EXTERNAL APPENDICES TO CHAPTER 9

Appendix X-9.1: METHODS OF DATA ADJUSTMENT

Since the size distribution data are grouped, it is necessary to interpolate and extrapolate these data in order to calculate the Florence median and the share of employment accounted for by the largest number of firms. Given the uncertainty in the type of distribution with which I was dealing, I only used the tail of the distribution (for enterprises, only those with 500 or more employees; for establishments, only those with 50 or more employees) for the curve fitting. For calculating the various interpolations and extrapolations, it proved useful to fit two types of curves.

For determining the size of the firm with a given number of workers, the Pareto distribution provided the best fit. That is, the coefficient of determination (as well as the standard errors of estimate) obtained by regressing the log of the lower limit of the size distribution against the log of the accumulated number of firms was higher than any other distribution curve with which I experimented, and it is from these calculations that the results in Table A-9.2 are derived. For determining the total number of employees of a given number of firms, another type of interpolation is necessary. Experimenting with 1992 data, I found empirically that regressing the log of the cumulative number of firms against the cumulative number of employees provided the best fit.

Given these estimating procedures and the small number of points with which to fit the curves used in interpolation and extrapolation, the statistics other than the arithmetical average and the percent of employees in firms with more than 999 or 9,999 employees are somewhat problematic. In descending order of reliability, I would rank highest the Florence median, which only required interpolations; then the average number of employees in the largest 1,000 enterprises, which required relatively small extrapola-

tions; and, lastly, the average number of employees in the largest 100 enterprises, which required extrapolations far beyond the lowest limit of the highest size category (over 9,999 employees).

Another measure of the size distribution is the Pareto coefficient, and estimates are presented in Table X-9.1 for two samples of large enterprises. They reveal the same trends as the more common measures used in the text tables.

Appendix X-9.2: ESTABLISHMENT SIZE

The statistics on establishment size come from various issues of County Business Patterns. In using this source, certain problems arise. First, the underlying data are not quite consistent. Prior to 1978 the published statistics came from administrative records for the Federal Insurance Contributions Act (FICA) and excluded workers not covered by Social Security. From 1978 to the present, the published statistics come from all establishments filing a Treasury Form 941 and cover all workers in establishments where at least some are covered by Social Security. This change is said to have an impact, for instance, on coverage of workers in hospitals and educational institutions, but I could make no adjustments for these changes.

Moreover, the series for the number of establishments from the Enterprise Statistics and from the County Business Patterns are somewhat different. For the period from 1967 through 1982 (with the exception of 1972), this difference amounted to less than 4 percent. In 1987 and 1992, when the least amount of estimation had to be carried out for both series, the former data show roughly 11.5 percent fewer establishments than the latter. This suggests that the estimates in Table 9.4 may have a downward bias up to 1982, which would only make the decline in establishment size less dramatic than the table shows. Such a bias also means that the early rise of the establishment/enterprise ratio

Table X-9.1: Pareto Coefficients (") for the Size Distribution of Enterprises

Years	Pareto coefficients	
	Census data for grouped data of all domestic enterprises with over 500 employees	Data from Fortune of largest 100 U.S. employers in the industrial sector (counting employees both at home and abroad)
1958	-0.98	-0.68
1963	-0.95	-0.67
1968	-0.91	-
1972	-0.90	-0.63
1977	-0.92	-
1982	-0.94	-0.60
1987	-0.98	-
1992	-0.99	-0.66
1997	-0.99	-0.66

Notes: Using Gibrat's ideas about a dynamic stochastic of enterprise growth, Ijiri and Simon (1977, p. 13) argue that the Pareto coefficient is a more theoretically based assessment of changing aggregate concentration (sometimes called agglomeration) of enterprises. The closer the Pareto coefficient is to zero, the greater the concentration.

may be overstated, and, as a result, the leveling off of this ratio in the late 1980s was not so marked.

Finally, I might add that the establishment data in the Enterprise Statistics are arranged by sector of parent company, while the data from County Business Practices are grouped by what the establishment is actually producing.

Appendix Table X-9.2 presents various measures of average employment size when the sector composition of employment is held constant. The data suggest that the changing structure of production has not had as great an impact on average establishment size as on the average enterprise size.

Appendix X-9.3: MEASURES OF COMPETITIVE DYNAMICS

Ijiri and Simon (1977, p. 13) argue that the standard deviation of the ratios of the size rankings for each firm at the end of a period to its size ranking at the beginning measures the "dynamism of competition." To explore the use of this statistic I use the Fortune data for largest industrial enterprises, realizing that this data base, for several reasons, is not ideal for the calculation. First, it does not include foreign firms operating in the U.S. Second, until the 1990s, the Fortune list focused only on industrial firms, so that classification of firms carrying out both industrial and service activities is difficult. Third, the list is dependent upon information voluntarily supplied by the firm, and if such information is not received, the firm is not included in the list. Fourth, the handling of subsidiaries, which are predominantly owned by one company but which have separate stock issues, raises other problems. For these reasons certain firms, such as IT&T, mysteriously appear and disappear from the Fortune list in different years. Finally, the Fortune list only covers publicly traded firms and certain large privately held enterprises are not included.

Table X-9.2: Various Measurements of Establishment Size Holding Employment Structure Constant

Year	Establishments with more than 19 employees		Florence median		Percent of employees in establishments with:					
	Arithmetical average		Number of employees		less than 20 employees		more than 500 employees		more than 1000 employees	
	The year chosen for the constant employment weights									
	1962	1995	1962	1995	1962	1995	1962	1995	1962	1995
Year for which calculations are made										
1962	101.3	93.1	99	66	27.0%	31.7%	27.6%	24.2%	18.7%	16.3%
1995	91.1	84.9	97	76	22.5	25.5	22.2	20.0	14.1	13.0

Note: Eight major sectors are used in the constant-employment-structure indices. For sources of data and other information, see notes for Table 9.3.

Since the Fortune editors rank companies according to sales, not by employment, as I have done, I had to dip into their lists of the top 500 and 1000 firms in order to obtain my list of the largest100 employers. Other problems arose because certain firms have changed their names, or have merged with other firms in the Fortune list. To take this into account, I consulted Derdak (various years) about all doubtful cases and calculated the results both including and excluding adjustments. As it turned out, such adjustments did not greatly affect the end results. Finally, since my data are only for the top 100 firms, I assigned a rank of 150 for firms that were not in the top 100 at the beginning of the period; experiments showed that the trends are not affected by this assumption.

The final calculations show much greater changes in the rank orderings in the 1972-82 decade than in either the 1963-72 or 1982-92 decades. The 1982-92 changes are also greater than the 1963-72 changes. Since such results seem primarily to reflect merger and divestment activities of conglomerates, rather than the "dynamism of competition," the Ijiri-Simon statistic is not appropriate for its intended use with this data set.

Apppendix X-9.4: EMPLOYMENT SIZE OF VERY LARGE ENTERPRISES

Since the census data refer only to enterprises within the United States, regardless of whether they are U.S. or foreign owned, other data sources must be used to gain some notion of the foreign activities of U.S. firms. For such purposes the Fortune magazine database of large companies, which include the worldwide activities of all American firms, is useful. We must, however, proceed cautiously with such an exercise, not just for the reasons outlined in Appendix 9.3, but also because the ranking of domestic firms by employment size may be quite different if their employment abroad is taken into account, so the two lists

of size rankings may contain different firms. This may not be a significant problem for the top 100 firms since anecdotal evidence suggests that most have branches abroad. For smaller firms, however, this is far from assured, so it seems prudent to focus only on the 100 largest industrial employers, for which data on foreign and domestic employment are more readily available.

Table X-9.3 shows that the average size of the 100 largest industrial firms in the U.S. follows the same pattern as all domestic enterprises up through 1992, namely, an increase in average employment up to the early 1980s and then a decrease up to 1992. Comparison of the Census and the Fortune data shows that foreign employment of domestic firms has become increasingly important, which is a well-known feature of the globalization process. The strange dip in this percentage in 1982 can not be explained, but may be due to different rates of layoffs of workers at home and abroad in this recession year. In particular, foreign employment in U.S. petroleum and capital goods firms is said to have considerably declined at that time.

The last two data columns provide a key comparison of the largest 100 non-U.S. enterprises to similar U.S. firms. The largest non-U.S. enterprises are larger than their U.S. counterparts for several reasons.

* The non-U.S. companies are drawn from the entire world. Since large economic areas feature more large companies (the top 100 firms in the U.S. have a larger average size than the top 100 firms in Pennsylvania), we would expect the global averages (excluding the U.S.) to be larger than in the U.S.

* In many foreign countries, firms have less desire or experience greater problems to divest themselves of particular branches or to split themselves up for greater efficiency. Furthermore, because of

Table X-9.3: Some Data on Large Enterprises from an International Perspective

Panel A: The Arithmetical Average Size of the Largest 100 Industrial Enterprises

Year	United States firms			Non-U.S. firms	
	Census data	Fortune data		Fortune data	Fortune data
	Average domestic employment	Average total employment	Ratio of total to domestic employment	Average total employment	Ratio of average size of 100 largest non-U.S. to 100 largest U.S. firms
1963	53,678	63,848	118.9%	74,372	116.5%
1972	72,879	88,331	121.2	98,305	111.3
1982	76,394	88,415	115.7	110,115	124.5
1992	55,073	78,032	141.7	113,904	146.0
1997	n.a.	77,547	n.a.	95,100	122.6

Panel B: The Arithmetic Average Size of the Largest Enterprises, All Industries

1997	98,214	132,138	134.5%	145,767	110.3%

Note: The census data come from various issues of Enterprise Statistics and, for the industrial firms, include only firms in mining and manufacturing. These Census data may include some foreign firms, but only their employment in the United States. The statistics in the table are calculated in the same manner as the data in previous tables for all enterprises.

The Fortune data come from various issues of that magazine and, as discussed in the text, classify enterprise by country of predominant ownership, and not by the country where the firm has the most employees. As discussed in the text, the Fortune data are not completely comparable with the data from Enterprise Statistics.

Both sets of data include firms classified as "industrial" that may carry out considerable production in the service and other sectors. Thus, the industrial classification of large conglomerates is problematic.

differences in labor laws, enterprises in some countries have not been able to downsize rapidly, particularly after mergers when redundant activities are eliminated. If this argument is correct, then many large non-U.S. enterprises exceed the optimal size, and only in the long-run (or during extreme economic duress) will they be able to reduce their total employment through attrition, divestment, or liquidation.[1]

* Many governments outside the U.S. have encouraged mergers, particularly of large firms, to serve as "national champions." Although the effectiveness of such a tool of industrial policy to "increase national competitiveness" is doubtful, this ideology is still strong. Moreover, anti-trust and other regulations inhibiting the growth of enterprises are not as strongly enforced abroad as in the U.S. In some countries, very large state enterprises have also increased in size by taking over bankrupt private firms as a means of maintaining employment.

* The close alliance of banks with enterprises in certain countries (for instance, the *keiretsu* in Japan) has served to encourage the rapid employment growth of large companies, particularly as certain industries become consolidated and as many of these enterprises deepen their vertical integration.

* The industrial environment in the U.S. is different than in other countries and this encourages a different type of growth pattern of firms. For instance, the unique U.S. capital markets provide small- and medium-size firms with access to investment funds that allow them to grow rapidly,

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[1] In 1998 and 1999 the U.S. business press (for instance, Business Week. March 15, 1999) featured a number of articles reporting the financial difficulties of some of the well-known Japanese *keiretsu* such as Mitsubishi, Fuyo, Mitsui, Sumitomo Dai-Ichi Kangin, and Sanwa. A number of Korean *chaebol* are experiencing great difficulties as well. Whether these problems presage a general breakup of these companies and company groups remains to be seen. In certain circumstances, greater global concentration of industry might result if large non-Japanese firms purchased parts of these troubled companies, as presaged by the large share of Nissan that was purchased by Renault in the early months of 1999 or the DaimlerChrysler purchase of Mitsubishi Motors in early 2000.

particularly in situations when established industry leaders have trouble recognizing new markets opened by new technologies. A well-known example was the fall of IBM from its dominant position as the personal computer began to displace mainframes; and smaller computer companies, many of which were new, began to expand rapidly. Although most public attention in the U.S. is focused on the dramatic cases when a small company such as Microsoft grows rapidly to dominate an industry, the more important action may take place in the movement between middle-size and large-size enterprises. In the book and its regular appendix I show that the average size of the top 100 U.S. firms has decreased somewhat between 1977 and 1992; however, the average size of the next largest 900 companies increased. The institutional environment in other capitalist countries may not allow such dynamism, so that when such technological changes occur, the established firms do not face so many upstart competitors. These established firms, if they are not knocked out by foreign competition and if they finally master the new technology, grow ever larger.[2] A variety of less visible institutional arrangements, ranging from higher minimum wages (that might discourage small enterprises) to subtle financial restrictions on small enterprises, also influence the end results.[3]

Although these conjectures are interesting, we cannot be sure about which, if any, of these explanations is the most important without rigorous testing, a difficult task which lies outside the scope of this study. Nevertheless, resolution of this puzzle is important, because if none of these conjectures has

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[2] I am grateful to Richard R. Nelson for a conversation about this point. His recent Tinbergen lecture "The Sources of Industrial Leadership: A Perspective on Industrial Policy" develops some of these ideas in greater detail.

[3] Audretsch (forthcoming) presents a fascinating summary of some such differences between the United States and Germany. The study of the institutional support for particular industrial activities is only beginning and promising examples include Nelson's (1988) study for the R & D sector and Storey's (1994) analysis of the small business sector.

much explanatory power, then we must ask if the rest of the industrial world is showing a trend that may soon appear in America. If this is the case, then we may well end up working for the giant enterprise sometime in the future. On the other hand, if the U.S. represents the future, then the industrial structure in other countries will change to reflect U.S. patterns. Of course, it is also possible that the size distribution of enterprises in the U.S. and other industrial nations will not converge, because of differences in the legal and social environments. In that case, the rest of the world will work in giant enterprises, while Americans will not.

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