

Bank Deregulation, Asset Concentration And Safety & Soundness Of Banking Industry

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ABSTRACT

In this paper, we examine the pattern of asset concentration among 900 largest bank holding companies in the United States during 1986-2008. The entropy coefficient is used as a measure of concentration because it is said to be theoretically sound and superior to other models due to its decomposition properties (Theil, 1972). Decomposing 900 bank holding companies in nine 100-subgroups and testing the within-set and between-set concentration of total assets and selected groups of individual assets revealed that the bottom 850 bank holding companies did not exhibit a noticeable change in asset concentration. However, a significant concentration of assets took place among the top 50 bank holding companies. The result of this study, in light of the recent financial turmoil that showed the largest bank holding companies' (i.e., Bank of America, Citicorp, etc.) systematic risk exceeded their ability to remain solvent, has significant policy implication (i.e., bail out the largest bank under the too-big to-fail doctrine).

Keywords: bank holding companies; total asset concentration; individual asset; systematic risk

INTRODUCTION

The Congressional Oversight Panel's 2009 Special Report on Regulatory Reform states that "financial crises are not new. As early as 1792, during the presidency of George Washington, the nation suffered a severe panic that froze credit and nearly brought the young economy to its knees. Over the next 140 years, financial crises struck on a regular basis—in 1797, 1819, 1837, 1857, 1873, 1893–96, 1907, and 1929–33 — roughly every 15 to 20 years." However, to avoid systematic risk as a prime objective, new financial regulation — including federal deposit insurance, securities regulation, and banking supervision — effectively protected the system from devastating financial crisis for more than 50 years. The safety and soundness of the financial system changed the attitude of financial firms and policy makers to see regulation as an impediment to efficient functioning of the capital markets. As a result, this attitude change led to the enactment of the Depository Institutions Deregulation and Monetary Control Act of 1980 — the most important federal legislation relating to the financial community since the 1930s, followed by several other banking acts between 1982 and 1999, such as the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994. These legislations encouraged consolidation of bank holding companies causing a substantial concentration of assets. Stiroh and Poole (2000) found that the rise in the concentration of assets among the 50 largest United States bank holding companies in the 1990s was almost entirely due to external growth through mergers and acquisitions.

In this paper, we use the entropy coefficient as a measure of concentration to examine the asset concentration pattern among 900 largest bank holding companies (BHCs) in the United States during 1986-2008. While there is wide array of concentration measures proposed in the industrial organization literature, the review of banking literature reveals that the k-firm concentration ratio and Herfindahl-Hirschman index (HHI) are predominately used to measure bank asset concentration (Yeyati and Micco, 2007). The use of the entropy coefficient as a measure of concentration is said to be theoretically sound and superior to other models due to its decomposition properties (Theil, 1972). Applying this methodology to the U.S. BHCs, we examine the pattern of

total assets concentration among the upper and lower tier BHCs from 1986 to 2008 (i.e., during and after regulatory reform of the 1980s). Furthermore, to examine the risk-taking behavior of BHCs, we also study the concentration patterns of selected groups of individual assets over the same time period.

By decomposing 900 BHCs in nine 100-subgroups and testing within-set and between-set concentrations of total assets and selected groups of individual assets, we find that the largest 50 bank holding companies had significant increases in asset concentration, while the remaining 850 bank holding companies did not exhibit a noticeable change of asset concentration.

METHODOLOGY

Ludwig Boltzmann (1877) has been credited for developing the entropy concept. Claude Shannon (1948) introduced probabilistic interpretation of entropy in information theory and Henry Theil, in his two books *Economics and Information Theory* (1967) and *Statistical Decomposition Analysis* (1972), developed some economics applications in relation to information theory. Entropy coefficient as a measure of concentration or diversity, is one of those economic applications that is said to be superior to other models due to its decomposition properties (Theil, 1972, and Attaran & Zwick, 1987).

The entropy measure of concentration (C) is defined as:

$$C(A_1, A_2, \dots, A_n) = -\sum_{i=1}^n A_i \log_2 A_i \tag{1}$$

where n is the number of BHCs and $A_i, i = 1, \dots, n$ is the i th firm’s assets relative to the sum of all BHCs’ assets, so $\sum_{i=1}^n A_i = 1$. The base of the logarithm is arbitrary and we chose two as the base¹. The entropy coefficient is an inverse measure of concentration: a lower coefficient of C indicates that smaller number of BHCs own most of the assets. For example, $C_{\min} = 0$ represents a case of one BHC owing 100% of all assets. The highest coefficient of concentration is given by $C_{\max} = \log_2(n)$ and stands for all BHCs owning an equal amount of assets. Therefore, the concentration coefficient lies between $0 = C_{\min} \leq C \leq C_{\max} = \log_2(n)$.

One of the properties of the entropy is that it could be decomposed or disaggregated into between-set and within-set entropies (Theil, 1972). This disaggregation property is very useful when data are available for number of BHCs by size of their assets. In this study, we divide BHCs into subgroups ($S_g, (g = 1, \dots, G)$) and monitor their asset concentration patterns over time and compare them with other subgroups. S_1 is the top group of bank holding companies owing the largest levels of assets and S_G is the bottom group of bank holding companies owing the lowest levels of assets. The proportion of each subgroup of BHCs’ assets to the total BHCs’ assets is given by:

$$A_g = \sum_{i \in S_g} A_i \quad g = 1, \dots, G$$

¹ When use at two, the measurement unit of entropy is known as BIT, binary digit.

The within-set entropy $C_{within S_g}$ is defined by Equation (2). The entropy coefficient of concentration within a particular subgroup, S_g , can be expressed by:

$$C_{within S_g} = - \sum_{i \in S_g} (A_i / A_g) \log_2 (A_i / A_g) \tag{2}$$

When the total number of BHCs is divided into subgroups, each subgroup would analytically have its own concentration coefficient. Weighting Equation (2) by A_g / A_s yields into the relative share of each subgroup to the total entropy, where $A_s = \sum_{i=1}^G A_i$. The total within-set entropy coefficient is given by Equation (3)

$$C_{within} = \sum_{g=1}^G (A_g / A_s) \left[- \sum_{i \in S_g} (A_i / A_g) \log_2 (A_i / A_g) \right] \tag{3}$$

Between-set entropy is defined by Equation (4).

$$C_{between} = - \sum_{g=1}^G (A_g / A_s) \log_2 (A_g / A_s) \tag{4}$$

The summation of Equation (3) and Equation (4) is the overall entropy measure of all BHCs.

$$E(C) = - \sum_{g=1}^G (A_g / A_s) \log_2 (A_g / A_s) + \sum_{g=1}^G (A_g / A_s) \left[- \sum_{i \in S_g} (A_i / A_g) \log_2 (A_i / A_g) \right] \tag{5}$$

SOURCE OF BANK HOLDING COMPANY DATA

We obtained financial data of BHCs from the Federal Reserve Bank of Chicago from the second quarter of 1986 through the third quarter of 2008. Table 1 depicts data used in this study².

RESULTS

We selected the top 900 BHCs for our study due to their consistency and reliability. To determine the pattern of the BHCs asset concentrations, we divided these 900 BHCs into nine subgroups, with each containing 100 BHCs ranked by their asset size. After careful examination of the raw data, we decided to divide the first top 100 BHCs into two subgroups of 50 BHCs as well. Using Equation (1) through Equation (5), we analyzed the entropy coefficients of total assets for the 900 BHCs and each subgroup. The result is presented in Table 2.

The total assets of the top 900 BHCs (Table 2, Column 12) demonstrate a slight trend toward diversification between 1986-1990 (7.27 – 7.59) and thereafter, a trend change toward concentration (7.59 – 5.21). Clearly, BHCs were responding to the banking deregulations of 1980 through 1999. Please note that the 900 BHCs entropy coefficients would range from a minimum of zero to a maximum value of $C = \log_2 900 = 9.81$. The maximum value is used to calculate the concentration index where the higher value indicates lower concentration. The asset concentration index is calculated by dividing entropy coefficient by the maximum value. Obviously, since

² Source: http://www.chicagofed.org/economic_research_and_data/bhc_data.cfm

1990, the BHCs have shown a remarkable degree of the total assets concentration increasing, which is indicated by the assets concentration index decreasing from 74% (7.27/9.81) in 1986 to 53% (5.21/9.81) in 2008.

Keeping each subgroup independent and applying Equation (3), the within-set entropy coefficient of each subgroup is calculated and presented in Table 2, Columns 1-9. Since each subgroup consists of 100 BHCs, the entropy coefficients should range from a minimum of zero and a maximum value of $C = \text{Log}_2 100 = 6.64$. Column 1 is the result of the first top 100 BHCs total assets entropy coefficients and exhibits the same pattern of changes that occurred in all 900 BHCs total assets reported earlier. Entropy coefficients dropped from 5.87 (88%) in 1986 to 4.49 (67%) in 2008, signifying the concentration of total assets among the first top 100 BHCs increased. However, remaining subgroups (second top 100 through bottom 100) did not exhibit any significant increase in total assets concentration (Figure 1). In fact, the *t*-statistics indicate slight diversification did take place in some subgroups during 1986 - 2008.

Table 1: Item Definition Of Data Used In This Study

	Database Item Number	Item Definition
Total Assets	BHCK2170	Total Assets
Asset I	BHCK0081	Noninterest-bearing balances and currency and coin
	BHCK0395	Interest-bearing balances in U.S. offices
	BHCK0397	Interest-bearing balances in foreign offices, edge and agreement subsidiaries and IBFs
	BHCK1350	Federal funds sold and securities purchased under agreements to resell in domestic offices of the bank and of its edge and agreement subsidiaries, and in IBFs
Asset II	BHCK2122	Total loans and leases, net of unearned income
Asset III	BHCK2145	Premises and fixed assets (including capitalized leases)
	BHCK2150	Other real estate owned
Asset IV	BHCK2130	Investments and unconsolidated subsidiaries and associated companies
	BHCK2155	Customers' liability to this bank on acceptances outstanding
Asset V	BHCK3164	Mortgage servicing assets
Asset VI	BHCK3163	Goodwill
	BHCK2160	Other assets
SWAP Instruments	BHCK3450	Interest rate contracts - notional value of all outstanding interest rate swaps
	BHCK3826	Foreign exchange swaps
	BHCK8719	Equity swaps
	BHCK8720	Commodity and other swaps

The result of the between-set entropy coefficients is given in Column 11 of Table 2. The between-set figures indicate the extent to which the total assets of 900 BHCs are distributed among nine subgroups with each containing 100 BHCs. The entropy coefficient of 1.24 in 1986 declined to 0.56 in 2008, indicating a trend toward a greater between-set concentration³.

The result of the entropy coefficients clearly confirmed our observation of the raw data indicating that most of the asset concentration took place among the first top 100 BHCs. Given this observation, we further divided the first top 100 BHCs into subgroups of the top 50 and the bottom 50.

³ Since there are 9 subgroups, entropy coefficients would range from a minimum of zero to a maximum value of $C = \text{Log}_2 9 = 3.17$.

Table 2: Within-Set And Between-Set Entropy Coefficients For 900 Bank Holding Companies Total Assets (1986 ~ 2008)

Quarter	(1) Within Set 1 st Top 100	(2) Within Set 2 nd Top 100	(3) Within Set 3 rd Top 100	(4) Within Set 4 th Top 100	(5) Within Set 5 th Top 100	(6) Within Set 6 th Top 100	(7) Within Set 7 th Top 100	(8) Within Set 8 th Top 100	(9) Within Set Bottom 100	(10) Total Weighted Within Set	(11) Between Sets	(12) Total
1986 Q3	5.8715	6.5708	6.6134	6.6262	6.6383	6.6403	6.6418	6.6425	6.6406	6.0281	1.2441	7.2723
1987 Q3	5.8702	6.5739	6.6142	6.6276	6.6382	6.6402	6.6420	6.6424	6.6422	6.0154	1.1779	7.1933
1988 Q3	5.8965	6.5766	6.6129	6.6342	6.6373	6.6401	6.6426	6.6425	6.6424	6.0352	1.1757	7.2108
1989 Q3	5.8930	6.5757	6.6155	6.6337	6.6379	6.6399	6.6424	6.6424	6.6426	6.0279	1.1495	7.1775
1990 Q3	6.1079	6.5761	6.6095	6.6142	6.6371	6.6372	6.6409	6.6424	6.6420	6.2309	1.3618	7.5927
1991 Q3	6.0758	6.5735	6.6069	6.6147	6.6351	6.6396	6.6412	6.6417	6.6426	6.2027	1.3397	7.5423
1992 Q3	5.9350	6.5803	6.6053	6.6205	6.6330	6.6415	6.6413	6.6418	6.6427	6.0869	1.2851	7.3720
1993 Q3	5.9541	6.5582	6.6141	6.6274	6.6361	6.6412	6.6418	6.6423	6.6429	6.0825	1.1734	7.2560
1994 Q3	5.8530	6.5457	6.6161	6.6250	6.6372	6.6397	6.6418	6.6425	6.6431	5.9892	1.1050	7.0942
1995 Q3	5.8516	6.5590	6.6145	6.6259	6.6372	6.6395	6.6419	6.6422	6.6429	5.9887	1.1031	7.0919
1996 Q3	5.7149	6.5744	6.6120	6.6338	6.6394	6.6405	6.6412	6.6426	6.6428	5.8609	1.0239	6.8848
1997 Q3	5.6542	6.5611	6.6150	6.6284	6.6408	6.6397	6.6417	6.6425	6.6429	5.7949	0.9574	6.7523
1998 Q3	5.5409	6.5409	6.6202	6.6325	6.6393	6.6415	6.6418	6.6426	6.6430	5.6861	0.9116	6.5977
1999 Q3	5.3875	6.5525	6.6176	6.6341	6.6395	6.6413	6.6415	6.6427	6.6427	5.5341	0.8225	6.3567
2000 Q3	5.3686	6.5460	6.6159	6.6354	6.6401	6.6417	6.6415	6.6425	6.6430	5.4954	0.7313	6.2267
2001 Q3	5.2140	6.5505	6.6170	6.6350	6.6403	6.6419	6.6422	6.6426	6.6428	5.3384	0.6587	5.9971
2002 Q3	5.2768	6.5511	6.6178	6.6353	6.6403	6.6415	6.6426	6.6421	6.6431	5.4004	0.6791	6.0795
2003 Q3	5.2657	6.5435	6.6216	6.6352	6.6407	6.6410	6.6421	6.6421	6.6433	5.3827	0.6469	6.0296
2004 Q3	5.1785	6.5546	6.6190	6.6369	6.6392	6.6414	6.6425	6.6426	6.6430	5.2881	0.5831	5.8713
2005 Q3	5.2285	6.5579	6.6226	6.6365	6.6395	6.6420	6.6420	6.6428	6.6430	5.3317	0.5732	5.9049
2006 Q3	4.7505	6.5723	6.6316	6.6384	6.6409	6.6419	6.6422	6.6430	6.6416	4.9095	0.6459	5.5554
2007 Q3	4.5729	6.5769	6.6313	6.6382	6.6407	6.6424	6.6411	6.6430	6.6406	4.7312	0.5991	5.3303
2008 Q3	4.4920	6.5852	6.6319	6.6372	6.6415	6.6422	6.6424	6.6426	6.6406	4.6444	0.5639	5.2083

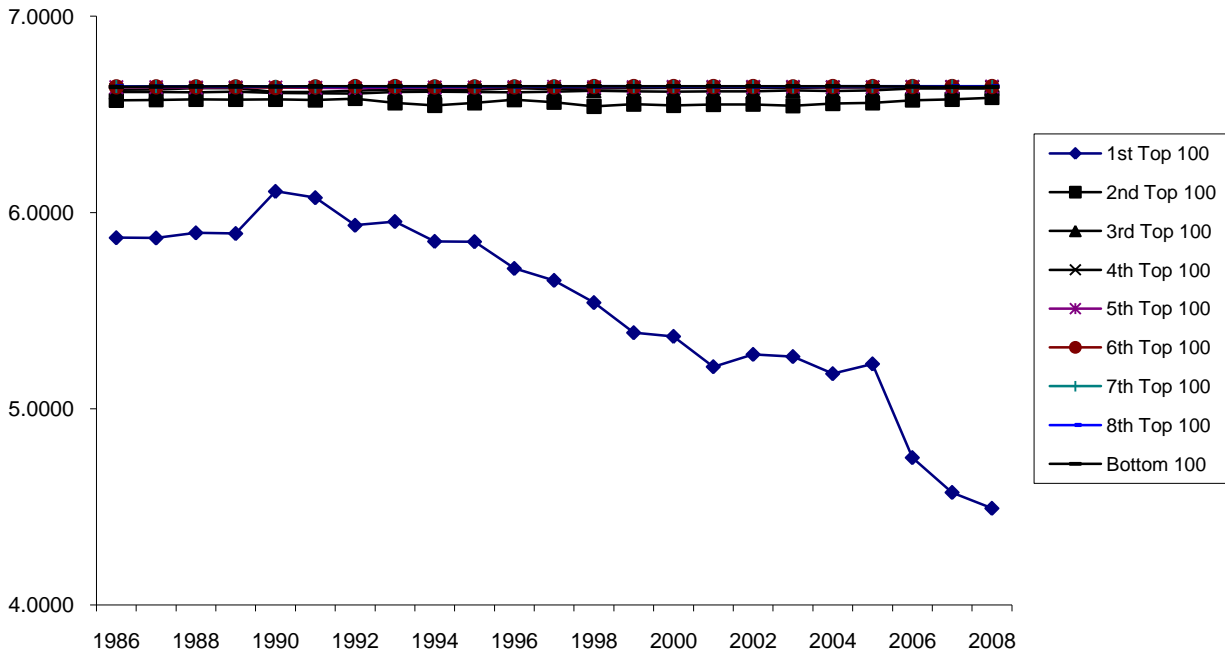


Figure 1: Entropy Coefficients Of Total Assets Of 900 BHCs (In 9 Subgroups Of 100)

The results of the entropy coefficients for the top 50 and bottom 50 BHCs total assets are given in Table 3, Column 1, and Table 4, Column 1, respectively. The top 50 BHCs subgroup shows a significant trend toward concentration of total assets (5.13 or 91% in 1986 to 4.23 or 75% in 2008) and the bottom 50 subgroup exhibits no concentration (5.60 or 99% both in 1986 and 2008).

Applying the same methodology to the selected groups of individual assets (see Table 1), we further examine the concentration pattern of these assets for the top 50 and bottom 50 BHCs during 1986-2008. The results of the entropy coefficients of different assets are given in Tables 3 and 4, Columns 2-8. The bottom 50 BHCs' entropy coefficients changed slightly while the top 50 BHCs entropy coefficients changed significantly for all selected types of assets. Entropy coefficients of mortgage serving assets for the top 50 BHCs increased from 3.40 in 1986 to 4.24 in 1991 and thereafter declined steadily, to 2.83 in 2008. Asset IV (as defined in Table 1) and SWAP instruments exhibited a major decline in entropy coefficients in relation to all other types of assets. The most noteworthy item was the entropy coefficients of the SWAP instruments by the top 50 BHCs that changed from 3.76 or 67% in 1986 to 1.84 or 33% in 2008.

Table 3: Entropy Coefficients For Top 50 Bank Holding Companies Assets (1986 ~ 2008)

Quarter	(1) Total Assets	(2) Asset I	(3) Asset II	(4) Asset III	(5) Asset IV	(6) Asset V	(7) Asset VI	(8) SWAP
1986 Q3	5.1293	5.0540	5.0900	5.1296	4.4080	3.4025	4.7221	3.7685
1987 Q3	5.1652	4.9190	5.1454	5.1128	4.5537	3.5515	4.6894	3.7813
1988 Q3	5.2155	5.0578	5.1862	5.1801	4.5606	3.5677	4.8028	3.6891
1989 Q3	5.2227	5.0523	5.1786	5.1841	4.4860	3.8475	4.7603	3.6615
1990 Q3	5.2961	5.2014	5.2469	5.2061	4.5924	3.8521	4.8980	3.6838
1991 Q3	5.2954	5.2575	5.2452	5.2193	4.4241	4.2351	4.9024	3.7536
1992 Q3	5.1823	5.1310	5.1178	5.1056	4.2052	4.0842	4.7571	3.4878
1993 Q3	5.2206	5.1621	5.1816	5.1434	4.2805	4.0304	4.7671	3.4232
1994 Q3	5.1496	5.0665	5.1414	5.1200	4.3420	4.0373	4.8904	3.2680
1995 Q3	5.1484	5.0618	5.1484	5.1121	4.3552	3.9694	4.9445	3.1664
1996 Q3	5.0589	5.0565	5.0757	4.9889	4.3561	3.6493	4.8869	2.8604
1997 Q3	5.0385	4.5308	5.1037	4.9962	4.3292	3.9751	4.8906	2.7512
1998 Q3	4.9439	4.3622	4.9947	4.9348	4.2094	3.9572	4.7515	2.7935
1999 Q3	4.8197	4.2798	4.8872	4.8947	4.1911	3.9025	4.5311	3.0100
2000 Q3	4.8589	4.3278	4.8848	4.9573	4.1286	3.9839	4.6224	3.0139
2001 Q3	4.7616	4.2728	4.8146	4.8827	4.0974	3.8799	4.4481	2.7624
2002 Q3	4.7980	4.8274	4.8238	4.8858	4.0433	3.8762	4.5854	2.8101
2003 Q3	4.8013	4.7485	4.8427	4.9687	4.0829	3.8633	4.5517	2.8305
2004 Q3	4.7492	4.6784	4.8200	4.9178	4.0601	3.9927	4.5801	2.9106
2005 Q3	4.8273	4.7249	4.8819	4.9341	3.9271	3.8787	4.7016	2.9043
2006 Q3	4.4282	4.3310	4.5645	4.7161	3.2199	3.2643	4.1672	1.9449
2007 Q3	4.2851	4.0700	4.4234	4.6309	3.0744	2.9947	4.1591	1.7969
2008 Q3	4.2258	3.9656	4.3420	4.5275	3.0745	2.8325	4.1072	1.8441

Table 4: Entropy Coefficients For Bottom 50 Bank Holding Companies Assets (1986 ~ 2008)

Quarter	(1) Total Assets	(2) Asset I	(3) Asset II	(4) Asset III	(5) Asset IV	(6) Asset V	(7) Asset VI	(8) SWAP
1986 Q3	5.5959	5.4793	5.5726	5.5267	4.2573	3.7783	5.4167	4.6065
1987 Q3	5.5902	5.3915	5.5731	5.5029	4.3733	3.5351	5.4556	4.4443
1988 Q3	5.5926	5.3950	5.5789	5.4908	4.2074	2.9508	5.4559	4.4735
1989 Q3	5.5898	5.3692	5.5654	5.5072	3.9731	3.9220	5.4392	4.3387
1990 Q3	5.6118	5.4302	5.5975	5.5049	4.7373	3.0845	5.1477	4.7359
1991 Q3	5.6068	5.3477	5.6013	5.4796	4.6176	3.6135	5.4060	4.7541
1992 Q3	5.5957	5.3549	5.5922	5.5051	4.0031	2.5726	5.4127	4.7238
1993 Q3	5.5943	5.3621	5.5945	5.4964	3.7703	3.7321	5.3572	4.9060
1994 Q3	5.5999	5.4445	5.5978	5.4978	3.6720	3.7387	5.4383	4.8729
1995 Q3	5.5940	5.4805	5.5900	5.5105	3.6564	3.7224	5.5247	4.5575
1996 Q3	5.5712	5.4708	5.5667	5.4924	3.1812	3.5083	5.4435	4.3088
1997 Q3	5.5537	5.3782	5.5533	5.4894	4.2909	3.8300	5.3644	4.3090
1998 Q3	5.5360	5.4134	5.5242	5.4892	3.9686	3.5303	5.2951	4.4007
1999 Q3	5.5292	5.2950	5.5080	5.4442	3.2432	3.2847	5.2203	3.4005
2000 Q3	5.5164	5.1052	5.5112	5.4059	4.0973	3.2975	5.1818	4.4359
2001 Q3	5.5322	4.9249	5.5199	5.3988	4.0307	3.2404	5.1870	4.2486
2002 Q3	5.5328	5.3666	5.4917	5.3588	4.1074	3.5024	5.1863	4.3621
2003 Q3	5.5309	5.3047	5.4794	5.3143	3.6627	3.4149	5.1215	4.2845
2004 Q3	5.4899	5.1678	5.4153	5.3390	3.9594	2.8397	5.1466	4.4353
2005 Q3	5.4448	5.2354	5.3316	5.2796	1.9568	2.2994	5.0904	4.3965
2006 Q3	5.5822	5.3265	5.5200	5.3087	3.5897	3.4988	5.4296	3.9625
2007 Q3	5.5908	5.4665	5.5429	5.3291	3.3973	3.3205	5.3650	4.2821
2008 Q3	5.5997	5.0387	5.5453	5.3441	3.2309	3.1395	5.4174	4.1630

CONCLUSION

In light of the recent financial turmoil which showed that the largest bank holding companies' (i.e., Bank of America, Citicorp, etc.) systematic risk exceeded their ability to remain solvent, the result of this study has a significant policy implication (i.e., bail out the largest bank under the too-big to-fail doctrine).

Among the largest 900 BHCs in the United States, only the top 50 exhibited significant rise in total assets concentration during 1986-2008, while the remaining 850 BHCs did not exhibit any noticeable change in total assets concentration. Similarly, the concentration of the selected groups of individual assets also increased only among the 50 largest BHCs. What is more revealing is the substantial increase in usage of SWAPs as hedging instruments by the largest BHCs in the United States.

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NOTES