

Changes in the Size Structure of the World's Largest Banks by Country, 1990-2000

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Using data on assets of the major banks of 29 countries, this paper compares these countries in terms of totals and averages. The paper also compares asset concentration among the leading banks of those 29 countries using the Herfindahl and Theil's entropy indexes for measuring concentration. Special comparisons are made among the leading countries. The paper also looks at banking laws and regulations that may impact the levels of concentration among the countries.

Introduction

International banking increased dramatically during the last decades with the establishment of substantial networks of banking offices and branches around the world. Rhoades (1996) notes that globalization of large-scale wholesale banking may explain, in part, the large bank mergers in the United States that began in the mid-1980s that parallel similar bank merger activity in the rest of the world.

The growth of large banks may contribute to concentration arising from the accumulation of other banks' assets or from internal growth. Concentration, according to Tschoegl (1982), is conducive to cartelistic and oligopolistic behavior where a relatively small number of banks trade simultaneously across international markets and, in the process, determine the global money supply and manipulate the exchange rate.

Concentration of financial power in the hands of a few large international banks was a concern as early as 1979 to the Organization of Economic Cooperation and Development (OECD, 1979).

During economic downturns in the global economy, a decline in asset values and deterioration of capital positions of major banks in the system may develop into a major banking crisis. Greater banking concentration may lead to greater severity of financial turmoil. The failure of a major bank can set in motion a fear that other banks may tumble, resulting, as Kaufman (1988, 1994) observes, in bank runs and

the fear of contagion on an international scale. The risk of disruption in the financial system may require lenders of last resort, as pointed out by Freixas et al. (2000).

Some notable works dealing with concentration in international banking are by Aliber (1975), Rhoades (1982), Rhoades (1983), Tschoegl (1982), and Goldberg and Hanweek (1991). Aliber (1975) researches the overall concentration of the world's largest 100 banks from 1965 to 1974. Rhoades (1982) compares U.S. banking firm sizes with industrial firm sizes. Rhoades (1983) analyzes the steady decline from 1956 to 1980 in the U.S. share of deposits in the 100 largest banks in the world. He also finds an increase in concentration by the largest banks. Tschoegl (1982), on the other hand, finds that concentration decreased among the largest 100 banks in the world between 1969 and 1979. Goldberg and Hanweek (1991) calculate the asset shares of the 300 largest banks by country.

Related Literature

Many other scholars have addressed a variety of subjects related to concentration in domestic and international banking. Short (1979), claiming that the relationship between concentration and profit in American banking is well studied, examines such relationship for banking in Canada and Western Europe. Short uses regression analysis and includes (along with concentration measures) other explanatory variables such as central bank discount rate, a dummy variable to distinguish government and privately owned banks, and leverage (the ratio of total assets to shareholders' funds). His findings substantiate the commonly accepted belief that greater concentration leads to higher profit rates. Bourke (1989) traces a similar theme to that of Short by addressing the connection between concentration and other determinants of profitability from 1972 to 1981 for twelve countries in Europe, North America, and Australia. The sample chosen, totaling 90 banks, is every bank that fell within the top 500 banks in the world in 1980 ranked by total assets. Bourke concludes that a connection is present between higher levels of concentration and lower levels of loan portfolio risk, supporting a hypothesis of risk avoidance by banks who command high degrees of market power.

Honohan and Kinsella (1982) employ a modified version of the traditional measures of concentration for a sample of twelve countries and find a significant connection between profitability and concentration. This issue is examined again by Emmons and Schmid (2000), reviewing at the same time the empirical approach to banking competition, the so-called SCP (structure-conduct-performance) paradigm. This paradigm remains the dominant approach in the regularity analysis of antitrust with a presumption that the SCP, including measures of concentration, is an adequate indicator of the intensity of competition. Competition influences prices of financial services which, in turn, determine profit—the higher the concentration, the higher the profits. Emmons and Schmid also point to contradictory opinion, explained for the banking industry by Berger (1995), that large market shares are a consequence of

efficiency (lower costs). This outcome is, of course, desirable because it increases social welfare. Emmons and Schmid investigate the role of credit unions in their competition with commercial banks. They find that concentration in commercial banking increases in response to increased credit union participation. Commercial banks, upon losing market share, respond with consolidation through mergers, by closing branches, or by the exit of some banks due to failures.

Cyree, Wansley, and Boehm (2000) find that profitability does not necessarily increase in response to increase in concentration. They conclude that deregulation and re-regulation of the banking industry (for example, by the erosion of the Glass-Steagall Act and the introduction of the Riegle-Neal Act of 1994 whereby banks can easily acquire other banks) partially may explain the growth of banks in recent years in the United States.

Wilson and Williams (2000) also cite regulatory framework in banking growth. They explain that banks are subject to tight regulation that often insulates them from competitive pressure. Because of fear that failure of a bank, especially a major one, may lead to a domino effect, regulation attempts to minimize failure. At times, regulatory authorities bail out banks to ensure stability of financial markets.

Removal of regulatory boundaries between two or more financial industries resulting in mergers—such as banking and insurance as observed by Bajtelsmit and Ligon (1996)—is another path to higher concentration of economic power. Economic power is a force that may impede regulators' abilities to control potential excesses of big enterprises. On the same theme, the Financial Services Modernization Act of 1999, also known as the Gramm-Leach-Bliley Act, extended economic power by opening the way for financial conglomerates to perform financial services normally offered by specialized entities.

This act, according to Robinson (2002), is one of the most important pieces of legislation affecting the banking industry in more than 50 years. It allows banks to engage in underwriting and dealing in securities, offer insurance products, and undertake merchant activities where firms directly invest in companies. Such investment, which includes seed money to start-up companies as well as funding to more mature firms, is done purely for greater returns. Venture capital responsible for the success of important companies such as Microsoft Corporation, Intel Corporation, Netscape Corporation, and Genentech Incorporated is responsible for almost 6 percent of jobs and 13 percent of U.S. gross domestic product in 2000. The entrance of banks into the venture capital sphere of activity will further boost their impact.

The easing of banking regulations in the United States may or may not coincide with similar trends in other countries. Bourke (1989) attests to the fact that regulation outside the United States varies considerably from country to country. The empirical problem in examining the intensity of regulation among a large number of countries is daunting. Regulations in various countries are not readily susceptible to comparative measurement.

Regulations, in general, are dependent on the economic and political make-up of institutions in a country. La Porta et al. (1999) stress the idea that good economic institutions that promote economic growth and prosperity are the products of good quality governments. Basic ingredients for good quality governments are uncorrupt bureaucracy; protection of property rights and enforcement of contracts; and modest taxation and regulation. These qualities, in turn, are the products of economic, political, and cultural forces such as whether the laws of the land have an English legal origin, a French legal origin, or socialist doctrines; whether the religion practiced by the majority of the population is Protestant, Catholic, or Muslim; and whether the country is close to the equator.

These ideas about the quality of government are examined further by Beck, Demirguc-Kunt, and Levine (2001, 2002) and La Porta et al. (2002) who empirically assess the connection of legal origin (common law, French, and German civil codes) in a large number of countries and their differences in financial and economic institutions. This research shows that legal traditions spread throughout the world by means of conquest, colonization, and imitation; these authors conclude that legal traditions have consequences. These articles also provide a rich source of data that will be used in the research.

This paper focuses on measuring asset concentration for the banking industry for 29 countries from a set of approximately 70 countries with banks in the top 1,000 largest international banks. In total, the number of banks included is about 800 of 1,000. In most studies, the number of countries does not exceed 12. The samples primarily are drawn from industrialized countries. The period under consideration is the 1990s. This period coincides with the most recent bubble in the U.S. economy and the post-bubble depression in the Japanese economy, two of the most powerful economies in the world. The concentration measures differ from most of those reviewed where descriptive measures are employed. Instead of relating concentration and profitability as is typically done, we will endeavor to solicit socio-economic variables related to regulation and variables pertinent to financial and banking considerations. It is of interest to determine whether regulations imposed by the Basle Committee on Banking Supervision produce uniform behavior among banks of different countries. All studies cited use data from a list of the top 300 or 500 banks in the world. The source of data in this research is the top 1,000 banks, allowing the inclusion of a larger number of countries.

Major empirical findings of the paper are that concentration among international banking differs significantly, and that banking in the United States experienced a big surge in concentration in most recent years. Furthermore, in spite of wide variation in laws and regulations, the paper finds almost no perceptible statistically significant differences in most permissible banking activities

Data and Preliminary Observations

The monthly publication *The Banker*, begun in 1926 in London, is a publication of the daily *Financial Times*. Since 1970 the July issue of *The Banker* has provided an authoritative yearly listing of the world's most prominent commercial banks ranked by strength according to the size of capital. The annual list initially consisted of the top 300; it then was expanded to 500; and finally it was enlarged to 1,000 in 1987. The banks are also grouped by countries. The period selected for this study is 1990 to 2000 in two-year intervals.

The 1,000 banks' total assets aggregates for the selected years 1990 to 2000 were (trillions of current dollars): \$19.9; \$24.4; \$26.9; \$32.0; \$32.2, and \$36.7. A summary of the 1,000 banks for 2000 by major geographical regions for \$36.7 trillion of assets and \$309.7 billion of pre-tax profits gives the following break-down:

	Number of Banks	Assets %	Pre-Tax Profit %
Japan	116	21	8
United States	199	14	33
Latin America	50	1	2
European Union	288	43	40
Rest of Europe	100	6	8
Asia ex-Japan	150	10	3
Middle East	77	2	2
Rest of the World	20	3	4
Total	1,000	100	100

The 1,000 banks are in approximately 70 countries. In this study, 29 countries were selected for inclusion based on the criterion that, with some exceptions, these countries have at least six banks. The rationale was that a sample of at least six is required to establish minimal statistical credibility. Approximately two-thirds of the countries are economically developed.

Measurement of Asset Concentration

The 1990 to 2000 assets data supplied by *The Banker* (1990-2000) provide an opportunity for a comparison of concentration among the largest international banks by country. The interest in the largest enterprises, as Driffield (2001) observes, stems from the realization that a significant motive of multinational activity is the potential for monopoly rents in the host countries. Trevino and Daniels (1994) similarly note that when the market is highly concentrated, competition most likely will be diminished.

Shares of assets for the largest banks in 29 selected countries are subjected to two statistical measures in order to determine the degree of concentration. Hannah and Kay (1977) found the Herfindahl (H) and Theil's entropy (E), the two concentration measures chosen for this study, to be the most reliable among the many

available measures. Two measures are used for a number of reasons, primarily for contrast. Also, while the H index gives higher weights to the banks with the largest assets, the E index gives higher weights to banks with the smallest assets. Additionally, two measures provide alternatives in the use of statistical analysis in the sense that one of them is better suited than the other. Both measures take the form $I = 3_i P_i W_i$, where P_i ($3_i P_i = 1.00$) is the share of the i^{th} bank, $i = 1, \dots, n$, and W_i is an assigned weight. Also calculated is the number-equivalent for both H and E, in the sense that the numbers are equal sized banks that yield H or E for a given country.

The Herfindahl (H) index weights each bank share P_i by itself

$$H = \sum_i P_i P_i . \quad (1)$$

When one bank holds all shares, $H = 1.0$; when shares are held equally, $H = 1/n$. Thus, $1/n \leq H \leq 1.0$. The appeal of H, according to Jacquemin and Berry (1979), is its intuition and its ease of understanding. Note that H gives larger weights to larger banks, making it a meaningful measure of concentration—perhaps explaining the reasoning behind its use in merger guidelines by the Department of Justice-Federal Trade Commission in horizontal merger and monopolization cases (Rhoades, 1997). Woosley, King, and Padhi (2000) also note that the Federal Reserve uses the index as a first step in deciding the likely competitive impact of mergers.

It can be shown (Clarke, 1985) that the coefficient of variation,

$$v = S / \bar{P} \quad (2)$$

where

$$\bar{P} = 1/n$$

and

$$S = [\sum_i (P_i - \bar{P})^2 / (n-1)]^{1/2}$$

and where $\bar{P}$ and S are the mean and the standard deviation, is related to H by the relationship

$$V^2 = nH - 1 . \quad (3)$$

As a measure of relative dispersion, the coefficient of variation is smallest when dispersion is least.

The second measure of concentration is based on information theory, the Theil's (1967) entropy

$$\begin{aligned} E &= \sum_i P_i \log 1/P_i \\ &= -\sum_i P_i \log P_i, \quad 0 \leq E \leq \log n, \end{aligned} \quad (4)$$

where $P_i(\sum P_i = 1.00)$ refers to the share of the i^{th} bank in a country. If all the n banks in a country have an equal share, then $E = \log n$, and concentration is at a minimum in contrast to $E = 0$ when one bank controls all shares. Clarke (1985) indicates that standardization of E so that it falls in the interval $<0, 1>$ is an appropriate way to facilitate comparison among countries. This is done by forming a relative measure of entropy,

$$E' = E / \log n . \quad (5)$$

E' , as explained by Jacquemin and Kumps (1971), is the actual entropy as a percent of maximum entropy. Note that the smaller the value of E , the larger is the concentration, and that, unlike H , E is more sensitive to very small banks.

The numbers-equivalent, which is the number of banks m yielding H or E if all firms were of equal size, is another way for measuring concentration. According to Miller (1972), given an H or E and n firms, m provides the number of equalized banks necessary to generate a level of concentration comparable to that obtained in the industry.

For the H index, when all banks have equal shares,

$$m = 1/H. \quad (6)$$

Clarke (1985) shows that m , in terms of the coefficient of variation V , is

$$m = n / (V^2 + 1) .$$

For the E index, the numbers-equivalent of equal-sized banks with the same value of E is

$$m = \text{antilogarithms of } E. \quad (7)$$

For comparative purposes, because the number of banks is not the same among the top 1,000, the numbers-equivalent m for H in equation (6) and E in equation (7) is standardized according to

$$m' = m / n . \quad (8)$$

Preliminary Empirical Results

Table 1 reports for 1990 to 2000 the mean assets and the number of banks for the 29 countries. Total assets in 1990 for the banks in the 29 countries were approximately \$18.62 trillion. Total assets increased to \$30.4 trillion in 1996 and reached \$34.5 trillion by 2000, all in current dollars.

The 112 banks of Japan had in 1990 \$6.4 (56.9×112) trillion in total assets, accounting for 32 (6.4×19.9) percent of total assets of 1,000 banks. By comparison, the 222 banks of the United States accounted for \$2.5 (11.4×222) trillion, a mere 13 (2.5×19.9) percent. Germany, with 82 banks and approximately 9 percent of total assets, accounted for \$1.8 trillion.

Table 1—Number and Mean Assets of Major Banks in 29 Countries, 1990-2000

Country	Mean Assets (\$ Billions)						Number of Banks in Top 1000					
	1990	1992	1994	1996	1998	2000	1990	1992	1994	1996	1998	2000
Argentina	3.5	2.8	4.1	4.4	7.9	8.6	6	7	8	10	8	8
Australia	30.2	32.2	27.8	39.1	66.3	66.8	9	10	10	9	7	7
Austria	10.0	13.4	14.1	15.3	16.6	19.2	20	18	16	22	20	18
Bahrain	6.1	5.3	4.5	4.7	5.3	5.8	6	6	7	6	6	6
Belgium	28.1	40.7	46.4	68.7	66.1	115.7	11	10	10	10	8	5
Brazil	9.0	8.1	10.3	10.1	15.0	12.5	18	17	18	29	26	18
Canada	48.6	89.6	60.2	74.3	107.6	98.7	8	3	9	9	8	9
China	21.8	35.6	161.6	169.4	209.4	151.2	8	8	6	6	6	9
Denmark	9.8	17.3	15.8	23.7	25.7	35.7	16	12	10	8	7	8
Finland	19.6	15.8	16.8	26.6	34.4	53.0	7	9	6	4	3	3
France	53.5	75.9	77.5	113.7	123.5	178.3	28	27	26	23	19	14
Germany	22.3	29.7	34.7	52.1	54.2	60.2	82	87	83	82	82	84
Hong Kong	24.8	13.5	4.5	6.0	6.6	7.3	6	16	20	20	20	22
Italy	11.1	17.0	16.4	20.6	21.2	24.7	108	96	79	71	68	58
Japan	56.9	62.9	73.9	72.3	59.8	68.0	112	108	117	118	118	116
Korea	13.3	10.2	12.4	16.1	14.4	30.6	19	28	28	30	20	14
Luxembourg	14.9	16.6	18.4	27.2	26.9	31.0	5	4	4	4	4	3
Netherlands	47.0	48.1	58.9	63.9	81.2	122.9	8	12	11	13	12	10
Portugal	6.4	8.9	11.2	20.1	17.0	25.7	9	10	11	9	9	7
Saudi Arabia	7.1	7.6	7.6	8.9	10.2	11.3	8	10	11	10	10	10
Spain	12.5	15.1	15.6	22.7	20.1	22.3	35	45	41	36	41	41
Sweden	20.7	26.2	44.7	54.9	82.9	96.4	12	13	5	5	4	3
Switzerland	15.8	22.4	30.7	40.6	46.6	41.4	30	33	30	30	31	33
Taiwan	12.1	17.1	10.5	12.7	13.6	14.2	15	17	35	37	37	38
Thailand	5.1	7.3	9.7	14.3	12.8	19.5	10	11	12	12	9	6
Turkey	3.9	4.9	4.9	5.9	7.2	8.7	7	7	8	6	8	12
U.A.E.	2.9	3.2	3.5	3.7	4.0	4.5	8	7	7	7	9	9
U.K.	29.1	33.0	41.1	51.3	76.6	90.5	32	34	33	31	32	29
U.S.	11.4	13.5	16.2	21.8	26.2	25.2	222	192	178	156	154	199
Total—All							867	860	840	813	786	799

Source: *The Banker* various issues.

Again in 1996, Japan, with the largest assets of \$8.5 trillion, accounted for close to 27 percent of total assets, followed by Germany, with 4.3 trillion accounting for approximately 13 percent, followed by the United States, with \$3.4 trillion, accounting for 11 percent. By 2000 the gaps in total assets between Japan, Germany, and the United States narrowed to approximately 7.9, 5.1, and 5.0 (in trillions) or in terms of percentages of totals to approximately 22, 14, and 14. France and the United Kingdom were the fourth and fifth countries, with large assets accounting in 1990, 1996, and 2000 for 8 percent and 5 percent; 9 percent and 5 percent; and 7.2 percent and 7.6 percent, respectively.

In 1990 Japan held the largest mean assets of \$56.9 billion, followed by the Netherlands with \$47 billion. The United Arab Emirates held the smallest mean assets, totaling \$2.9 billion. In 1996 China held the largest mean assets, with an

Table 2a—Herfindahl Index of Concentration of Major Banks in 29 Countries, 1990-2000

Country	H					
	1990	1992	1994	1996	1998	2000
Argentina	.2766	.3798	.2507	.1679	.1853	.2055
Australia	.1941	.1990	.1965	.2231	.2292	.2227
Austria	.1131	.1370	.1565	.1151	.1947	.2183
Bahrain	.4842	.5174	.4502	.6612	.6544	.5866
Belgium	.1498	.1464	.1541	.1638	.2266	.4675
Brazil	.3034	.2937	.1944	.1229	.1323	.1806
Canada	.1753	.3690	.1589	.1572	.1682	.1670
China	.7604	.1948	.2669	.2727	.2806	.2396
Denmark	.1008	.2102	.2147	.2530	.3345	.2620
Finland	.2110	.2068	.2450	.5063	.4240	.5694
France	.1084	.1012	.1087	.1001	.1302	.1747
Germany	.0444	.0439	.0452	.0489	.0531	.0702
Hong Kong	.9288	.5922	.0646	.0626	.0642	.0601
Italy	.0444	.0442	.0479	.0528	.0519	.0917
Japan	.0307	.0357	.0323	.0322	.0383	.0381
Korea	.0982	.0671	.0684	.0628	.0763	.1014
Luxembourg	.2228	.2540	.2545	.2557	.2567	.3344
Netherlands	.2432	.3378	.2898	.2738	.2889	.2977
Portugal	.1729	.1518	.1417	.1727	.1864	.2142
Saudi Arabia	.2283	.1708	.1289	.1347	.1316	.1447
Spain	.0762	.0774	.0827	.0943	.1036	.1639
Sweden	.1761	.1920	.2336	.2358	.2696	.3389
Switzerland	.1554	.1642	.1702	.2146	.2354	.3227
Taiwan	.1144	.1082	.0734	.0622	.0563	.0529
Thailand	.1772	.1654	.1430	.1331	.1550	.1986
Turkey	.2213	.1867	.1867	.2109	.1542	.1246
United Arab Emirates	.1905	.1899	.2016	.1879	.1555	.1473
United Kingdom	.1254	.1325	.1370	.1438	.1161	.1181
United States	.0216	.0234	.0268	.0298	.0368	.0581

Table 2b—Herfindahl Index of Concentration of Major Banks in 29 Countries, 1990-2000

Country	m					
	1990	1992	1994	1996	1998	2000
Argentina	3.61	2.63	3.99	5.96	5.40	4.87
Australia	5.15	5.02	5.09	4.48	4.36	4.49
Austria	8.84	7.30	6.39	8.69	5.14	4.58
Bahrain	2.07	1.93	2.22	1.51	1.53	1.70
Belgium	6.68	6.83	6.49	6.10	4.41	2.14
Brazil	3.30	3.40	5.14	8.14	7.56	5.54
Canada	5.70	2.71	6.29	6.36	5.95	5.99
China	1.32	5.13	3.75	3.67	3.56	4.17
Denmark	9.92	4.76	4.66	3.95	2.99	3.82
Finland	4.74	4.83	4.08	1.98	2.36	1.76
France	9.23	9.88	9.20	9.99	7.68	5.73
Germany	22.51	22.78	22.13	20.45	18.83	14.26
Hong Kong	1.08	1.69	15.49	15.97	15.57	16.64
Italy	22.53	22.64	20.88	18.93	19.26	10.90
Japan	32.60	28.03	30.96	31.06	26.08	26.25
Korea	10.18	14.90	14.61	15.93	13.11	9.86
Luxembourg	4.49	3.94	3.93	3.91	3.90	2.99
Netherlands	4.11	2.96	3.45	3.65	3.46	3.36
Portugal	5.78	6.59	7.06	5.79	5.36	4.67
Saudi Arabia	4.38	5.85	7.76	7.42	7.60	6.91
Spain	13.12	12.92	12.09	10.60	9.65	6.10
Sweden	5.68	5.21	4.28	4.24	3.71	2.95
Switzerland	6.43	6.09	5.87	4.66	4.25	3.10
Taiwan	8.74	9.24	13.63	16.09	17.77	18.92
Thailand	5.64	6.05	6.99	7.51	6.45	5.04
Turkey	4.52	5.36	5.36	4.74	6.49	8.03
United Arab Emirates	5.25	5.26	4.96	5.32	6.43	6.79
United Kingdom	7.98	7.55	7.30	6.95	8.61	8.47
United States	46.38	42.65	37.36	33.59	27.20	17.22

Table 2c—Herfindahl Index of Concentration of Major Banks in 29 Countries, 1990-2000

Country	m'=m/n					
	1990	1992	1994	1996	1998	2000
Argentina	.60	.38	.50	.60	.67	.61
Australia	.57	.50	.51	.50	.62	.64
Austria	.44	.41	.40	.39	.26	.25
Bahrain	.34	.32	.32	.25	.25	.28
Belgium	.61	.68	.65	.61	.55	.43
Brazil	.18	.20	.29	.28	.29	.31
Canada	.71	.90	.70	.71	.74	.67
China	.16	.64	.62	.61	.59	.46
Denmark	.62	.40	.47	.49	.43	.48
Finland	.68	.54	.68	.49	.79	.59
France	.33	.37	.35	.43	.40	.41
Germany	.28	.26	.27	.25	.23	.17
Hong Kong	.18	.11	.77	.80	.78	.76
Italy	.21	.24	.26	.27	.28	.19
Japan	.29	.26	.26	.26	.22	.23
Korea	.54	.53	.52	.53	.66	.70
Luxembourg	.90	.98	.98	.98	.97	1.00
Netherlands	.51	.25	.31	.28	.29	.34
Portugal	.64	.66	.64	.64	.60	.67
Saudi Arabia	.55	.59	.71	.74	.76	.69
Spain	.38	.29	.29	.29	.24	.15
Sweden	.47	.40	.86	.85	.93	.98
Switzerland	.21	.18	.20	.16	.14	.09
Taiwan	.58	.54	.39	.43	.48	.50
Thailand	.56	.55	.58	.63	.72	.84
Turkey	.66	.77	.67	.79	.81	.67
United Arab Emirates	.66	.75	.71	.76	.71	.75
United Kingdom	.25	.22	.22	.22	.27	.29
United States	.21	.22	.21	.22	.18	.09

Note: H is the Herfindahl index by equation (1), m is number equivalent by equation (6), and n is the number of banks. Source: *The Banker* various issues

average of more than \$169 billion. Again, the United Arab Emirates held the smallest mean among the 29 countries, with more than \$3.7 billion in assets. In 2000 France led with \$178 billion, followed by China with \$151 billion.

Concentration Results

The results of the two concentration measures, the Herfindahl (H) and Theil's entropy (E), for the 29 selected countries are shown in Tables 2 and 3. Table 2 shows the concentration measure Herfindahl (H), with the corresponding numbers-equivalent, m , by equation (6) followed by its standardization $m' = m/n$ by equation (8). For the top three countries in total assets (Japan, Germany, the United States), the numbers-equivalent for 1990, 32.6; 22.5; and 46.4, were changed in 1996 to 31.1; 20.1; and 33.6, and were changed further to 26.3; 14.3; and 17.2 in 2000. For the next two countries (France, United Kingdom), those ranked fourth and fifth in assets, the numbers-equivalent in 1990 were 9.2 and 8, were 10 and 7 in 1996, and were 16 and 8 in 2000.

Standardization of m to m' by dividing by number of banks n by equation (8) provides a clearer picture of the extent of concentration, the smaller m/n , the more concentration. These numbers for Japan, Germany, the United States, France, and the United Kingdom for 1990 were 0.29, 0.28, 0.21, 0.33, and 0.25. The numbers for 1996 changed to 0.26, 0.25, 0.22, 0.43, and 0.22. The numbers for 2000 changed further to 0.23, 0.17, 0.09, 0.41, and 0.29. The most dramatic change, indicating significant increase in concentration, is for the United States from 0.21 in 1990 to 0.09 in 2000.

Table 3 shows the results for 1990 to 2000 of Theil's entropy (E) standardization (E') by equation (5). To a great extent, the Theil values for m and $m' = m/n$ are consistent with those obtained from the Herfindahl (H). The respective numbers equivalent for Japan, Germany, United States, France, and the United Kingdom for 1990 were 51, 36, 93, 12, and 12, while for 1996 they were 51, 32, 59, 12, and 10. For 2000, the scores were 46, 24, 39, 7, and 12. In terms of m/n , the corresponding scores of the five countries for 1990, 1996, and 2000 were 0.45, 0.44, 0.42, 0.44, 0.39; 0.43, 0.39, 0.38, 0.54, 0.31; and 0.40, 0.28, 0.20, 0.51, and 0.41. Again, United States banking shows the greatest increase in concentration over the period.

Testing for Significance among the 29 Countries

To test for significant differences among mean concentration for the entire 29 countries under investigation, the analysis of variance approach is used with the entropy measure E. If the null hypothesis is rejected, it is possible to undertake further analysis by computing confidence intervals for each country and noticing the overlaps of the confidence intervals to judge which groups of countries are closest. It is possible for a country to be significantly different from others with mean scores less close.

Table 3a—Theil's Entropy Index of Concentration of Major Banks in 29 Countries, 1990-2000

Country	E'					
	1990	1992	1994	1996	1998	2000
Argentina	.8243	.6999	.8318	.8910	.8956	.8522
Australia	.8404	.7900	.8010	.7772	.8457	.8689
Austria	.8318	.8059	.7999	.8196	.7337	.7303
Bahrain	.6199	.6099	.6287	.5135	.5220	.5837
Belgium	.8661	.9000	.8850	.8560	.7946	.6574
Brazil	.6509	.6810	.7596	.7869	.7556	.7371
Canada	.8956	.9651	.8998	.8998	.9098	.8705
China	.3799	.8823	.8227	.8250	.8250	.7394
Denmark	.8952	.7472	.7950	.7937	.7157	.7592
Finland	.8846	.8083	.8752	.7129	.9227	.8013
France	.7511	.7800	.7653	.8013	.7607	.7439
Germany	.8137	.8070	.8044	.7858	.7708	.7159
Hong Kong	.2784	.4447	.9563	.9614	.9597	.9559
Italy	.7781	.7938	.8043	.8000	.8060	.7358
Japan	.8313	.8153	.8220	.8235	.8019	.8058
Korea	.8665	.8792	.8714	.8819	.9171	.9191
Luxembourg	.9743	.9956	.9949	.9935	.9923	.9991
Netherlands	.7539	.5404	.6369	.6477	.6416	.6430
Portugal	.9073	.9100	.9095	.8866	.8649	.8805
Saudi Arabia	.8557	.8860	.9232	.9375	.9420	.9090
Spain	.8271	.7937	.7893	.7846	.7583	.6841
Sweden	.8017	.7399	.9464	.9442	.9778	.9948
Switzerland	.7056	.6774	.6560	.6014	.5612	.4944
Taiwan	.8698	.8784	.8283	.8652	.8857	.8984
Thailand	.8750	.8704	.8862	.9029	.9224	.9546
Turkey	.8747	.9405	.9062	.9459	.9579	.9085
United Arab Emirates	.8938	.9327	.9012	.9202	.9177	.9300
United Kingdom	.7252	.6920	.6772	.6550	.7097	.7286
United States	.8383	.8384	.8155	.8180	.7772	.6925

Table 3a—Theil's Entropy Index of Concentration of Major Banks in 29 Countries, 1990-2000

Country	m					
	1990	1992	1994	1996	1998	2000
Argentina	4.38	3.90	5.64	7.78	6.44	5.9
Australia	6.34	6.17	6.32	5.52	5.18	5.4
Austria	12.08	10.27	9.19	12.60	9.01	8.3
Bahrain	3.04	2.98	3.40	2.51	2.55	2.8
Belgium	7.98	7.94	7.67	7.18	5.22	2.9
Brazil	6.56	6.89	8.98	14.15	11.73	8.4
Canada	6.44	2.89	7.22	7.22	6.63	6.8
China	2.20	6.26	4.37	4.39	4.39	5.1
Denmark	11.97	6.40	6.24	5.21	4.03	4.8
Finland	5.59	5.91	4.80	2.69	2.76	2.4
France	12.22	13.08	12.10	12.33	9.39	7.1
Germany	36.07	36.74	34.98	31.91	29.87	23.9
Hong Kong	1.65	3.43	17.55	17.82	17.73	19.2
Italy	38.21	37.45	33.60	30.27	29.99	19.8
Japan	50.53	45.58	50.12	50.85	45.86	46.1
Korea	12.83	18.72	18.24	20.07	15.60	11.3
Luxembourg	4.80	3.98	3.97	3.96	3.96	3.0
Netherlands	4.80	3.83	4.61	5.27	4.93	4.4
Portugal	7.34	8.13	8.85	7.01	6.69	5.5
Saudi Arabia	5.93	7.69	9.15	8.66	8.75	8.1
Spain	18.93	20.52	18.75	16.64	16.71	12.7
Sweden	7.33	6.67	4.59	4.57	3.88	3.0
Switzerland	11.02	10.68	9.31	7.73	6.88	5.6
Taiwan	10.54	12.05	19.01	22.74	24.49	26.3
Thailand	7.50	8.06	9.04	9.43	7.59	5.5
Turkey	5.49	6.23	6.58	5.45	7.33	9.6
United Arab Emirates	6.42	6.14	5.78	5.99	7.51	7.7
United Kingdom	12.35	11.48	10.67	9.48	11.70	11.6
United States	92.67	82.08	68.42	59.18	50.14	39.1

Table 3c—Theil's Entropy Index of Concentration of Major Banks in 29 Countries, 1990-2000

Country	m'=m/n					
	1990	1992	1994	1996	1998	2000
Argentina	.73	.56	.70	.78	.81	.74
Australia	.70	.62	.63	.61	.74	.78
Austria	.60	.57	.57	.57	.45	.46
Bahrain	.51	.50	.49	.42	.43	.47
Belgium	.73	.79	.77	.72	.65	.58
Brazil	.37	.41	.50	.49	.45	.47
Canada	.81	.96	.80	.80	.83	.75
China	.28	.78	.73	.73	.73	.56
Denmark	.75	.53	.62	.65	.58	.61
Finland	.80	.66	.80	.67	.92	.80
France	.44	.48	.47	.54	.50	.51
Germany	.44	.42	.42	.39	.36	.28
Hong Kong	.27	.21	.88	.89	.89	.87
Italy	.35	.39	.43	.43	.44	.34
Japan	.45	.42	.43	.43	.39	.40
Korea	.68	.67	.65	.67	.78	.81
Luxembourg	.96	.99	.99	.99	.99	1.00
Netherlands	.60	.32	.42	.41	.41	.44
Portugal	.82	.81	.80	.78	.74	.79
Saudi Arabia	.74	.77	.83	.87	.88	.81
Spain	.54	.56	.46	.46	.41	.31
Sweden	.61	.51	.92	.91	.97	.99
Switzerland	.37	.32	.31	.26	.22	.17
Taiwan	.70	.71	.54	.61	.66	.69
Thailand	.75	.73	.75	.79	.84	.92
Turkey	.78	.89	.82	.91	.92	.80
United Arab Emirates	.80	.88	.83	.86	.84	.86
United Kingdom	.39	.34	.32	.31	.37	.40
United States	.42	.43	.38	.38	.33	.20

Note: E' is standardize entropy by equation (5), m is the number equivalent by equation (7), and n is the number of banks. Source: *The Banker* various issues

For every period under consideration, the null hypothesis of equality of mean entropies, as expected, is rejected. The groups of countries as determined by the overlapping of confidence intervals at the five percent level, from the most concentrated to least concentrated for 1990 and 2000 are:

- 1990: Germany, Italy, Japan, United States
 France, Hong Kong, Spain, Switzerland, United Kingdom
 Austria, Brazil, China, Korea
 Denmark, Sweden, Taiwan
 Australia, Bahrain, Belgium, Netherlands, Portugal, Saudi Arabia, Thailand
 Argentina, Canada, Finland, Luxembourg, Turkey, United Arab Emirates
- 2000: Germany, Japan, United States
 Italy, Spain, Switzerland, Taiwan, United Kingdom
 Austria, Brazil, Hong Kong
 Bahrain, China, France, Korea, Netherlands
 Argentina, Australia, Belgium, Canada, Denmark
 Portugal, Saudi Arabia, Turkey, United Arab Emirates
 Finland, Luxembourg, Sweden, Thailand

For instance, the schematic representation for 1990 groups Germany, Italy, Japan, and the United States into a select group of the most concentrated in banking, on average. By 2000 Italy leaves this group, joining the next lesser concentrated group.

Testing for Significance among the G-7 Countries

Because of the importance of G-7 countries in global banking, statistical significance of the equality of Theil's entropy among the G-7 countries on an average basis was performed for the years under consideration, using analysis of variance. For every year, the null hypothesis was rejected at P-value 0.000. To find which country differs significantly from others, a statistical procedure that compares mean entropies two countries at a time is devised following a similar procedure by Woosley, King, and Padhi (2000), employing in their case the H index.

For this purpose, let the entropy associated with total assets for country j and bank i , $i = 1, 2, \dots, n_j$, where n_j = the number of banks be denoted,

$$X_i = -P_i \log P_i .$$

From equation (3),

$$E = -\sum_{i=1}^{n_j} P_i \log P_i = \sum_{i=1}^{n_j} X_i .$$

Therefore, the mean entropy for country j is

$$\bar{x}_j = \sum_{i=1}^{n_j} x_i / n_j.$$

The test statistic for testing significance of equality of means of two countries at a time denoted by country 1 and country 2 using approximate standard normal distribution is

$$Z = (\bar{X}_1 - \bar{X}_2) / (S_{1j}^2 / n_{1j} + S_{2j}^2 / n_{2j})^{1/2} \quad (9)$$

where S_{1j}^2 and S_{2j}^2 are the variances for the two selected countries (country 1, country 2). The results in every case and every year between 1990 and 1998 were identical. For economy of space, the years 1998 and 2000 are chosen as representative, shown in a matrix form in Table 4 by arranging the G-7 countries in ascending order of banking concentration. For the year 2000, significances in mean entropy concentration among the banks of the G-7 were almost the same as 1998 with one major exception. Concentration in U.S. banking was greater than Japanese banking concentration. In matrices of Table 4, differences in average entropy are not statistically significant at $\alpha = .05$, $|Z| < 1.96$. Some of the computed $|Z|$ values exceed 1.96 and are asterisked to denote statistical significance between the two countries.

Table 4—Z-Values for Testing of Equality of Means of Entropy of Major Banks in the G-7 Countries

1998	Canada	France	U.K.	Italy	Germany	Japan	U.S.A.
Canada	-	2.68*	4.06*	5.18*	5.44*	5.74*	5.95*
France	-	-	1.30	2.48*	2.81*	3.19*	3.46*
United Kingdom	-	-	-	1.45	1.94	2.52*	2.95*
Italy	-	-	-	-	0.93	2.20	3.22*
Germany	-	-	-	-	-	1.23	2.32*
Japan	-	-	-	-	-	-	1.28
2000	Canada	France	U.K.	Italy	Germany	Japan	U.S.A.
Canada	-	1.38*	2.96*	4.00*	4.40*	4.55*	4.94*
France	-	-	1.42	2.48*	2.91*	3.07*	3.50*
United Kingdom	-	-	-	1.63	2.42*	2.76*	3.59*
Italy	-	-	-	-	1.25	1.90	3.56*
Germany	-	-	-	-	-	0.62	2.74*
Japan	-	-	-	-	-	-	3.01*

The findings are of interest because they reveal whether concentration of pairs of countries in the G-7 differs significantly on an average basis. While average entropy for U.S. banks in 1998 is significantly different from the other countries with the exception of Japan, Japan is significantly different than the United Kingdom, France, and Canada. For Canada, the average entropy is significantly different from all others. The picture changed a bit in 2000 where U.S. banking shows a more

significant difference than did even the banking in Japan. Similar results on an average basis for 1989 are reported by Cameron (1991), where the measure of concentration is the Herfindahl index.

Testing for Significance: Japan, Germany, United States

To test whether the changes in the Herfindahl along the years within the countries with the largest assets (Japan, Germany, the United States) are statistically significant, a device connecting H of equation (1) with V^2 of equation (3) is of help. This is done by testing for equality of variances and by implication, as the mean $(1/n)$ is approximately the same for each country, the equality of V^2 which leads to an implied equality of H for pairs of years j and k by the test statistic,

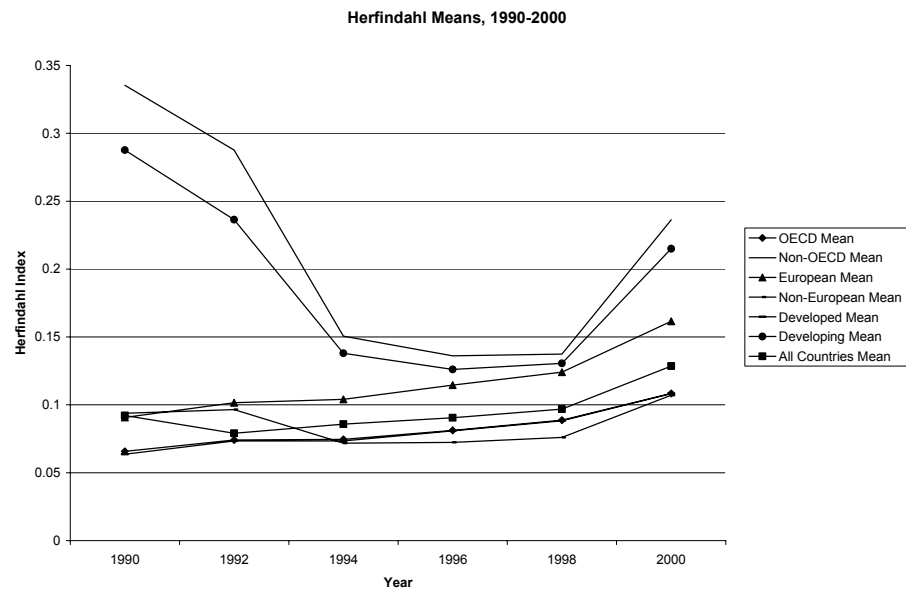
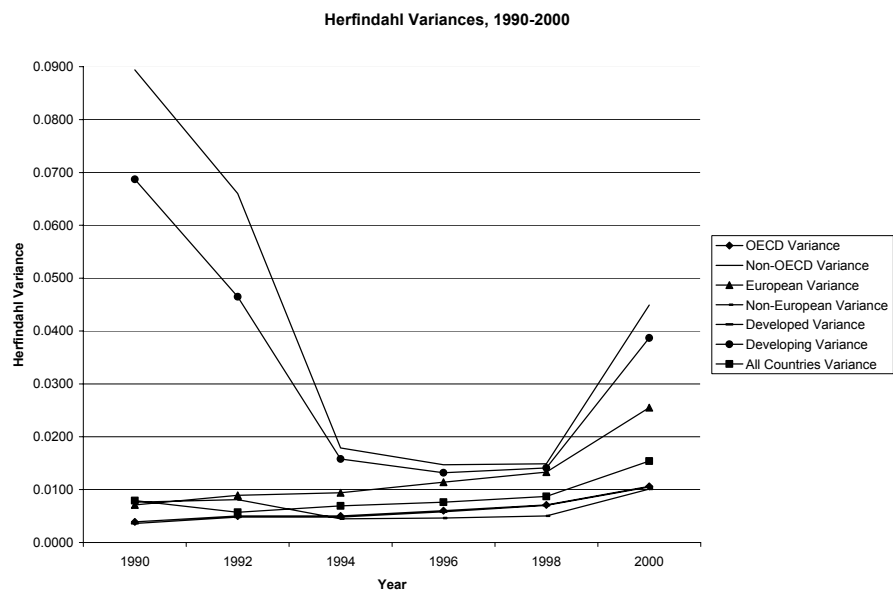
$$F^* = S_j^2 / S_k^2. \quad (10)$$

The test statistic F^* is compared for significance with a tabular $F(\alpha/2, n_j-1, n_k-1)$. For the years 1990, 1992, 1994, 1996, 1998, and 2000, the values of V^2 for the three countries are:

Japan:	2.437, 2.853, 2.779, 2.799, 3.523, 3.412;
Germany:	2.644, 2.819, 2.752, 3.010, 3.356, 4.893;
United States:	3.787, 3.500, 3.764, 3.644, 4.661, 10.556.

For Japan and the United States with more than 100 banks, the critical F at $\alpha = .05$ is approximately 1.31, while for Germany with the number of banks around 80, the critical $F = 1.67$. It seems on inspection that the most significant change is for the United States between 1988 and 2000, where $F^* = 10.556/4.661 = 2.26$. This reflects a large increase in concentration in the sector due to a merger wave in recent years resulting from deregulation, as indicated by Dymski (1999), and Brook, Hendershott, and Lee (1998).

According to Guzman (2003), most of the mergers are due to the 1994 repeal of branch banking restrictions. Mergers peaked in 1998 to the tune of \$1,013 billion. Guzman also contends that the benefits of the Gramm-Leach-Bliley are slow in coming because of the recent economic downturn, in addition to corporate scandals. Brewer III, Jackson III, and Jagtiani (2000) enforce these claims by providing further evidence for the unprecedented pace of bank mergers and acquisitions between 1990 and 1998, when bank mergers averaged about 510 per year compared to 345 per year in the previous decade. Such an increase in mergers and acquisitions resulted in an approximate 30 percent decline in the number of banks since 1990. Emmons and Schmid (2000) report that the number of commercial-bank charters has declined between 3 and 5 percent annually since 1988, resulting in a disappearance of 33 percent of all bank charters between 1988 and 1997. Mergers and failures accounted for about 84 percent and 16 percent, respectively.

Figure 1—Herfindahl Means by Groups of Countries, 1990-2000**Figure 2—Herfindahl Variances by Groups of Countries, 1990-2000**

Testing for Significance for Regions

This section deals with testing for significance of the Herfindahl index at the regional levels for countries grouped by regions. The regional classifications are OECD versus non-OECD countries, European versus non-European countries, and developed versus developing countries. Descriptive statistics (number of banks, means, and variances) are provided in Table 5 in Panels A, B, and C, respectively. For the purpose of comparisons, Table 5 also includes Panel D for all countries combined. Figure 1 is the plot of means, and Figure 2 is the plot of the variances in Table 5. Table 5 and Figures 1 and 2 show noticeable dips in both the means and the variances, starting in 1994 approaching the other groupings of the countries and increasing again relative to the other groups between 1998 and 2000.

In Panel A, upon comparing OECD with non-OECD countries, noticeable differences in concentration are apparent. The average level of concentration in the non-OECD countries is much higher than in the OECD countries (Figure 1). The differences in averages using a t-test for equality of means confirm this hypothesis. For instance, for 1990, the test statistics is $t = 8.50 > 1.96$, which is the critical value for all the years under consideration. A plausible reason for the statistical significance is the number of banks and the type of countries involved. Most of the OECD countries have a larger number of banks in the list of 1,000 banks than do the non-OECD countries, which make their levels of concentration smaller than non-OECD countries. This is reflected in the variances of the two groups of countries (Figure 2). The variances of the non-OECD countries are much larger than those of the OECD countries, indicating larger dispersion which, in turn, implies larger concentration.

When dealing with changes over time among the two groups themselves in Panel A and by using the F*-test of equation (10), there are indications that the levels of concentration increased over the years. For the OECD countries, because the number of banks involved is large, the critical value for significance at the 5 percent level is $F(.05) = 1.00$. Upon dividing the variance of a later period on the variance of a preceding period, $F \geq 1.0$ for all comparisons, indicating—as for example the years 2000 and 1998—that $F^* = 0.0106/0.0071 = 1.49 > 1.00$.

For the non-OECD countries, there were trends of decreases in variances from 1990 to 1998, then a sudden jump between 1998 and 2000 from 0.0149 to 0.0449, giving $F^* = 0.0449/0.0149 = 3.01$, which is highly significant at the 5 percent level when compared with tabular $F(.05) = 1.39$. The conclusion is that the banking sector in the OECD has increased its concentration over the period 1990 to 2000, while the banking sector in non-OECD countries witnessed such an increase between 1998 and 2000. This increase in concentration may be indicative of the increase in mergers and acquisitions in the late 1990s.

Panel B and Figures 1 and 2 group the countries into European and non-European categories. The non-European classification includes countries with a large

Table 5—Descriptive Statistics for Herfindahl Index of Major Banks in 29 Countries by Regions, 1990-2000

Panel A: OECD vs. Non-OECD Countries						
Year	OECD			Non-OECD		
	n	Mean	Variance	n	Mean	Variance
1990	780	0.0658	0.0039	85	0.3355	0.0894
1992	758	0.0742	0.0050	99	0.2877	0.0660
1994	716	0.0746	0.0050	124	0.1505	0.0179
1996	676	0.0812	0.0060	137	0.1362	0.0147
1998	655	0.0887	0.0071	131	0.1375	0.0149
2000	673	0.1084	0.0106	126	0.2363	0.0449

Panel B: European vs. Non-European Countries						
Year	European			Non-European		
	n	Mean	Variance	n	Mean	Variance
1990	403	0.0907	0.0071	462	0.0938	0.0076
1992	410	0.1015	0.0089	447	0.0965	0.0081
1994	365	0.1040	0.0094	474	0.0718	0.0045
1996	348	0.1146	0.0114	465	0.0724	0.0046
1998	340	0.1241	0.0133	446	0.0760	0.0050
2000	316	0.1615	0.0255	483	0.1071	0.0101

Panel C: Developed vs. Developing Countries						
Year	Developed			Developing		
	n	Mean	Variance	n	Mean	Variance
1990	754	0.0636	0.0036	111	0.2877	0.0687
1992	723	0.0734	0.0048	134	0.2364	0.0465
1994	629	0.0735	0.0048	160	0.1380	0.0158
1996	640	0.0809	0.0058	173	0.1261	0.0132
1998	627	0.0882	0.0070	159	0.1306	0.0141
2000	647	0.1083	0.0105	152	0.2150	0.0387

Panel D: All Countries			
Year	All Countries		
	n	Mean	Variance
1990	867	0.0921	0.0079
1992	860	0.0791	0.0057
1994	840	0.0857	0.0069
1996	813	0.0905	0.0076
1998	786	0.0968	0.0087
2000	799	0.1286	0.0154

number of banks in the sample, such as the United States and Japan, which makes the number of banks in the two groups about the same. The means and the variances for the European group grew steadily over the years, indicating an increase in concentration. We specially note the increases between 1998 and 2000 from 0.1241 to 0.1615 for the means and from 0.0133 to 0.0255 for the variances. The F*-test for variance is $F^* = 0.0255/0.0133 = 1.92 > 1.16$, indicating statistical significance at the 5 percent level.

For the non-European countries in Panel B, similar jumps in means and variances were also noticeable between 1998 and 2000, increasing from 0.0760 to 0.1071 for the former and increasing from 0.0050 to 0.0101 for the latter. Employing the F*-test, the ratio $F^* = 0.0101/0.0050 = 2.02 > 1.16$, indicating significance at the 5 percent level. There are indications of mergers and acquisitions in the late 1990s for both groups.

Panel C and Figures 1 and 2 group the countries into developed and developing classifications. The means and the variances for the developing countries, similar to the situation in Panel A, are much higher than those in the developed countries. Again, the noticeable differences are the jumps in their values between 1998 and 2000. For the developed countries, $F^* = 0.0105/0.0070 = 1.5 > 1.39$, and for the developing countries, $F^* = 0.0387/0.0141 = 2.74 > 1.39$, indicating significance at the 5 percent level.

Panel D and Figure 4 provide the concentration levels for all countries combined. Again, the biggest jumps registered for the means and the variances are between the years 1998 and 2000, changing for the means from 0.0968 to 0.1286 and changing for the variances from 0.0087 to 0.0154, giving an $F^* = 0.0154/0.0087 = 1.77 > 1.00$, indicating significance at the 5 percent level.

The numbers in Panel C are used next to address a null hypothesis of the form

$$H_0: \mu = \mu_0 \text{ against } H_a: \mu \neq \mu_0,$$

where μ stands for mean Herfindahl for the groups in Panels A, B, and C, and μ_0 stands for mean Herfindahl for all the countries for the six observations in Table 5. The groupings are OECD, non-OECD, European, non-European, developed, and developing. The test statistic is the standard normal Z as given in equation (9). The results of the Z-tests are shown below:

Year	OECD	non-OECD	European	Non-European	Developed	Developing
1990	-6.99	7.47	0.28	0.33	-7.66	7.81
1992	-1.36	8.02	4.20	3.47	-1.58	8.36
1994	-2.85	5.24	3.15	-3.32	-3.12	5.06
1996	-2.17	4.22	3.72	-4.12	-2.23	3.85
1998	-1.74	3.64	3.85	-4.39	-1.82	3.38
2000	-3.40	5.55	3.29	-3.40	-3.41	5.22

For 5 percent significance for a two-sided test, the critical values are $Z = \pm 1.96$. When the $Z < 0$, the implication is that the group selected has a smaller value for H (less concentration) in its banking sector than the banking sector worldwide. The converse is true when $Z > 0$. The arrays of the Z-values indicate statistical significance for the majority of years under consideration. The signs of the Z-tests, however, tell an interesting story. OECD with negative Zs and non-OECD with positive Zs resemble the Zs when grouping the banks by developed and developing

categories because most OECD countries belong to the developed category (Figure 1). When comparing European and non-European groups, the opposite signs of the Zs make sense. Non-European includes countries with a large number of banks with lesser concentration than the European countries.

Institutions and Banking Structure

Adkins, Moomaw, and Savvides (2002) summarize a debate among economists that institutions greatly impact economic performance in different countries. These studies examine the role of institutions on economic growth, unemployment, technical inefficiency, productivity, and the like. Similar examinations have focused on the mix of laws and regulations on bank performance in individual countries. Notable among such works is Barth, Nolle, and Rice (1997), whose extensive study on commercial banking structure produced a large number of tables providing a rich source of data on the banking sector in the European Union and the G-10 countries. These countries account for 79 percent of the world's GDP and 86 percent of the world's banking assets.

After a thorough search for variables in the Barth, Nolle, and Rice study that directly or indirectly may affect the levels of concentration in banking reported in Table 2, this paper employs simple regression to determine which of the variables may provide explanations. Both levels and dummy variables are used. Data are available for 17 of the 29 countries in Table 2: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Luxembourg, Netherlands, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Table 6 provides descriptions of the variables as well as the testing results of the regression coefficients showing the t-values and their corresponding p-values. For ease of presentation, the variables are denoted by X_i , $i = 1, 2, \dots, 23$. The regression methodology uses the average of the concentration index H for each country for the years 1990-2000 as the dependent variable and the X_i as the independent variable. There are two reasons for using simple rather than multiple regression. The first is that many of the explanatory variables in Table 6 are highly correlated as reported by Barth, Nolle, and Rice, the source of the data. High correlation (multicollinearity) among the explanatory variables renders it difficult to obtain any statistical significance for the corresponding coefficients. The second reason for not using multiple regression is the limited number of the degrees of freedom in the sample. Data are available for only 17 countries while the number of explanatory variables is 23, making it impossible to employ multiple regression.

The results in Table 6 constitute a mixed bag of significant and not significant explanatory variables. The six variables denoted by X_1 through X_6 with negative t - values indicate that the larger the share of a country in terms of population, GDP, banking assets, world equity market, international and national debt securities, the lower is the concentration level in banking. Among the permissible activities, only

the variable dealing with securities (X_{13}) is found to be positively significant, unlike the case when dealing with insurance and real estate. This result implies that the

Table 6—Description of Variables and Regression Results

Level	Variables	Coefficients	t-Value	p-Value
X_1	Share of World Population	-0.0580	-3.91	.0014
X_2	Share of World GDP	-0.0089	-3.62	.0025
X_3	Share of World Banking Assets	-0.0101	-3.74	.0020
X_4	Share of World Equity Market	-0.0056	-2.67	.0174
X_5	Share of World International Debt Securities	-0.0129	-2.77	.0143
X_6	Share of OECD Domestic Debt Securities	-0.0047	-2.79	.0138
X_7	Number of Commercial Banks	-0.0001	-1.64	.1222
X_8	Population per Bank	-0.0006	-0.54	.5989
X_9	Staff per Banking Office	0.0032	1.16	.2635
X_{10}	Banking Assets per USD of GDP	-0.0020	-1.30	.2126
X_{11}	Deposit-to-Asset Ratio	-0.0010	-0.34	.7391
X_{12}	GNP per Capita	-0.0004	-0.11	.9160

Dummy Variables, 0/1 Indicators, 0 = No, 1 = Yes

X_{13}	Permissible Securities Activity	0.1527	2.43	.0284
X_{14}	Permissible Insurance Activity	0.0636	1.18	.2566
X_{15}	Permissible Real Estate Activity	0.0665	1.46	.1583
X_{16}	Investment in Non-financial Firms	0.0590	1.24	.2354
X_{17}	Non-Financial Firm Investment in Banks	0.0474	0.98	.3446
X_{18}	Deposit Insurance of Foreign Branches in EU Covered	0.0288	0.55	.5876
X_{19}	Deposit Insurance of Foreign Branches in non-EU Covered	-0.1018	-2.04	.0594
X_{20}	Foreign-Currency Deposits Insurance Covered	0.1526	2.43	.0284
X_{21}	Non-resident Depositors Insurance Covered	0.1526	2.43	.0284
X_{22}	On-Site Examination	-0.0583	-0.44	.6645
X_{23}	Public Disclosure of Enforcement Action	-0.0661	-1.33	.2031

Note: Countries included in regression are Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Luxembourg, Netherlands, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States

Source: Barth, Nolle, and Rice (1997)

gest banks dominate the securities market. Furthermore, deposit insurance of foreign-currency and non-resident deposits (X_{18} , X_{19}) schemes also are found to be positively related to larger levels of concentration. Two of the variables dealing with examination and supervision of banks (X_{22} , X_{23}) have the proper negative sign for the coefficients, even though the coefficients are not statistically significant. Note that though many of the coefficients in Table 6 are not statistically significant, the results, nevertheless, are reported. The coefficients provide the proper signs for proper interpretations. Furthermore, the chosen 23 variables provide a rich sample of the issues related to the regulations of international banking.

Conclusions

The interest in international banking concentration stems from the fear that a few giant banks may not be inhibited from entering each other's market. Some type

of collusive arrangements also may arise. The arrangements may be an outright market-sharing agreement, which moderates competition. This paper determines relative concentration of bank assets of 29 countries, paying special attention to grouping countries into regions (G-7, OECD, non-OECD, European, non-European, developed, and developing). In each case, the paper provides ample statistical testing procedures to test hypotheses of equality in means and variances as measured by one of the two indexes of concentration, the Herfindahl and Theil's entropy. A common finding from the statistical analysis indicates that concentration in the banking sector, irrespective of region, increased during the late 1990s, especially between 1998 and 2000. An explanation for the trends in increasing concentration is provided by DeYoung (1994). DeYoung traces the changes in merger regulations in the United States. New laws during the 1980s deregulated financial institutions and increased actual and potential competition in banking markets, leading to relaxation of enforcement of merger antitrust laws. Also, studies in industrial organization question the notion the concentration is a root cause of excess profit, which weakens one of the most important justifications for denying mergers. Many relaxations in regulatory standards are discussed in this paper.

Similarly, in Europe, as noted by Wilson and Williams (2000), the banking industry has experienced a great deal of change due to globalization, de-regulation, de-intermediation, technological change, and the introduction of a single currency. These aspects suggest that large banks could gain a competitive advantage through improvements in efficiency and market power, which results in banks growing at faster rates than their smaller rivals. Market power in turn leads to increases in concentration.

Demirguc-Kunt and Kane (2002) explain that in order to limit banking breakdowns, policy makers around the world enact regulations as safety nets. Around the globe in both developed and developing countries, there have been waves of banking crises. Bank crises, especially involving banks in highly concentrated markets, are costly and disruptive. For this reason, the paper also investigates the relationship between concentration levels and 23 explanatory variables depicting a variety of laws and regulations, as well as structural considerations selected from 17 countries, which overlap between the EU and G-10. The countries account for a small portion of world population, yet account for a large share of GDP. Aside from ten variables that show significant negative or positive relationships with concentration, the remaining 13 variables, which deal with questions of laws and regulations, show no significant relationships. This is perhaps an indication that laws and regulations in the banking sector in these countries were uniform in cooperating with the Basle Committee on Banking Supervision, even though the banking industry is too dynamic to be constrained by something as static as government regulations.

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