National Organizing Principles of Work and the Erstwhile Dominance of the American Multinational Corporation

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Did American development of the largest corporations in the world drive its dominance of world markets in the first three quarters of this century? The evolution of the large diversified firm and the internationalization of the firm across national borders clearly rank as two of the most important economic developments in the twentieth century. To many, these two developments are linked. In the influential and seminal works of Alfred Chandler, the modern corporation arose to exploit fully the new technologies of transport and communication. In his most recent study *Scale and Scope. The Dynamics of Industrial Capitalism* (1990), Chandler develops the thesis that entrepreneurs gave way to the professional management of firms which succeeded in building, as first movers, three interrelated sets of investments: production, distribution, and management to achieve advantages of scale, scope, or both.

These first movers were not first to the market but first to build these organizational capabilities. Of course, a firm had to innovate first in order to enter successfully, but its subsequent growth can be interpreted as moving from the strengths of individual entrepreneurs to the strengths of the organization. It was through these 'three-pronged investments,' to use Chandler's phrase, that firms grew not only nationally, but also internationally.

The intriguing aspect of the epoch to which Chandler addresses his analysis is the unique coinciding of a wave of technological innovation *in the absence of organizational capabilities*. The problems of entrepreneurs in moving from innovation to an organization are well known. But the legacy of the twentieth century is that there exists currently a large number of established firms, who by acting as suppliers, buyers, or partners, can open up supply and distribution channels.

In the late 19th century, organizational innovation was forced to *co-evolve*

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simultaneously along with the exploitation of technological innovations. These were Stiglerian industries, the kind of which do not really exist any longer. There is today no lack of large pharmaceutical companies willing to sell the drugs of new biotechnology firms. There were no extensive distribution channels for the late 1800s and early 1900s pharmaceutical companies, or, for that matter, for the other new industries of the second industrial revolution. What Chandler has characterized so well is the problem of entrepreneurial firms having to create vertically the entire industrial foundation to support their innovations.[1]

Indeed, the process of the creation of industries appears to have required new organizational capabilities. The functional organization, first initiated by railroad companies, gradually diffused, permitting the growth of the giant firm, as Alfred Marshall called the product of this evolution in his *Industry and Trade* (1921). With this growth came the subsequent need for new product development by investments in R&D and marketing, which led to diversification and eventually divisionalization. It is also striking that the same firms that played such central roles in their national economies also spilled over borders into international markets.

The logic of these developments appears as if a firm's country of origin played a minor and inhibiting role. With common technology, the difference among countries is that of creating the conditions to enact the new managerial vision. Without question, Chandler's argument is tempered by attention to such institutional differences as the legal system or the presence, as in the case of Germany, of a strong university and science base. Still, it is fair to say that the emphasis upon the causal implications of technologies that were widely diffused in the world by the end of the 19th century leads to an argument that is, in its essential logic, without geography. The US came to dominate world markets because its large firms got there first.

This article presents a demurring, though still sympathetic explanation of the dominance of American corporations in world markets. The growth of large firms reflects not only the strength of their own technological and organizational capabilities, but also the capabilities of their countries of origin. Internationalization requires, by definition, that a critical threshold in size has been reached and that the requisite abilities to run multiplant operations have been created. It is not surprising that the size distribution of multinational corporations is shifted far to the right compared to the size distribution of all firms.

[1] For example, in the study by Kocka and Siegrist (1979), they found that, in 1887, 27 of 100 of the largest firms were only product firms, with about 50% using a sales syndicate; in 1907, this number fell to 12. The number of fully-integrated firms—with internal sales, production, and procurement functions—went from 13 to 62.

But this tendency towards foreign direct investment being carried out by larger firms is not equivalent to equating the sufficient capabilities to succeed internationally with economies of size. Both large and small firms express the capabilities which are diffused widely in their countries of origins, including the inter-firm strengths of their national industrial networks. Firms must first grow nationally (inclusive of exports) before they internationalize their investments. The engine of this early growth may be the efficiency of shopfloor management, ties to universities, the quality of the workforce, or, possibly, the advantage of large firm organization.

On the basis of this seemingly innocuous claim, the following interpretation of Chandler's arguments can be made. The emergence of large firms is an outcome of the initial entrepreneurial success in the home market. R&D is the search activity of successful firms looking to renew the engine of their growth. Related diversification is the outcome of the success of this search; divisionalization is the accompaniment. Unrelated diversification is the outcome of failure of this search. These stages are depicted in Figure 1.

FIGURE 1. Growth of Large Firms

Rise of New Organizing Principles	T_0 Entrepreneurs	T_1 Organizing of Work	T_3 Investment in New Products
		-Rationalization of factories -Cost Accounting -Functional Control	-R&D and advertising for product development -Diversification -Divisionalization
Approximate Date of Wide Commencement	1885	1900	1950

This article focuses primarily on showing that the initial growth of US foreign direct investment was related not to economies of size, R&D, or marketing, but to the organizing principles that were widely diffused in the American economy. The argument is historical; it is not meant to be valid currently in its details, though its logic should be general. In reference to the sequence drawn in Figure 1, our efforts are largely addressed to explaining the passage of the entrepreneurial firms to the efficient organizing of work, an efficiency that led to the spilling of investments across borders.

The argument proceeds by first decomposing the early history into two events: the entrepreneurial wave at the turn of the century—with the attending consequences for the shift in the size distribution of firms—and the introduction of standardization and rationalization that characterized the US manufacturing industries. To match Chandler's history, we focus on a

comparison of Germany, United Kingdom, and the US.[2] We begin by first looking briefly at how the country of origin influences the capabilities of firms through the embodiment of country-specific skills in people, firms, and national networks. The historical analysis begins by embedding the emergence of the large firm in the wave of technological innovations and firm births which swept the latter half of the 1800s. The statistical analysis demonstrates that there has been a striking convergence in the *sectoral* distribution of firm sizes in the three countries despite large differences in their initial positions. Chandler's thesis of a common set of technological and market factors influencing the size of firms across industrial countries is strongly supported.

The final three sections analyze whether the larger size of US firms explains the American dominance of international markets in this century. The historical record is argued to weigh against the thesis of superior size economies, either at the plant or enterprise level, as the explanatory factor. We put forth the thesis that the American performance was driven by the wide-diffusion of the principles of standardization and rationalization of work, principles which were cumulatively developed since the early 19th century. A statistical test of the determinants of the stock of American foreign direct investment in 1930 indicates no support for size economies, or R&D and marketing, but the degree of standardization of the work is found to be highly significant.

The historical and statistical results point to the rise of American foreign direct investment as stemming from organizing principles which were broadly diffused in the US economy. Economies of size do not seem to be instrumental, though size provides a critical threshold for carrying out direct investment. Rather, country strength should be seen as resting in principles that were expanded and developed by both small and large firms within a national industrial network.

1. *Knowledge of the Firm and Country Location*

If the histories investigated by Chandler were to be briefly summarized, certainly their most prominent aspect would be their description of the process by which the largest corporations of this century learned. This learning consisted of how to create functional, and later, divisional organizations, to integrate vertically, and to extend their activities across borders. But it also consisted of the creation of new information systems, especially regarding management accounting procedures.[3]

[2] Throughout the text, the United Kingdom and Great Britain are used interchangeably.

[3] See, for example, Chandler's discussion in *The Visible Hand* (1977, pp. 109–110, and p. 279) and in the co-authored chapter with H. Daems (1979, pp. 35–39).

The act of learning implies that an organization consists of a stock of knowledge. This knowledge can be distinguished in terms of two aspects: information and knowhow.[4] It is largely Chandler's description of the change in knowhow that is most well known. From a distance, the implementation of divisionalizing a corporation appears to be a fairly easy task. But the requisite knowhow is, as the evidence suggests, not well understood and is only tacitly known. If we were to accept Armour and Teece's finding that the adoption of the multidivisional structure by American oil companies raised the rate of return on average of 2% and if we keep in mind the value of capital assets in the petroleum industry, there is the striking insight into the difficulty of organizational change that this process of adoption occurred over at least 30 years and was still not complete when the study ended (Armour and Teece, 1978).

This emphasis on the knowhow of structuring work, or what can be called 'organizing principles', should be accompanied by an understanding of the role of information. In fact, the major changes in how work is organized has invariably been escorted by changes in accounting and evaluation systems.[5] Of course, how information is collected and sorted is an expression of a kind of knowhow. But we should not lose sight that firms have only impartial information of their environments, and they differ in what they know. Not even market prices are known equally to firms. Even if they were known, a firm would still have only impartial knowledge of its own costs and, consequently, profits.

To use a current example to distinguish between these two aspects of knowledge, the problems confronting the economies of eastern Europe have largely been analyzed in terms of creating the right information in terms of price reform. But, of course, price reform, as the experience in the territories of the former East Germany show, is a minor obstacle compared to the problem of developing the proper skills at the individual level and organizing principles inside the organization. In fact, as any witness of these reforms could relate, the skills of arbitrage and trading on information appear to have diffused with an impressive rapidity throughout eastern Europe. The long-term dilemma is in the buildup of the requisite knowhow.

It is important to distinguish between the *specificity* and the *embodiment* of knowledge. Knowhow may be embodied in firms without being specific to any firm. In a purely domestic setting, this distinction is frequently lost, because common knowledge is of no consequence in explaining performance differentials.

[4] This distinction is discussed at length in Kogut and Zander (1992).

[5] In addition to the already cited passages in Chandler's work, see Johnson and Kaplan (1987) discussion of the relationship of cost accounting systems to Taylorism.

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Of course, firms change—as the studies by Chandler show—as they develop. While some spontaneity in the arrival of these changes cannot be ruled out, the diffusion of these practices rest upon the common experiences of competing firms in the context of a national environment. This environment includes the skills which workers bring to their jobs, the role of governments, how other firms compete, and, perhaps most critically, the characteristics of national demand.[12]

Whether the origins of firm-embodied knowledge is derived from a kind of imprinting or evolutionary logic, this knowledge is expressed in the principles that organize work within and between groups of people. At the shopfloor, these principles may consist of Taylorist methods of work scheduling and evaluation; at the corporate level, they entail the use of divisionalization to assign responsibilities. To each of these principles, there is usually also a concomitant development of accounting and information systems.

But the competitive strengths of a company also rest in the nature of its relationships with other firms and institutions. Firms build up over time unique assets in terms of knowing where to find certain technologies or buyers, how to cooperate for the development of new products, or whom to fund in external university-based research centers. The organizing principles of national networks vary by country, as seen in a comparison of small firm flexibility in the northern Italian machine-tool industry to the large firm, small firm clusters in Japan.

The social structure of a network is also an expression of knowledge, for members to this network are competitively stronger due to their cooperative ties with each other. In fact, even competitive relationships are instrumental, as competitors have invested in the capabilities to detect and imitate new learning.

It is important to note that industrial networks have tended to be largely national in their orientation. Indeed, there are strong reasons why local knowledge spills most quickly across the boundaries of firms in the same nation than across the borders of countries.[13] While large firms, and here is a point to which we return later, may play a critical role in spanning national networks, this development has only become extensive in the post-World War II era. Indeed, one of the most damaging aspects of international competition is that foreign entry often disrupts the structure of these networks, and this disruption results in a loss of competitive knowledge due to displaced suppliers or buyers.

[12] These issues have been widely discussed. For an insightful study into how differences in demand influences country-specific capabilities embodied in firms, see Malerba's (1985) description of the international semiconductor industry.

[13] See Kogut (1990, 1991) for a discussion.

Of course, knowledge is continually in a process of development. However, much like technologies, organizing principles tend to develop within well-defined trajectories. The principles of mass production started in a few firms, but gradually spread out across manufacturing and service industries.[14] *It is the tendency of organizing principles to remain more within national boundaries than technologies that leads to international rivalry among firms who share similar technologies but are organized by different national principles of work.*

The firm of the post-war period moved from the exploitation of existing knowledge for known markets to the recombining of these capabilities through learning for the application to new opportunities. Capabilities differ, however, in terms of their technological and organizational potential for subsequent development. Eventually, there are declining returns to further routinizing a corporation by rationalizing production and administration.

With these ideas as background, let us turn to the details of the argument.

2. *Entrepeneurial Wave and Size Distributions*

The growth of large firms and the internationalization of firm production activities are linked historically to the sudden birth of new firms at the commencement of the second industrial revolution. This revolution brought to bear technologies of transport and communication that enabled the firm to serve and control geographically disparate activities. The growth in the size of firms is also due to the critical adoption of limited liability law in the UK, France, Germany, and the United States in the period between 1855 and 1875 (Horn, 1979).

An indication of the wave of innovations in the epoch prior to the Great War is suggested in patenting data. In 1860, 7653 patents were issued in the United States; by 1880, annual patenting had reached 21 761; and at the start of World War I, patent registrations had climbed to 67 774. Carrying this series out another 55 years reveals that registrations were only 79 590 in 1960.[15]

Some evidence of the concomitant rise of firms can be gleaned from disparate reports. In his study on the duration of firms born following the passage of limited liability laws, Shannon (1932) reports that 264 firms were registered between the period of 1856–1865 as already existing prior to

[14] For a discussion of technological trajectories, see Nelson and Winter (1977), and Dosi (1982); for organizing trajectories, see Kogut (1990, 1991).

[15] Data are from *Technology Assessment and Forecast*, 1977, US Department of Commerce. It is interesting to note that the share of foreign patenting grew from 83 in 1860, to 4595 in 1914, and to 27 134 (of 102 344 registered patents) in 1976. I would like to acknowledge the help of Pari Patel in bringing this data to my attention.

1856; 5310 were registered as formed during this period. Industry breakdowns show mining to have the largest number of entrants, with cotton manufacturing and food provisions following close behind.

Over 70 years ago, Marshall (1921, pp. 846–849) showed that the representative size of an American establishment grew rapidly between 1850 and 1910. Due to changes in data collection, only a few pairwise comparisons can be made. Between 1850 and 1880, industrial establishments 'of all sorts, including those in "hand and neighborhood industries" ' grew from 123 000 to 254 000, with capital assets increasing 5-fold and wage earners also increasing 4-fold in this period. The more restricted definition of the later censuses—including only establishments that were a 'separated plant or mill'—showed an increase of 208 000 to 268 000, with a particularly large jump between 1905 and 1910. Capital assets doubled, though the number of wage earners increased by only 20%. Despite the absence of data on terminations, it can be inferred that the late 1800s was an especially active time for new establishment entry.[16]

Since the UK was slow to advance in the so-called new industries of the second industrial revolution and the US is peculiar due to its large immigrant inflow, it is instructive to look at both sectoral studies and other countries. In a remarkable study on the origins of the Berlin-based electronic industries, Czada (1969) found a rapid growth of firm foundings in Germany. In 1875, 88 firms were attributed to be active in this industry. This number grew quickly in the following years. In 1882, there were 169; in 1895, 673; in 1907, 1011. Between 1875 and 1907, the number of employees grew from 1296 to 91 249 employees in Germany, with over 50% concentrated in the larger Berlin area (Czada, 1969, p. 53).

Moreover, the legacy of these foundings served as the basis for subsequent developments in the twentieth century. For Sweden, Dahmen (1950) reports that despite high entry rates in the interwar period, most of the new firms were not responsible for major innovations, but rather served the already existing major firms, with the exception of the auto and aerospace industries. Even in autos, the pioneering French and American industries experienced major shakeouts and firm failures prior to World War I (Laux, 1976).

We can conclude the following from the above. In at least a few major industrial countries, the late 1800s revealed a dramatic increase in the number of firms. In part, this increase was due to the effect of new technologies on reducing capital needs; for example, electrification worked also to power each machine individually, freeing the small firm from investing in

[16] Of course, establishments are not equivalent with firms, though it should be recalled that multiplant establishments were very uncommon in the late 1800s, and they are still surprisingly small in *numbers* today (unpublished Small Business Administration data from Dun and Bradstreet listings).

large systems of power generation running factory belts. At the same time, these technologies resulted also in increasing the productivity of capital and increasing the capital intensity of the work place in a few select industries. In this sense, the development of technologies and organizing principles of large firms were linked in co-evolutionary paths.

The dramatic growth of the size of firms in the upper tail of the distribution is an especially impressive development. As Hart and Prais (1956) and Prais (1976) have shown, the growth of giant businesses can be predicted solely as an outcome of 'spontaneous drift,' which they specified as a log-normal random process. With the introduction of limited liability in the major countries, this process was in a sense kicked off in the last trimester of the 19th century. Given the high growth rates of these economies (in the environ of 4–5% for the US and Germany) and the high volatility of the markets, large sizes could be effectively generated within a few decades.

Of course, this process of growth was abetted by large mergers. Mergers played an especially major role in the US. The peak year in the UK and the US was 1899, but in the UK, there were 255 mergers with value of 22 million pounds; in the US, there were 979 but with a value over 400 million pounds (Hannah, 1983, p. 22).[17] In Germany, the few mergers were located in the industries of chemicals and electronics, the industries where mass production was clearly spreading. Chandler notes that the only nation-wide acquisitions prior to World War I were made by Siemens and AEG in the electronics industry (Chandler, 1990, p. 467). Still, the study by Kocka and Siegrist (1979, pp. 116–117) showed that of 95 of the 100 largest firms in 1907, 61 firms were responsible for 158 mergers between 1887 and 1907. As in the United States, most of the mergers were within the same product industry.

By World War I, the industrial structures of the UK, US, and Germany were well established. Giant firms had come to dominate many of the most important new progressive sectors in the most industrialized countries. Though the size of American firms tended to be considerably larger, all three countries showed remarkable increases in concentration. In the UK, by 1909, the top 100 firms (including subsidiaries of American corporations) share of manufacturing output was approximately 16%; by 1924 and 1935, this share rose to 22% and 24%. For the United States, the share of the top 100 firms was 22%, 25%, and 24% in the years 1909, 1929, and 1935, respectively (Paris, 1976, p. 4 and p. 213).[18]

[17] See also Fligstein (1990) on the US. Of course, the UK merger wave had a second wind in the 1930s when the US was relatively quiet. This wave had a remarkable effect on concentration. See Hannah (1983) for a summary of his work with John Kay.

[18] Unfortunately, I could not find equivalent data for Germany.

TABLE 1. Descriptive Statistics of Firm Sizes

	Min	Max	Mean	Median	Standard	Coefficient of variation
United States ($ millions)						
1917	24.4	2449.5	85.19	43.55	182.41	2.14
1930	20.1	2394.5	172.46	79.8	268.43	1.55
1948	66.1	3526	286.71	138.05	432.9	1.50
Great Britain (Pound millions)						
1919	1	62.8	4.27	2.1	6.77	1.58
1930	1.3	132	8.32	3.4	17.26	2.07
1948	4.4	257.8	17.41	8	32.88	1.88
Germany (DM millions)						
1913	12.6	599.5	42.89	23.35	64.74	1.50
1929	16	2145.7	83.32	36.65	219.41	2.63
1953	16.7	1091.1	137.59	58.5	189.46	1.37

Rais data from Chandler (1970).

The difficulty in testing whether there are common industry effects is the problem of measurement. There are two approaches around this problem, both derived from using unit-free measures, the first one looking at a within-country industry comparison, the second looking at the across-country industry comparison. In Table 1, the appendices from Chandler's book providing a listing of the top 200 firms for the years around 1919, 1930, and 1948 are summarized. (Appendices to this paper provide the sectoral breakdown.) A unit-free measure of the size variance is derived by looking at the coefficient of variation (i.e standard deviation by the mean).[21] This measure provides a sense which industries were unusually variable in their size distributions compared against the overall variation for a country.

An analysis of this kind provides many interesting statistics, but only limited insight. In all three countries, the overall variability of size tends, with a few exceptions, to be greater than the within sector variability. The median firm size appears to have increased about the same for all countries from the Great War to about 1930; the UK median size grew substantially

[21] The mean was chosen so as to give an approximation of the variation around the central tendency of a normal distribution. For this purpose, the logarithm of sizes probably provides a beter fit to the normal. However, the results are unlikely to be strongly affected, and the presentation of the untransformed means and median is more transparent to the reader.

during the 1930s, presumably due to the merger wave. Despite, then, the wide debate on rationalization and the need for larger firm size in both the UK and Germany, these movements had no considerable effect relative to the US during the first decade of the interwar period.

Turning to the issue of sectoral variation (see appendices), the overall coefficient of variation in the United States decreased from 1917 to 1930. In 1917, the primary metal industry is the most variable, whereas by 1930, the transport industry was the only sector to have greater variability than that for the entire sample. The UK shows an increase in its overall size variation between the first two periods, a confirmation of the fundamental changes that occurred in the British economy during the interwar years. This result for the UK is strongly affected by the formation of ICI, which is responsible for increasing the variation in size in the chemical industry. A similar pattern holds for Germany, which due to the formation of I. G. Farben in the chemical industry, plus the consolidation in the primary metal industries, also shows increasing variation during the first two periods. What these statistics suggest is that in a few industries, mergers pushed the size distributions of UK and Germany disproportionally and substantially to the right.

The second way to compare size distributions is to provide a better sense of the across-country similarities. Again, we need to find a method by which to transform the size measures into a standard unit and to compare the industry effects across countries. To carry this out, we normalize the firm sizes by subtracting the *country* mean and dividing by the *country* standard deviation. This transformation gives, now, a Z-score to each firm, generating a distribution for each country for each sampled year with a zero mean and standard deviation. For each country and for each year, we regress a vector of industry dummies on these Z-scores to generate a vector of industry coefficients. These industry coefficients for each country are then correlated to check to see if industry effects are similar across the countries. (See Figure 2 for a description.)

These results are given in Table 2. The estimates provide several interesting insights. First of all, the correlations are rather high and increase with time. What the progression in these correlations show above all is convergence in industrial structure among these countries. That is, over time, large firms tend to appear in the same industries across countries. These results are a very strong confirmation that there are a common set of technological and market factors that shifted the size distribution in UK, Germany, and the US.

There is also the intriguing suggestion that despite the differences in starting points, these factors push the industrial structures of these countries

FIGURE 2. Testing for Common Industry Effects on Firm Size Across Countries

Step One: Take firm size and subtract country mean and divide by country standard deviation. This procedure assigns a Z-score to each firm.

$$\frac{S_{ij} - \mu_j}{\sigma_j} = Z_{ij}$$

Step Two: Run an ordinary least squares regression for each country with the firm Z-score as the dependent variable and industry dummies as independent variables:

$$Z_{ij} = a_j + \sum_{k=i}^{n-1} B_{kj} D_{kj} + \xi_j$$

Step Three: Do steps 1 and 2 for each panel (i.e. time period).

Step Four: Take the dummy coefficients (B_{kjt}) which represent the industry (k) effect for country (j) for year (t) and

a) correlate these effects for each country over time to get the "within-country over time" correlation;

b) correlate the effects for each year across countries to get the "across-country" correlations.

if not to convergence, then to rather proximate neighborhoods. Even though the UK industrial structure was very much unlike the German and American at the time of World War I, all three countries evidenced similar structures by mid-century. There is much less path dependence—that is, the tendency of differences in initial conditions to persist—in the evolution of the sectoral distribution of large firms than what might *a priori* be expected.[22]

To those weaned on doctrines of comparative advantage and its effect on increasing specialization, this conclusion may seem surprising. But comparative advantage should affect the volume of activity in an industry for a given country; it is by no means manifest what the effects of the workings of comparative advantage on the size of the largest firms should be, unless the industry volume is below the optimum.[23] It can also be argued that comparative advantage in the context of intra-industry trade and investment is hard to capture at this level of aggregation. But, despite these caveats, these

[22] A common trend, such as industrial growth, could perhaps generate a correlation in the untransformed series, but this problem is corrected in our procedure by subtracting the country mean.

[23] It is surprising in this regard, given Great Britain's easy access to food supplies, that the preponderance of firms in its food industry should be taken for economic backwardness rather than an expression of its advantage.

TABLE 2. Convergence Among Countries over Time: Correlation of Industry Effects on Firm Size

	US–UK	US–Germany	UK–Germany
1917*	0.2367	0.4285	−0.0665
1930**	0.5322	0.6579	0.2297
1948***	0.7519	0.7106	0.5364

* UK 1919, Germany 1913.
** Germany 1929.
*** Germany 1953.

findings point to the importance of competition through technological and product differentiation in advanced industrial markets than through comparative advantage resulting in specialization.

A second interesting issue is the change in the country patterns of the correlations over time. Around the time of the Great War, the industrial structure of the UK was rather dissimilar from the US and Germany. One explanation for the growing similarity of the UK industrial structure is that the rapid concentration of the British chemical industry in the 1920s, which mirrored earlier developments in the US and Germany. (Of course, I. G. Farben was also formed in the 1920s, but the German industry was already rather concentrated.) In fact, it was during the interwar period that the UK finally began to enter significantly the industries of the second revolution: chemicals and electronics.[24]

But there are indications that a major factor was the effect of World War I. In Table 3, the within-country correlations are given. The German evolution shows a greater divergence from its path. Of the three countries, the correlation between the coefficients for Germany in 1913 and 1929 is relatively low. One explanation for this divergence is that the German data were collected for the year 1913; the British and the American panels are for 1917 and 1919, respectively. The lower within-country correlation for Germany may well be picking up the shock of war on forcing economies to concentrate production on transport, chemicals, and packaging. It is a provocative thesis that enemies become postwar economic competitors due to the accident of wars and their enduring effect of wartime production on convergence in industrial structures.

Another interpretation, which does not exclude the effects of wartime

[24] See Richardson (1970) for an assessment.

TABLE 3. Convergence Within Countries over Time: Correlation of Industry Effects on Firm Size

	1917–1930*	1917–1948**	1930–1948***
US	0.72	0.62	0.87
UK	0.86	0.96	0.94
Germany	0.68	0.64	0.87

* UK 1919, Germany 1913, Germany 1929.
** UK 1919, Germany 1913, Germany 1953.
*** Germany 1929, Germany 1953.

production on industrial structure, is that the German economy was severely disturbed during the 1920s. As Chandler (1990) describes at length in his book, the 1920s was a period of retrenchment for German industry. Due to reparation payments, loss of territory and markets, and prohibitions on armament production, the German industries, especially electronics, machinery, and oil, were considerably weaker in their international positions.[25]

It cannot escape remarking that the British international recovery in this period, despite a depressed domestic economy, was facilitated by the devastation of Germany. This observation is all the more supported in light of the sharp inroads which Germany made into British colonies and into the UK itself in a number of industries prior to 1914 (Aldcroft, 1968, p. 19). The postwar inflationary experience of Germany and its loss of overseas subsidiaries appears to have reduced the competitive pressures on the UK from German firms.[26]

But a major benefactor of this period was the United States, which at the start of World War I had a net debt of $3.7 billion but ended the war as a net creditor to the same amount (Wilkins, 1974, p. 29). Its corporations were the largest in the world, it possessed many of the leading technologies, and it was politically dominant. For 1914, it is estimated that the US was responsible for 18.5% of the world stock of foreign direct investment, with the UK leading at 45.5% and Germany third at 10.5%. By 1938, the shares for the US, the UK, and Germany were 27.7%, 39.8%, and 1.3%.[27] The strength

[25] For a discussion of the German ambivalence towards American investment after World War I, see Hartmann (1963, p. 44) and Southard (1931, p. 180).

[26] One cannot but concede that, in this sense, the finance capitalism arguments of Lenin, Hilferding, and Hobson have a degree of historical support.

[27] Data are taken from Dunning (1983, p. 87).

TABLE 4. Country Shares of Six Country Total Exports*

	1913	1929	1938
US	29.9%	35.45%	33.5%
UK	18.65%	11.75%	9.9%
Germany	28.0%	19.9%	14.7%

Derived from figures in Maddison, 1982: 248–254.
* Additional countries are Japan, France, and Canada.

of the US position was also reflected in the increase in its export share of the top exporting countries, as shown in Table 4.[28]

Thus, by the interwar period, the United States had clearly consolidated its position on world markets. Though many of the same factors encouraged growth of firms and international trade and investment in all three countries, the US developed a dominant position due its industrial strengths and also to the collapse of Germany as a major competitor. But how much of this success was due to its superior management of the large corporation?

3. *Firm Size and Mass Production*

It is easy to conclude from the above discussion that new technologies and markets were driving firm size in the most industrialized countries and that it was the American managerial innovations that were responsible for the larger growth of the US firms. It was the size of American operations which appeared to impress many European commentators. At the turn of the century, the press in Germany and in the UK was actively debating the American danger.[29] Attention was drawn first to the tremendous sizes being created through the formation of trusts and, later, to the size of American manufacturing plants.[30]

Yet, on examination, the scale economies of firm and plant size do not appear as such overwhelming American advantages. In part, these doubts are raised by the recognition that coordinating international business is itself expensive. No matter the American lead in the efficient administration of

[28] Regarding growth rates, the exports from both Japan and Italy grew more quickly than those from the US. As implied in the 1938 totals, the decrease of the shares of the US, Germany, and UK were due to the rise in a third country. This country was Japan which grew from 1.9% to 19.9% in its share.

[29] See the discussion in Blaich (1984), Hannah (1983, p. 38 and p. 209), and Aldcroft (1968).

[30] Lenin's fascination with Fordism is well known. See also Gramsci's (1973) comments. Hughes (1989) presents an interesting account of the effect of Fordism and Taylorism on European architects, such as Gropius and Le Corbusier.

hierarchy, this advantage would have to be substantial to offset the costs of operating as a foreign company in Europe.

Of course, size may matter for more than efficiency but also for market control. While a few firms, such as General Electric, played an important role in the development of the European electronic industries, their endeavors were often marked by a desire to stabilize markets by amalgamation or by agreement. General Electric's international experience looks anything but happy during its first fifty years. The early stake in AEG by GE's predecessor company was lost through a series of events, it failed to acquire an equity stake in a weakened Siemens after World War I, and its success in consolidating the British electronics through its merging of its Thomson-Houston subsidiary with the new acquisition of Metropolitan-Vickers (which had acquired the Westinghouse facilities) into Associated Electrical Industries ended gradually in a complete divestiture.[31] While these experiences are perhaps unusual, it should be also noted that such central American firms as Du Pont stayed out of Europe due to international agreements, as did the American steel companies. These actions speak far less to the issues of efficiency than to oligopolistic rivalry in international markets.

But even if we accept the efficiency argument of scale economies in firm size—for which, without question, there is strong historical support as outlined in Chandler (1977), the evidence is not entirely persuasive that the European companies lagged severely in the development of corporate hierarchies. Within Europe, there were indigenous movements towards the management of corporate hierarchies by functional organization, stemming from the Prussian military as well as the engineering tradition in France (as best expressed in the unity of command principle of Fayol).[32] In Table 5, the findings of Bendix (1956) on the ratio of administrative employees to production employees shows the US clearly in the lead in the first decades of the centuries, but with rather fair convergence by 1930. At least in Germany, as Chandler recognizes, corporate hierarchies did develop rather early, with German corporations achieving a similar level of diversification and integration to the US by 1907 (Kocka and Siegrist, 1979). Europe did lag the US, but not by many years.

But what captured the attention of keen contemporary observers can be a misleading guide. Even if subsidiaries were treated on a stand alone basis, very few were listed among the top firms in the UK and Germany.[33] Thus,

[31] See the discussion in Chandler (1990, pp. 351–353) and Wilkins (1970, pp. 55–59; 1974, pp. 67–68).

[32] These influences are partly explored in Chandler and Daems (1979). For a glimpse of what outsiders thought were country advantages in organizing, see Westney's (1987) interesting study on Japan's adoption of organization of the mail service from Britain and the police from France.

[33] However, of the 100 listed by Channon (1973, p. 64) for 1970, 14 companies were not from the UK: nine were from the US, two from Canada, one from Switzerland, one from South Africa, and one from Holland.

TABLE 5. Number of Administrative and Production Employees in Industry for Selected Countries and Selected Years

Year	Administrative employees	Production employees	A/P
	I. United States		
1899	348 000	4 496 000	7.7%
1909	750 000	6 256 000	12.0
1923	1 280 000	8 187 000	15.6
1929	1 496 000	8 361 000	17.9
1937	1 518 000	8 553 000	17.7
1947	2 578 000	11 916 000	21.6
	II. Great Britain		
1907	408 000	4 755 000	8.6
1924	627 000	4 708 000	13.0
1930	589 000	4 286 000	13.7
1935	676 000	4 482 000	15.0
1948	1 126 000	5 651 000	20.0
	III. Germany		
1895	266 000	5 530 000	4.8
1907	606 000	7 922 000	7.6
1925	1 122 000	9 463 000	11.9
1933	802 000	5 718 000	14.0

Source: Reinhard Bendix, 1956.

in his study on American investment in the German machine tool industry, Blaich (1984, p. 88) concludes:

> This investigation of some of the branches of the German machine industry shows that it was by no means firms belonging to a trust which decided to invest in Germany and that moreover not all American investors had a capital size advantage over the domestic producers.

A rough indication of the size distribution of American parent corporations conducting foreign direct investment in Europe is suggested in the statistics. According to the data collected under the auspices of the Multinational Enterprise project run by Raymond Vernon, the top 187 US firms in 1967 had made 22 entries in Great Britain and 14 in Germany by World

War I.[34] Dunning (1958: 36) estimates between 1901 and 1914, 70 US companies with a capital of $70–100 million and with 12000–15000 employees were operating in the UK. The Harvard data show only an additional increase of 42 between 1918 and 1930 over the original 22 entries, for a total of 64 entries. The first US census of foreign direct investments in 1929 found 169 manufacturing units operating at that time in the United Kingdom (with no corrections for deaths), for a value of $268 million. The capital size of American operations appears to have risen, but not by very much; their average size was under $2 million in book value.

The difference in the numbers between the Census and Harvard data is probably partly due to the exit of large firms by time of 1967 when the Vernon sample identified the larger 187 firms. There is in other words, the problem of selection bias. From a study by Rumelt for the period 1949–1969, we know that 247 of the top 500 American firms exited due to being displaced by faster growing firms and by acquisitions, the latter accounting for 154 exits (Rumelt, 1974, p. 55). As acquisitions would result in larger companies and would still be reflected in the historical data, then the selection bias incurred by applying Vernon's method to Rumelt's data would be the omission of 93 firms which exited from the Rumelt sample, or about 19% of the total, in the 20 year period. Adjusting upward the Harvard Multinational Database count of 64 entries by 40% (the census data are from 1929 and the Harvard data are from 1967 or about 40 years) gives an entry account of 90. This number is still substantially less than the census estimate of 169; it appears that many investments were by smaller firms.[35]

We also have reason to suspect the census data itself suffers from a selection bias, for it only counted surviving plants as of 1929. The number of entries is unquestionably higher, especially as several exits from Britain—e.g. Westinghouse's—are well documented. We can conclude from this discussion that the number of entries into Great Britain by smaller American firms than the top 200 of Chandler's listings was probably substantial.

There is wide agreement that European companies did suffer from a much smaller size of plant operations. The historical data on plant scale economies are very scanty, but there is enough known to question the importance of techniques of mass production to American direct investment. It is important to note that despite the success of a few well-known cases, such as Singer's early investment in a Scottish plant, there is little evidence on the size of American plants in Europe being larger. Even within the United

[34] Figures cited in Chandler, 1990, pp. 158–59. Chandler indicates the starting date as 1900, but this is probably because the database lumped all pre-1901 entries in this year. Vernon (1971) gives the number of entries into the UK as of 1901 at 37. See Vaupel and Curhan (1973) for the raw data.

[35] A similar exercise can be used for comparisons against the Dunning data, with similar conclusions.

States, there is only slight evidence for the creation of any significant scale economies in manufacturing by 1890 when US direct investment was already underway, with a recent study only finding distilling, flour and meal, pig iron and iron rolling mills show significant scale economies.[36]

It should also be recognized that the smaller market sizes of the European countries not only deterred indigenous efforts at mass production, but also hampered American operations. The Westinghouse plant in Wales, built in 1890, was one of the most modern, and it was largely idle. In the German machine tool industry, the more differentiated and less standardized market led to a policy of product diversity in order to achieve a modicum of joint economies (Blaich, 1984, p. 93). As late as the 1950s, Dunning (1958) still wrote of the problems of achieving long-runs in England due to market heterogeneity.

Finally, the relationship between mass production and productivity has been a hard one to pindown. First of all, larger plant size in the US reflects partly the joint effect of a lack of skilled labor along with higher wages. In James' (1983) study on scale economies in American manufacturing, a considerable proportion of the rise in factory size was due to the cheapening of capital relative to labor. Wages were lower in Europe, a factor as being cited as instrumental for investment by many American corporations (Dunning, 1958; Blaich, 1984; Wilkins, 1974).[37] Consequently, the benefit of capital-intensive operations were lower in Europe.

But leaving aside the effect of relative factor costs, it is not clear how important mass production was to productivity, nor even how much an advantage the US had, at least by the mid 1930s. In his detailed study comparing American and British manufacturing productivity, Rostas found that out of 35 industries, the US average establishment was larger in 13 cases (especially in integrated steelworks, cotton textile, motor cars, and tires) and smaller in 22 cases, though in 12 of these 22, the US was probably bigger in output value. He found no relationship between size and plant scale.[38] Similarly, Prais (1976, p. 46) found no evidence for a link in plant size and the growth in industrial concentration (that is, the share held by the largest firms) between 1930 and 1970.

4. *Organizing Principles and the American Strengths*

So where are we left if it were not the scale economies of enterprise and plant

[36] See James (1983). Steel and petroleum were not part of the sample.

[37] See also the discussion in Richardson (1970, p. 365) on the lower wage costs in Britain and the effects on scale.

[38] See Rostas, 1948, p. 60. He also found that market size does not seem to be critical, as plant sizes for Holland and Sweden were frequently larger than the UK.

which drove American investment in Europe? Part of the answer lies in the unquestionable magnitude of the innovations that were made and exploited by Americans at the turn of the century. Comparisons of this kind are always plagued by difficulties, but there is good reason to suspect that the US surge in new products was an important aspect of its success.[39]

Yet, the problem of explanations based on technologies is that the scientific leadership was largely European. For Germany, the importance of university research was fundamental. The clear spillover from university research and the training role played by the technical and apprentice colleges were evident first in the chemical industry and, later, in electronics.[40] The fundamental breakthroughs in electricity were all carried out by British scientists, who were engaged in trying to establish the foundation of a British industry (Coleman and Macleod, 1986). The auto industry began in Germany and, especially, in France (Laux, 1976). Moreover, even though many innovations were American, the European countries had the human resources and technical capabilities to imitate and to improve these innovations within a surprisingly short period of time.

But if technologies diffuse rather quickly among countries of similar capabilities, the organizing principles of work diffuse much more slowly. Throughout the 1800s, the United States had built up a slow accumulation of organizing techniques regarding the standardization of measurements, the creation of interchangeable parts, and the reduction of skill labor inputs.[41] These elements came to be known as the 'American System of Manufacturing'. This label was coined by the impressed British delegation sent to the United States to investigate manufacturing methods following the 1851 Crystal Palace exhibition in London, where American firms, such as Colt, first demonstrated the principle of interchangeability in parts. By the later part of the 1800s, Siemens had christened its manufacturing plant the 'American Factory'. By 1869, Ludwig Loewe returned from an United States visit and began producing machine-tool machinery 'after American methods' (Blaich, 1984, p. 15). This firm grew to be one of the largest in Europe's machine-tool industry.

[39] Because of the speculative nature of the data, it is hazardous to put too much weight on statistics. Streit (1949), as cited by Dunning (1983), estimated that the US was responsible for 37.7% and 46% of all major innovations in the periods 1870–1900 and 1901–1914, respectively. For historical assessment of the 'tidal wave' of American innovations, see Hughes (1989).

[40] In comparing Britain and Germany, Chandler can only partly dismiss the role played by German institutions, including the banks willing to finance the new enterprises. 'Nevertheless, Germany's organizational capabilities,' he writes, 'cannot be entirely attributed to the symbiosis that developed in Germany—but not in Britain—between the country's industrial enterprises and its financial and educational institutions' (Chandler, 1990, p. 499).

[41] Indeed, despite Habbakuk's (1962) seminal insight into the effects of higher labor costs on American innovations, what was dear in the US was skilled labor, especially as immigration grew in the 1800s.

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ized over the next 100 years. Taylorism
l expression of American organizing ideas as
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bs became specialized and interdependent.[43]
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pecific are reflected in the recommendations
is ideas by stages. Despite these warnings,
or strikes in the US (Waterdown Arsenal),
(Renault). Nevertheless, Taylorist ideas had
1920s, from manufacturing to the organiza-
spitals.[44] By 1935, 34% of all American
than 250 employees reported the use of time

ion techniques, see Hounshell (1984). The pattern of diffusion
discussed in Kogut and Parkinson (1992).

of Taylorism was made by a Dr. Robert Dickinson to hospital
, where time-motion studies were carried out to determine ways
other procedures. See the volume edited by Morman (1989).

There is no question that European managers and engineers were anxious to embrace many of Taylor's ideas. But progress before World War I was slow.[46] A stunning example of the claim that product technologies were adopted more rapidly than organizing innovations is the rapidity by which Taylor's high-speed steel techniques were adopted and bettered by British and German companies, but the painful process by which Taylorist organizational ideas were adapted to European conditions.[47] This comparison underlines the link in the co-evolution of technologies and organization.

Of equal importance, Taylorist, or standardized, principles were also embodied within the national industrial and social network. Business schools widely adopted Taylorist teachings, with Harvard's Professor Thomson writing several of the most important textbooks and readings. The Wharton School at the University of Pennsylvania maintained a Taylorist laboratory for the teaching of time-motion studies up until the 1960s.

In addition to being institutionalized in the educational system and government boards, methods of standardization spilled over into procurement practices (e.g. buying in bulk, quality control). Large consultancies were built on the implementation of cost accounting schemes. The multidivisional structure was itself an expression of the application of rationalization to the newly evolved corporate hierarchy, complete with new accounting principles. The current dominance in world markets by American accounting and management consulting firms was built on the basis of their knowledge of American organizing and accounting.[48]

The weakness of European accounting systems is one of the recurrent themes in the European government reports on the effects of American investment.[49] Along with the Marshall Plan came the sending of productivity missions by European countries and Japan to the United States. In one document, the Anglo-American Productivity Team reported that efficient management was the most significant factor in the American advantage (Dunning, 1958, p. 120). Moreover, Dunning found in his late 1950 survey that 70% of American subsidiaries used their parent accounting methods and 20% partly used them (Dunning, 1958, pp. 252–253). In fact, one of

[46] See Moutet (1975), for France; Homburg (1984) and Strassberger (1989), for Germany, and Littler (1984), for the UK.

[47] Merkle (1980, p. 99n) notes that this innovation had been invented earlier in France, but, according to Emile Pouget writing in 1914, 'languished for want of an appropriate system of machinery and organization to make use of it.' Still, the invention was adopted, and Taylor, made a considerable fortune from his patented invention.

[48] See Channon (1974, p. 239), Dyas and Thanheiser (1976, p. 112 and p. 247) and Chandler (1977) for a discussion of McKinsey's role in diffusing the multidivisional structure.

[49] See Pollard (1965) for slow development of accounting principles in Europe. Edwards and Newell (1991) disagree, but there appears to be a rather large consensus on the relative backwardness of British accounting compared to American advances in the early 1900s.

the leading failures of the Anglo-American Productivity teams was the management and labor resistance to productivity measurement and control (Tomlinson, 1991).

Similarly, Channon also reports that there was resistance to the adoption of American methods of accountability. He writes:

> British companies thus widely adopted the multidivisional structure during the past 20 years as the organizational form best suited to manage the diversified enterprise. However, the observations indicated that while companies accepted the need to divide their organizations into logical multifunctional units, many of the internal characteristics of the corporations adopting multidivisional structure reflected prior structural forms. In particular, there was little evidence of change in the reward system, especially as a mechanism to apply pressure and internal competition for divisional performance (Channon, 1973, pp. 213–214).

Overall, the use of variable rewards for top management was found to be 'generally distasteful' (Channon, 1973, p. 210).

The evidence for Germany suggests also that the United States had achieved a considerable advance in methods of rationalizing and evaluating work. 'It was by no means only the technical advancement,' writes Blaich (1984, p. 13) regarding the machine-tool industry, 'which the German firms wanted to achieve. The American firms showed themselves more advanced in firm organization, in accounting, sales, and financial planning.' It is important to note that these organizational advantages grew logically from the standardization in manufacturing; catalogues could be printed because products were standardized; after-sales service was less costly to provide because spare parts were interchangeable. The German machine-tool industry, because of their craft tradition, produced in response to customer demand rather than relying on marketing, quality, and cost to persuade customers.[50]

Indeed, a wide-spread adoption of standards did not start until the close of World War I and only became fully felt with the Rationalization movement in the 1920s.[51] In general, World War I had a major impact on European countries in promoting standardization, from the navy yards of France, to the war planning committee first headed by Walter Rathenau (director of AEG), and, to a lesser extent, in the UK. Yet, still, the adoption of standards for electrification proceeded slowly in the UK despite the example of the US and Germany (Hannah, 1979).

[50] See Blaich (1984). Chandler seems to put this ability to market to the credit of organizational capabilities developed uniquely by larger American companies. 'The American machinery companies successfully "invaded" Europe because so few European enterprises were able to produce better-performing machines at comparable prices and to provide the necessary marketing services of demonstration, installation, after-sales repair and service, and consumer credit' (Chandler, 1990, p. 201).

[51] See Brady (1933).

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Chandler regarding firm size
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production function using manufacturing
37) and James (1983).

structure by 1930. The last variable is the percentage of firms reporting the use of time-motion studies. This variable picks up the extent to which methods of standardization and cost accounting methods diffused in the work place, regardless of the size of enterprises. To this extent, it is a measure of the development of shopfloor organizing principles.

In Table 6, we provide a correlation matrix. There is a high correlation between time-motion studies and foreign direct investment. There is also the possibility of collinearity between the measure of R&D scale and executive incentives.

TABLE 6. Correlation Results

	1	2	3	4	5	6	7
(1) Foreign Direct Investment	—						
(2) Plant Scale	−0.05	—					
(3) Advertising	−0.06	−0.15	—				
(4) R&D	−0.03	0.24	0.39	—			
(5) Firm Scale	−0.04	0.11	0.05	0.21	—		
(6) Time and Motion	0.56	0.16	−0.15	−0.11	0.02	—	
(7) Executive Incentives	0.36	0.20	0.16	0.84	0.21	0.05	—

In Table 7, the results from an ordinary least squares regression are given. The estimates confirm that time-motion studies is significantly related to direct investment. None of the other variables, even when omitting variables to avoid collinearity, are significant.

With data as rough as these, it would be unwise to draw strong conclusions from these results. At the same time, given our earlier discussion, the importance of size and management hierarchy on explaining the industrial pattern of American direct investment should be skeptically regarded. Rather, the weight of the historical and statistical evidence suggests that direct investment came from those industries in which the evolution of the organizing principles of rationalization and standardization of work had most fully developed.

It is surprising, that neither R&D, nor marketing expenditures are significant. Both of these measures have been found to be robustly correlated with recent flows of direct investment.[53] Unquestionably, it cannot be ruled out that data problems, or the use of book values for the stock of foreign direct investment, are responsible for the poor results. Also, the international

[53] See Caves (1982) for a summary of these findings.

TABLE 7. Regression results

	Dependent Variable: *US Outward Foreign Direct Investment in 1929* (1000s of dollars)			
Model	1	2	3	4
Intercept	279688	685957	410713	265767
	(0.37)	(1.06)	(0.77)	(0.38)
R&D	1876.52	16365	—	—
	(0.14)	(0.90)		
Advertising	−2825.00	−5458.98	−450.04	−2701.76
	(−0.25)	(−0.57)	(−0.07)	(−0.28)
Plant scale	−190089	−688589	−439326	−187990
	(−0.25)	(−1.06)	(−0.81)	(−0.26)
Firm scale	−470.60	−671.59	−719.57	−460.74
	(−0.20)	(−0.34)	(−0.39)	(−0.19)
Time and motion studies	—	4422.24*	3943.21*	—
		(2.78)	(2.79)	
Executive incentives	—	−3884.09	—	900.069
		(−0.69)		(0.22)
R–sq	0.01	0.45	0.40	0.02
N	16	16	16	16

* Significant at 5% level.

environment was characterized far more by government intervention and by cartelization than in the post-war period. The omission of these variables certainly may have depressed the correlations of direct investment to R&D and marketing.

There is still good reason to believe these correlations are telling. The role of firm R&D was minor prior to the post-war period. Only a handful of companies in the United States can be identified as pursuing a policy of funding laboratories for the development of new products. The correlation of R&D and FDI for the past three decades reflects the historical transition of firms having exploited their initial innovations in closely related applications to finding new products. The diversified firm is a creation of the past 30 years, as the studies of Rumelt (1974), Channon (1973), and Dyas and Thanheiser (1976) have amply shown. Statistical relationships are historically embedded.

6. *Conclusions*

This essay began by claiming a demurring but sympathetic view of the Chandler thesis of the early development of managerial hierarchies in explaining the better performance of Germany and the US. The demurral is simply that the strength of the American performance rested upon organizing principles that had widely diffused in the United States to both small and large firms. These organizing heuristics were already evident in the late 1800s and had already begun to be adapted to Europe and elsewhere by the turn of the century.

The sympathetic element is that organizing factors were a major driver of firm and country performance in the past century.[54] Given the remarkable evolution of large companies and the dominance in their national economies, it would be wrong to conclude that the development of the capabilities to manage these giant firms was not consequential. The most important managerial inventions, such as the financial control methods developed by Brown at Du Pont, were predominantly pioneered by large firms. But, the principles by which they have come to be managed are expressions of an organizing logic of standardization, rationalization, and measurement developed and adopted by firms of all sizes.

There remains, however, the intriguing possibility that variation in country practices persist in the lower part of the size distribution. In his comparison of American and UK productivity, Rostas (1948, p. 67) wrote:

> Our estimates have revealed substantial differences in average physical output per head *between* the individual industries in the U.K. and the U.S. Various studies undertaken in the two countries have shown that *within* the individual industries of each country there are equally substantial differences in the output per head of the best and the worst firm; these are as great, if not greater, as are the differences between the averages in the respective industries of the two countries.

It is very likely that the frontier of best practice is widely distributed among the leading firms of countries.

Yet, there is also another side to the missing lower component of the size distribution in international comparisons. That is, smaller firms play an important role, as Marshall claimed almost a century ago, in the creation and diffusion of new technologies and techniques. In fact, after a century of exhortation to build larger firms, the UK found itself in the interesting position in the mid-1970s of having created an industrial structure far more

[54] See also Wright and Nelson (1991) for a similar view.

concentrated than the US and Germany and with proportionally fewer smaller firms (Prais, 1976).

It may well be that certain countries have excelled in the creation of small firms and in the development of inter-firm network knowledge. The Italian and Taiwanese economies appear to fit well this description, and it is important that neither country has developed strong international investment positions relative to comparable nations, such as France and Korea, respectively. Not all country organizing principles of work are equally capable of being transported. Given the growth of wealth in both countries, their development should provide caution to focusing on economic strength through direct investments by giant firms.

There is, though, an evolution in the internationalization of investments that bridges this contrast between large and small firms. For the legacy of the American investment has left a substantial share of the invested capital in Europe under the control of American subsidiaries. After a century of development, many of these subsidiaries are fully integrated into the local economy. It is through the dispersion of the assets of the multinational corporation and their joint integration into local economies and into the global hierarchy of the parent company that national industrial networks, and the small firm constituents, are linked more tightly today in a world economy.

This essay has traced the co-evolution of technological innovations, that spawned a wave of new firms, and the concomitant organizational innovations that developed to manage their growth. The evolution of these firms were stimulated by common industry-specific technologies and market demand characteristics. But the similarity of the structural forces influencing firm size across countries does not explain the rise of the United States to a singular dominance. Rather, this rise can be attributed to a long cumulative development of widely-diffused principles of rationalizing work. That these principles are now internationally diffused has proven to be the limiting condition on American expansion.

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l	Coeff
2.12	1.08
7	0.61
5.28	0.77
4.38	0.15
0.25	0.88
7.82	0.41
0.4	0.01
4.55	0.86
1.44	1.04
9.61	0.68
3.35	0.56
6.71	0.20
7.03	2.37
9.11	0.63
8.13	1.13
3.47	0.67
1.46	0.38
0	0
0	0
32.41	2.14

:d	Coeff
86.08	0.89
79.21	0.51
27.95	0.45
29.73	0.51
0	0
46.58	1.44
23.55	0.23
51.32	1.09
73.89	1.07
59.93	0.37
32.5	0.41
17.72	0.30

1930 (*contd.*)

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
33	23	39.7	2394.5	300.42	148.3	482.35	1.60
34	10	37.8	215	91.36	59.1	62.03	0.67
35	17	37.9	383.8	77.64	54.3	78.84	1.01
36	7	40.6	493.9	229.29	183.2	147.69	0.64
37	23	36.1	1315.8	108.2	70	296.1	2.73
38	2	129	167.1	148.05	148.05	19.05	0.12
39	2	59.9	145.5	102.7	102.7	42.8	0.41
Total	200	20.1	2394.5	172.46	79.8	268.43	1.55

1948

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
20	27	67.2	522.5	182.62	133.5	120.26	0.65
21	5	96.4	686.6	370.46	425	232.21	0.62
22	8	72.8	256.6	158.51	146.3	56.68	0.35
24	2	80.5	210.1	145.3	145.3	64.8	0.44
25	1	68.9	68.9	68.9	68.9	0	0
26	6	75.8	323.2	152.42	140.55	83.19	0.54
27	2	71.5	161.7	116.6	116.6	45.1	0.38
28	23	66.1	1189.3	210.77	107.6	251.62	1.19
29	22	136	3526	715.53	340.45	758.61	1.06
30	5	69.8	424.9	289.84	344.3	121.54	0.41
31	2	82.5	117.8	100.15	100.15	17.65	0.17
32	6	82.2	227.3	142.87	139.3	50.66	0.35
33	23	67.9	2534.9	388.93	290.4	513.38	1.31
34	6	72.1	275.8	160.2	156.65	73.11	0.45
35	21	68.4	671.8	144.96	79.3	138.74	0.95
36	9	68.3	1177.3	385.93	209.1	377.5	0.97
37	29	67.9	2957.7	264.7	122.8	548.08	2.07
38	1	411.6	411.6	411.6	411.6	0	0
39	2	67	109.1	88.05	88.05	21.05	0.23
Total	200	66.1	3526	286.71	138.05	432.9	1.50

Appendix 2

Great Britain

1919

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
20	61	1	19	2.59	1.8	2.48	0.95
21	3	1.3	22.8	8.53	1.5	10.09	1.18
22	26	1.1	45	5.09	2	8.66	1.70
26	3	1.4	6	2.33	1.7	0.97	0.41
27	5	1.4	24.3	3.54	4.2	1.68	0.47
28	14	1.3	62.8	7.39	4.7	7.03	0.95
29	3	18.2	8.9	36.7	29.1	18.98	0.51
30	3	1.4	1.5	3.93	1.5	3.51	0.89
31	1	1.5	9.1	1.5	1.5	0	0
32	2	2.6	23.2	5.85	5.85	3.25	0.55
33	40	1.1	8.2	3.21	2.1	3.57	1.11
34	1	8.2	6.5	8.2	8.2	0	0
35	6	2	4	3.27	2.5	1.59	0.48
36	7	1	19.5	2.27	1.9	1.11	0.48
37	23	1.1	2.4	4.29	2.3	4.66	1.08
39	2	2		2.2	2.2	0.22	0.09
Total	200	1	62.8	4.27	2.1	6.77	1.58

1930

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
20	63	1.4	45	5.96	3.7	7.77	1.30
21	4	2.3	130.5	36.28	6.15	54.49	1.50
22	21	1.3	51.9	8.42	4.6	13.58	1.61
23	1	1.6	1.6	1.6	1.6	0	0
26	5	2.8	7.9	4.62	3.8	1.94	0.41
27	10	1.5	27.6	6.87	2.95	8.09	1.17
28	11	1.9	132	23.45	3.3	40.2	1.71
29	4	8	104.6	51.45	46.6	35.74	0.69
30	3	1.6	28.2	10.53	1.8	12.49	1.18
31	1	8.5	8.5	8.5	8.5	0	0
32	7	1.6	13.9	5.66	3.3	4.86	0.85
33	24	1.4	10.3	4.16	3.35	2.49	0.59
34	8	1.7	20.3	5.13	3.15	5.83	1.13
35	5	1.7	11	4.47	3.02	3.12	0.69
36	11	1.5	14.5	5.26	3.7	3.88	0.73

1930 (*contd.*)

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
37	17	1.4	21.2	5.14	2.9	5.82	1.13
38	2	2.1	2.7	2.4	2.4	0.3	0.12
39	3	4.4	8.1	5.63	4.4	1.74	0.30
Total	200	1.3	132	8.32	3.4	17.26	2.07

1948

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
20	53	8.9	127.6	13.39	7.4	18.75	1.40
21	6	4.8	257.8	52.97	12.35	91.89	1.73
22	17	4.5	57.1	14.08	7.2	15.77	1.12
23	2	6.2	15	10.6	10.6	4.4	0.41
26	6	6.8	24.9	12.15	10.7	6.07	0.49
27	7	4.5	31.8	12.58	10.6	8.49	0.67
28	17	4.5	197.5	33.12	10.7	58.11	1.75
29	3	56.4	204.4	144.63	173.1	63.69	0.44
30	2	5.3	55.9	30.6	30.6	25.3	0.82
31	1	10.9	10.0	10.9	10.9	0	0
32	8	4.4	28	12.69	9.7	8.44	0.66
33	25	4.4	31.9	12.04	8.5	7.52	0.62
34	7	4.8	35.3	13.39	7.5	10.9	0.81
35	10	4.5	17.5	7.95	5.9	4.52	0.56
36	11	4.5	28.9	11.38	8	8.47	0.74
37	21	4.8	39.3	10.71	7.2	8.3	0.77
38	1	5.2	5.2	5.2	5.2	0	0
39	3	5.3	18.6	10.83	8.6	5.65	0.52
Total	200	4.4	257.8	17.41	8	32.88	1.88

Appendix 3

Germany

1913

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
20	26	12.6	46.9	20.71	16.85	8.56	0.41
21	1	24.2	24.2	24.2	24.2	0	0
22	16	13.2	74.1	23.24	15.95	15.34	0.66
23	1	13.2	13.2	13.2	13.2	0	0
24	1	14.8	14.8	14.8	14.8	0	0
26	4	13.6	97.9	42.05	28.35	33.34	0.79
28	30	12.7	128.2	38.49	25.7	33.61	0.87
29	5	16.8	51.6	25.42	19	13.28	0.52
30	4	12.8	52.5	25.1	17.55	16.18	0.64
31	2	16.9	30.8	23.85	23.85	6.95	0.29
32	7	12.8	24.4	19.59	21.1	3.99	0.20
33	49	12.9	599.5	65.01	63.7	92.63	1.42
34	5	13.1	57.7	26.7	21	15.84	0.59
35	25	12.8	117.5	30.99	26.4	22.71	0.73
36	7	15.5	463	164.79	104.2	159.32	0.96
37	16	13	118.6	39.38	24.7	32.28	0.81
38	2	13.2	14.5	13.85	13.85	0.65	0.04
Total	200	12.6	599.5	42.89	23.35	64.74	1.50

1929

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
20	28	16.6	121.6	37.26	28.6	23.27	0.62
21	1	29.3	29.3	29.3	29.3	0	0
22	24	16	239.8	48.58	31.65	58.44	1.20
23	1	27.4	27.4	27.4	27.4	0	0
26	5	18	121.6	57.68	49.2	34.36	0.59
27	1	44.3	44.3	44.3	44.3	0	0
28	24	16.6	2090.2	157.42	48	412.18	2.61
29	7	17.9	259.3	89.6	44.9	81.08	0.90
30	2	18.5	102	60.25	60.25	41.75	0.69
31	5	18.2	46.7	31.56	28.8	11.34	0.35
32	7	18.7	53.5	29.24	21.7	12.28	0.41
33	33	17.2	2145.7	153.61	48.7	364.21	2.37
34	3	19.1	39.2	32.4	38.9	9.41	0.29
35	17	19.1	102.8	39.8	35.4	19.39	0.48

1929 (*contd.*)

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
36	13	17	579.4	144.07	50.5	183.43	1.27
37	24	17.9	116.5	52.57	39.75	30.23	0.57
38	3	26.1	31.2	28.37	27.8	2.12	0.07
39	2	19.2	96.3	57.75	57.75	38.55	0.66
Total	200	16	2145.7	83.32	36.65	219.41	2.63

1953

Sic	(N)	Min	Max	Mean	Median	Std	Coeff
20	22	17	349.6	50.68	32.6	70.64	1.39
22	26	18.8	307.6	56.49	36.95	63.46	1.12
23	1	24.6	24.6	24.6	24.6	0	0
26	3	99.5	169.9	134.47	134	28.74	0.21
28	24	22.4	1086	199.84	91.15	270.54	1.35
29	6	66.3	448.3	301.7	331.95	134.55	0.44
30	5	28.3	227.8	92.14	73.7	70.47	0.76
31	2	23.4	84.7	54.05	54.05	30.65	0.56
32	6	31.4	95.5	60.58	54.05	26.06	0.43
33	40	21.4	1091.1	253.71	155.2	258.06	1.01
34	5	31.3	65.6	43.72	36.3	13.53	0.30
35	28	16.7	307.1	69.66	49.2	68.02	0.97
36	8	32.8	739.8	251.75	104.2	270.01	1.07
37	18	32.5	340.2	133.61	102.65	90.22	0.67
38	3	29.9	52.4	37.63	30.6	10.45	0.27
39	3	26.5	64.6	39.24	26.6	17.94	0.45
Total	200	16.7	1091.1	137.59	58.5	189.46	1.37

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