equilibrium. However, the $\chi^2$-test results for securities industry reject the null hypothesis of long-run equilibrium.

5. This may call to remind 'contestable market theory,' where the market is perfectly competitive even though there is only a single player.

***Table 12.*** $\chi^2$-statistic for Long-Run Equilibrium

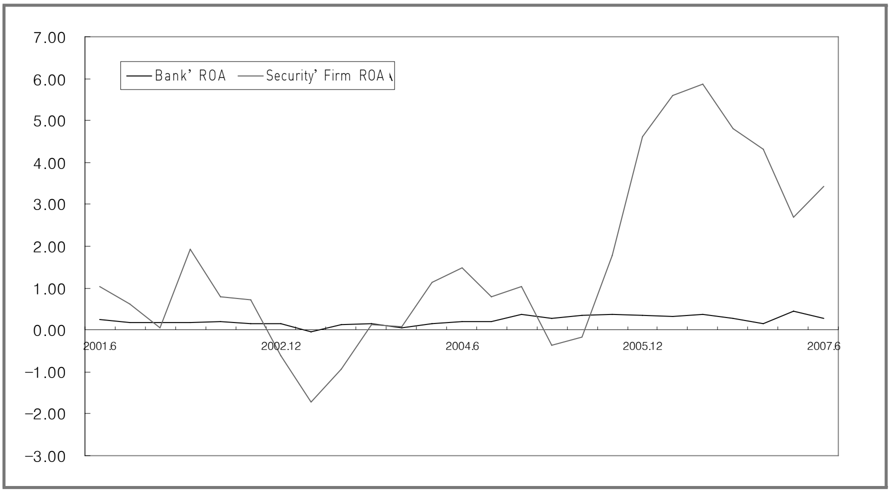
| | banks | securities firms |
|---|---|---|
| 2000 | -64.68 | 1,837.3 |
| 2001 | 8.30 | -3,361.2 |
| 2002 | 6.72 | 582.19 |
| 2003 | 22.08 | -541.86 |
| 2004 | 3.86 | 2,315.6 |
| 2005 | 6.46 | -16,661.5 |
| 2006 | 2.58 | 202.9 |
| 2007 | 1.76 | 481.6 |

note: critical value for the null hypothesis is 26.5 at the 5% significance level.

***Table 12.*** ROA means for banks and securities firms

| | banks | securities firms |
|---|---|---|
| 2001 | 0.66 | 2.97 |
| 2002 | 0.60 | -0.27 |
| 2003 | 0.17 | 0.29 |
| 2004 | 0.85 | 1.54 |
| 2005 | 1.27 | 4.42 |
| 2006 | 1.11 | 3.66 |
| 2007 | 1.10 | 3.23 |

***Figure 2.*** ROA means of Banks and Securities Firms (2001.1Q~2007.4Q)



## Ⅴ. Concluding Remarks

In a monopolistically competitive market, players are producing differentiated products but competition is not as intense as in a perfectly competitive market. The degree of competition is less than that of perfect competition so that, at least in the short-run, players do not exit voluntarily, even if they do not achieve cost efficiency.

According to our results, the Panzar-Rosse statistic estimates imply that the competition structure of the banking industry is perfect competition or monopolistically competitive with high value of Panzar-Rosse test while securities industry is monopolistically competitive with low value of Panzar-Rosse test. The results mean that banking industry is relatively competitive to be named monopolistically "competitve" and the securities industry is relatively less competitive to be named "monopolistically" competitive.

Why is banking industry more competitive than securities industry? As mentioned earlier, according to Bikker and Haaf (2002), larger banks behave more competitively than smaller banks since they are more exposed to the international competitive environment.

During the Asian crisis from 1997 to 1998, the banking industry was drastically reformed based on international accounting and supervisory codes, and many banks were merged, resulted in a small number of larger banks. Post-reform, banks had to adhere to international codes that were based on better defined efficiency and competition principles than prior domestic accounting and supervisory criteria.

How to improve the competition structure of securities industry toward more competitive structure? The reform experiences in the banking industry may be useful for improving market structures and strengthening the competitiveness of the security industry. The low estimate of the Panzar-Rosse statistic implies low dynamics of the securities industry in terms of competition. Therefore, a restructuring plan for 'higher' concentration and efficiency would be necessary to promote competitive dynamics of securities industry.

## Ⅵ. Appendix

**Alternative Derivation of Panzar-Rosse Statistic**

First, for perfect competition, the profit maximization objective function is defined as follows.

$$\max_y \quad p \cdot y - c(y) \tag{11}$$

where $y$ is output, $p$ is price, and $c(y)$ is a cost function that is twice differentiable and convex. The first order condition for profit maximization is $p = MC$, where $MC$ is marginal cost. If $y$ is multiplied to both sides of the equilibrium condition, we have $p \cdot y = MC \cdot y$, that is, $TR = MC \cdot y$, where $TR$ is total revenue. It should be noted that $MC = \frac{\partial c}{\partial y}$, and $c = w \cdot L(w, r, y) + r \cdot K(w, r, y)$, so that $MC = w\frac{\partial L}{\partial y} + r\frac{\partial K}{\partial y}$.

Therefore, since $\frac{\partial TR}{\partial w} = \frac{\partial L}{\partial y}y$, and $\frac{\partial TR}{\partial r} = \frac{\partial K}{\partial y}y$, the elasticity of total revenue with respect to input factor prices is given as follows.

$$\begin{aligned} H^c &= \frac{\partial TR}{\partial w}\frac{w}{TR} + \frac{\partial TR}{\partial r}\frac{r}{TR} \\ &= \frac{\partial L}{\partial y}y\frac{w}{TR} + \frac{\partial K}{\partial y}y\frac{r}{TR} \\ &= \left(w\frac{\partial L}{\partial y} + r\frac{\partial K}{\partial y}\right)\frac{y}{TR} \\ &= MC\frac{y}{TR} \end{aligned} \tag{12}$$

This equates to unity value since $TR = MC \cdot y$.

Second is the monopoly case. The objective function is:

$$\max_y \quad p(y) \cdot y - c(y) \tag{13}$$

The first order condition of profit maximization is $MR = p(y) + y \cdot p'(y) = MC$. If $y$ is multiplied to the both sides of equilibrium condition, we get $p(y) \cdot y + y^2 p'(y) = TR + y^2 p'(y) = MC \cdot y$, the is, $TR = MC \cdot y - y^2 p'(y)$ where $p'(y) < 0$. Since $\frac{\partial TR}{\partial w} = \frac{\partial L}{\partial y} y - y^2 \frac{\partial p'(y)}{\partial w}$, and $\frac{\partial TR}{\partial w} = \frac{\partial K}{\partial r} y - y^2 \frac{\partial p'(y)}{\partial r}$, we have the elasticity of total revenue with respect to input factor prices as follows.

$$\begin{aligned} H^m &= \frac{\partial TR}{\partial w} \frac{w}{TR} + \frac{\partial TR}{\partial r} \frac{r}{TR} \\ &= \left( \frac{\partial L}{\partial y} y - y^2 \frac{\partial p'(y)}{\partial w} \right) \frac{w}{TR} + \left( \frac{\partial K}{\partial y} y - y^2 \frac{\partial p'(y)}{\partial r} \right) \frac{r}{TR} \\ &= \left( w \frac{\partial L}{\partial y} - wy \frac{\partial p'(y)}{\partial w} + r \frac{\partial K}{\partial y} - ry \frac{\partial p'(y)}{\partial r} \right) \frac{y}{TR} \\ &= k \frac{y}{TR} \end{aligned} \tag{14}$$

where

$$\begin{aligned} k &= \left( w \frac{\partial L}{\partial y} - wy \frac{\partial p'(y)}{\partial w} + r \frac{\partial K}{\partial y} - ry \frac{\partial p'(y)}{\partial r} \right) \\ &= \left( w \frac{\partial L}{\partial y} - w \frac{\partial L}{\partial y} \frac{\partial^2 p(y)}{\partial w \partial L} y \right) + \left( w \frac{\partial K}{\partial y} - r \frac{\partial K}{\partial y} \frac{\partial^2 p(y)}{\partial r \partial K} y \right) \\ &= w \frac{\partial L}{\partial y} \left( 1 - \frac{\partial^2 p(y)}{\partial w \partial L} y \right) + r \frac{\partial K}{\partial y} \left( 1 - \frac{\partial^2 p(y)}{\partial r \partial K} y \right) \\ &= w \frac{\partial L}{\partial y} (1 - \theta_w y) + r \frac{\partial K}{\partial y} (1 - \theta_r y) \\ \theta_w &= \frac{\partial^2 p(y)}{\theta_w \partial L} = \frac{\partial}{\partial L} \frac{\partial p(y)}{\theta_w} = \frac{\partial}{\partial L} \lambda_w \\ \theta_r &= \frac{\partial^2 p(y)}{\theta_r \partial K} = \frac{\partial}{\partial K} \frac{\partial p(y)}{\theta_w} = \frac{\partial}{\partial K} \lambda_r \end{aligned} \tag{15}$$

where $\lambda_w = \dfrac{\partial p(y)}{\partial w}$, $\lambda_r = \dfrac{\partial p(y)}{\partial w}$. According to the last expression, $k$ is always less than or equal to zero as long as $\theta_w y > 1$ and $\theta_r y > 1$, which is plausible if $\theta_w$, $\theta_r$ or $y$ are large enough.

It should be noted that since, from the profit function under monopoly, $\pi^m = p(y)y - wL(w,\ r,\ y) - rK(w,\ r,\ y) > 0$ and $\dfrac{\partial p(y)}{\partial w} < \dfrac{L}{y}$,[6] then $\theta_w = \dfrac{\partial}{\partial L}\dfrac{\partial p(y)}{\partial w} \geq \dfrac{\partial}{\partial L}\dfrac{L}{y} = \dfrac{1}{y}$. Suppose $\theta_w = \dfrac{1}{y}$, then $1 - \theta_w \cdot y = 1 - \dfrac{q}{y} \cdot y = 1 - q < 0$. Also we can find $1 - \theta_r \cdot y \leq 0$ following the same procedure. Therefore, it is obvious that $k \leq 0$ and $H^m \leq 0$.

Third is the monopolistic competition case. Suppose there are $n$ number of monopolistically competitive firms in the market. The profit function is

(16) $\max_{y_i} p(y_i; p_1, \cdots, p_{i-1}, p_{i+1}, \cdots, p_n) \cdot y_i - c_i(y_i),\ i = 1, 2, \cdots, n$

from which we can get the following first-order condition for profit maximization:

(17) $MR_i = p(y_i; \{p_j\}) + y_i p'(y_i;\ \{p_j\}) = MC_i, \quad j = 1, 2, \cdots, n,\ j \neq i$

If $y_i$ is multiplied to both sides of the first-order condition, we have

(18) $$p(y_i; \{p_j\}) \cdot y_i + y_i^2 p'(y_i;\ \{p_j\}) = MC_i \cdot y_i$$

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6. $p(y)y > wL(w,\ r, y)$, $\dfrac{\partial p(y)}{\partial w} y + p(y)\dfrac{\partial y}{w} > L(w,\ r,\ y) + w\dfrac{\partial L}{\partial w}$, $\dfrac{\partial p(y)}{\partial w} > \dfrac{L(w,\ r,\ y)}{y} + \dfrac{1}{y}\left(w\dfrac{\partial L}{\partial w} - p(y)\dfrac{\partial y}{w}\right)$, where the second thrm on the right-hand side is positive. Hence, we get the result of $\dfrac{\partial p(y)}{\partial w} > \dfrac{L}{y}$. If a market is perfectly competitive, $\dfrac{\partial p}{\partial w} = \dfrac{\partial L}{\partial y}$, $\theta_w = \dfrac{\partial}{\partial L}\dfrac{\partial p}{\partial w} = \dfrac{\partial}{\partial L}\dfrac{\partial L}{\partial y} = \dfrac{\partial}{\partial y} 1 = 0$. In such a case, we have the same elasticity as a competitive firm, as discussed above.

For a representative firm $i$, total revenue is expressed as $TR_i = MC_i y_i - y_i^2 p_i'(y_i)$. Since $MC_i = w\dfrac{\partial L_i}{\partial w} + r\dfrac{\partial K_i}{\partial r}$,

$$\text{(19)} \qquad \begin{aligned} \frac{\partial TR_i}{\partial w} &= \frac{\partial L_i}{\partial y_i} y_i - y_i^2 \frac{\partial \lambda_w}{\partial y_i} \\ \frac{\partial TR_i}{\partial r} &= \frac{\partial K_i}{\partial y_i} y_i - y_i^2 \frac{\partial \lambda_r}{\partial y_i} \end{aligned}$$

Therefore, we have the following elasticity.

$$\text{(20)} \qquad \begin{aligned} H_i^{mc} &= \frac{\partial TR_i}{\partial w}\frac{w}{TR_i} + \frac{\partial TR_i}{\partial r}\frac{r}{TR_i} \\ &= k_i \frac{y_i}{TR_i} \end{aligned}$$

where

$$\text{(21)} \qquad \begin{aligned} k_i &= w\frac{\partial L_i}{\partial y_i}(1 - \theta_{wi} y_i) + r\frac{\partial K_i}{\partial y_i}(1 - \theta_{ri} y_i) \\ \theta_{wi} &= \frac{\partial^2 p(y_i)}{\partial w \partial L} = \frac{\partial}{\partial L_i}\frac{\partial p(y_i)}{\partial w} \\ \theta_{ri} &= \frac{\partial^2 p(y_i)}{\partial r \partial K_i} = \frac{\partial}{\partial K_i}\frac{\partial p(y_i)}{\partial w}. \end{aligned}$$

Since monopolistically competitive market is somewhat close to competitive, even if not perfectly competitive, $\theta_w \approx 0$ and $\theta_w > 0$ so that $H^{mc} \approx 1$ but $H^{mc} < 1$. The monopolistically competitive market is also somewhat close to monopolistic even though it is not perfectly monopolistic, $\theta_w \approx \dfrac{1}{y}$ and $\theta_w \geq \dfrac{1}{y}$ so that $H^{mc} \leq 0$. Combing the two results, it is clear that $H^{mc} < 1$.

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