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THE ROLE OF SMALL-SCALE MANUFACTURING IN ECONOMIC DEVELOPMENT

THE EXPERIENCE OF INDUSTRIALLY ADVANCED NATIONS AS A GUIDE FOR NEWLY DEVELOPING AREAS

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Chapter I

INTRODUCTION

Stanford Research Institute was requested by the International Cooperation Administration to prepare a manual on the developmental role which medium and small industrial units can play in the early stages of economic development. It was specified that the manual should provide bases for determining the industries in which small units can be effectively encouraged and for judging the relative amount of effort which should be devoted to encouraging and supporting small industrial units. It was further specified that the manual should include a comprehensive statistical investigation of the role played by small manufacturing units in the economic growth of selected industrially advanced countries, and should consider the function and status of small industrial units in typical underdeveloped areas. In general, it is the purpose of this manual to explore the potential of small industrial units to advance the pace of economic growth.

In meeting this assignment, Stanford Research Institute placed heavy emphasis on an analysis of the experiences of industrially advanced countries and on the significance of these experiences for underdeveloped areas.

A Summary of the Manual

Chapter II deals with the problem of economic growth and with those factors which influence the economic development of a nation. In establishing a frame of reference for what follows, this chapter indicates that the proper scale of manufacturing is but one of many factors influencing the useful economic growth of underdeveloped areas.

Chapter III defines some terms which are employed frequently throughout the manual. The findings of previous studies are discussed as they relate to industrial growth in various countries. Although there are many similarities between the industries of these countries, the economic efficiency of a given plant depends upon local markets and local costs.

Chapter IV gives statistical evidence of the structure of manufacturing in the United States. The following points stand out: (1) most manufacturing industries are composed of plants ranging from small to large, with only 54 of the 452 industries covered being composed primarily of large plants; (2) large-scale manufacturing industries are characteristically concentrated geographically, have relatively high capital costs, and are composed of multiplant firms; (3) the economic efficiency of manufacturing establishments is

demonstrated primarily by economic survival, with no positive evidence that either large plants or small plants are the most efficient for all industries; (4) the interrelationships of manufacturing establishments are extremely intricate; and (5) even the largest manufacturing establishments are not large compared to the size of the market.

Chapter V outlines the economic development of the United States and shows that large plants have developed in this country only over a considerable period of time, in response to the market, and together with many other establishments and industries, particularly transportation.

Chapter VI summarizes the experiences of various other industrially advanced countries. On the basis of the evidence it appears that (1) such prerequisites to industrialization as well-developed systems of transportation, banking, and education have been established in these countries; (2) large and small plants coexist in most industries just as they do in the United States; (3) some of the products which require large-scale production in the United States are being produced efficiently by smaller plants in other countries; and (4) countries with relatively small domestic markets depend upon export markets for the sale of most products requiring large-scale production.

Chapter VII relates the preceding discussion to the problem of investment in newly developing areas. It is suggested that an objective of new investment in any country should be to maximize the productivity of society. Planners in some underdeveloped countries erroneously associate the maximization of productivity with large plants and large-scale industries. However, consideration of the size of domestic markets and the availability of the factors of production leads to the generalization that (except in those industries producing for the export market) the productivity of underdeveloped countries will be maximized by plants smaller than those which exist in the United States. This conclusion is modified, though not fundamentally upset, by a discussion of such considerations as producers' goods, integrated plants, and automatic factories.

The Project Team

This research was conducted in the Institute's Southern California Laboratories under the administrative direction of Harry M. Bridgeman, Manager of the Economics Group. Emil L. deGraeve was project manager, and Robert W. Oliver was project leader. Henry E. Robison contributed to all phases of the study. Rosemarie Stroy, Louise Biddle, Betty Neitzel, and Jane Hall prepared the appendixes.

Professor Robert Campbell of the Department of Economics, University of Southern California, served as a consultant to the project team and prepared the section on the Soviet Union.

To Whom Addressed

Depending upon the particular country in question, economic development is guided to a greater or lesser extent by the individual enterpreneurs who base their investment decisions upon their own anticipations of profit. But even in the United States, where governmental direction and regulation have encumbered free private enterprise less than in most of the rest of the world, profit anticipations are influenced by federal, state, and local governments through protective tariffs, public utility regulations, subsidies, taxation, zoning laws, and so on. In addition, particularly in recent years, profit anticipations have been influenced by research designed to provide more complete evidence upon which an entrepreneur may base his investment decision.

This manual may be of interest, therefore, to private citizens and government officials as well as businessmen. Specifically, it is addressed to the following individuals or groups:

1. Public officials in underdeveloped countries who are engaged in promoting the industrial development of their countries

2. Businessmen who may be considering the advisability of establishing or expanding industrial enterprises in underdeveloped countries

3. The officers and field representatives of the International Cooperation Administration who are concerned with assisting the industrialization of underdeveloped countries.

The Need for Additional Research

Since this manual was prepared in less than nine months and solely from facts available in the United States, it should be regarded as no more than an introduction to a study of the role of small-scale manufacturing in economic development. There is a general paucity of knowledge and literature on exactly how a country or an area in a less-developed region of the world can and should go about building up rural and small-scale industry. Additional research, particularly that which might be carried on in other countries as parts of a coordinated research program, might yield many new insights into this problem.

For example, a research team of engineers and economists might consider the technological reasons why the efficient production of various goods may or may not require large plants. In this connection, a detailed, on-the-spot investigation of specific industrial techniques in industrially advanced nations other than the United States would undoubtedly be useful.

Investigations of the industrial statistics of the industrially advanced nations not discussed in this manual would be useful. For that matter it would be useful to study in greater detail the industrial statistics of the nations considered in this manual.

This manual should be supplemented by studies of (1) the relationships between the markets for various products and their scales of production; (2) the interrelationships among products; and (3) the interdependence of the various sized plants of given industries.

Useful field studies could be made of the reasons why small enterprises succeed or fail, both in the United States and in other countries.

In short, the role of small-scale industries in economic development should receive continuing study.

Chapter II

SCOPE AND PURPOSE OF THE MANUAL

This manual is concerned with the appropriate structure of manufacturing in underindustrialized but developing countries.[1] It is not concerned with the over-all process of economic growth. It assumes that some degree of industrialization will occur in underindustrialized societies and inquires only as to the proper balance between large-scale and small-scale manufacturing units. More specifically, it examines the proposition that economic growth may be retarded by overemphasis upon large scale industrial operations.

Useful Economic Growth

Useful national economic growth is that which results in a general increase in per capita income[2] within a given nation. The basic factors which influence the useful economic growth of a nation are (1) national income, (2) income distribution, and (3) population. To be sure, these three factors are by no means independent of each other,

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1/ In this manual the terms "underdeveloped" and "underindustrialized" are used more or less interchangeably to describe the "newly developing" countries of the world. These are the countries where per capita income is low relative to that in the United States, Western Europe, and the more advanced member nations of the British Commonwealth. Unfortunately, for reasons which need not be discussed here, the terms "underdeveloped" and "underindustrialized" are not altogether satisfactory. They will be used in this manual, however, for the reason that they have become a part of common usage. For a discussion of the problems of defining an underdeveloped area, see Norman S. Buchanan and Howard S. Ellis, Approaches to Economic Development (New York: The Twentieth Century Fund, 1955), pp. 3-22. See also infra, p. 13.

2/ Income refers here to the flow over time of economic goods. Per capita income is national income divided by the number of people in the given country. In the broadest sense, income may refer to happiness (pleasure, well-being) and may include freedom, security, health, beauty, and so on, in addition to such goods as may command a money price in the market. Nevertheless, unless otherwise specified, income will refer in this manual to the flow over time of economic goods, and unless an increase in per capita income in this sense can be shown to be related to a decrease in per capita income in the broader sense (as may be true in the Soviet Union where goods may be substituted for freedom), an increase in per capita economic income will be regarded as desirable.

but if any two of the three could be held constant while only the third were changed, useful economic growth would depend upon a rising national income, a more equitable distribution of income, or a declining population.

It is probably unrealistic to consider the economic growth of underdeveloped societies in terms of declining populations, and it may be true that the national income of a given society will increase more rapidly if the population is also increasing. 3/ Nevertheless, a rising per capita income requires that national income increase more rapidly than population. 4/

It should also be mentioned that, beyond a point, a tendency toward equalization of per capita income may retard the growth of national income. On the other hand, if the entire increase in national income should accrue to a small fraction of the people while the per capita income of the greater fraction of the people remained unchanged or declined, national economic growth would have little meaning from an over-all point of view.

Given these qualifications, we are generally concerned in this manual with rising national income or, in other words, with rising national output. 5/

With a constant labor force and a given total demand, rising national income depends upon greater quantity and/or improved quality and/or better use of the land or capital (man-made instruments of production) with which the people work. Thus, other things being equal, the economic growth of a society requires the discovery of new land resources or the application of new techniques for using the known land resources; an increase in the available quantity of plant and equipment; or the discovery and/or the application of new techniques for using plant and equipment.

3/ It may also be true that the rate of population increase is related to the manner in which national income increases. See Harvey Leibenstein, The Theory of Economic-Demographic Development (Princeton: Princeton University Press, 1953).

4/ It is clear that the population of the world must be held in check in the long-run if per capita income is to increase or even to remain as high as it is today. For an excellent summary of the long-run population problem of the world, see Harrison Brown, The Challenge of Man's Future (New York: The Viking Press, 1954).

5/ In the absence of gifts to or from other countries, national income and national output are the same, since the flow of goods to the people (income) depends, in the long-run, upon the flow of goods from their productive activity (output).

Within limits, assuming a constant quantity and quality of land and capital and a given demand, national income may increase as a consequence of an increased quantity or quality of labor. Health measures and educational programs may contribute to economic progress in that the one may increase the strength and/or the life expectancy of the worker and the other may improve his skills.

It is also possible for a given national income to rise for a time as a consequence of international shifts in demand which increase the exchange value of the products of the given nation. But in the long-run, the most important requisite to a rising national income is an expanding supply (qualitative or quantitative) of appropriately managed capital (the equipment with which people work). For this reason, the primary economic problem of underdeveloped areas lies in providing appropriately managed new investment (the increase during a given time period in the supply of capital).

All of this is well enough understood by those who are concerned with the development of underdeveloped areas. There is, moreover, an abundance of literature dealing with the various aspects of capital formation (investment) in the aggregate--problems of saving, money markets, price inflation, international trade, foreign investment, political stability, entrepreneurial activity, social traditions and attitudes, and so on.6/ Consequently, a general understanding of the problems of capital formation will be assumed in this manual. The focus here will be upon the narrower subject: the proper balance between large and small manufacturing units.

The Elements of Industrial Development

It is assumed that the elements of industrial development are present and that their importance is understood in the underdeveloped countries to which this manual is directed. The necessary elements include natural resources, human resources, basic utilities and services, and organizing factors.

Natural resources must be available for industrialization. These include minerals, raw materials, agriculture, forests, and fisheries as well as propitious climate, geography, and topography. Human resources are needed, and it must be remembered that they can be substantially improved by such factors as health, education, and vocational training.

6/ For a bibliography on economic development, see United Nations, Bibliography on Industrialization in Underdeveloped Countries (United Nations Headquarters Library, Bibliographical Series No. 6, 1956. II. B. 2).

Because of its relation to the size of the market, transportation is particularly important. Even where a fair-sized market might exist if it could all be tapped, it is often broken up into local segments by the lack or excessive cost of transportation.

Without reasonably adequate local and long-distance communications, marketing in the volume needed to sustain modern manufacturing is impossible. Active wholesale and retail trade establishments and related facilities for warehousing, advertising, servicing, and repairing manufactured products need to be developed simultaneously with factory production.

Cheap and abundant power is essential for some branches of manufacturing and advantageous to most. Some manufacturing operations require large quantities of water.

Banks, insurance firms, securities markets, and related facilities are necessary for handling money transactions and for assembling savings to finance some of the capital for industrial development.

As factories multiply and bring more people into cities and towns, considerable public and private investment is required in houses, paved streets, distribution systems for water and electricity, sewage systems, urban transport, police and fire protection, and so on.

Finally, industrial development requires active leadership to provide the intangible but all-important "will to develop" and to organize the new human relationships in the technical production facilities that constitute a modern industrial system. Key organizational factors are business initiative and management, trade union leadership, governmental leadership, and applied scientific research.

Industrial versus Agricultural Development

The concern of this manual with certain aspects of industrialization should not be taken to imply a disregard for other aspects of economic growth. Indeed, as will become apparent, the general thesis of this study is that total growth should be balanced.

Discussions of economic development often seem to imply that underdeveloped countries should increase their industrial output instead of their agricultural output, or vice versa; but these are not mutually exclusive alternatives.

The first step for most preindustrial and mainly agricultural societies is the modernization of agriculture. But, in the absence of a commensurately expanding market for the increased agricultural

output,[7] industry must provide jobs for those who are employed superfluously in agriculture.

Agriculture, fishing, and other so-called "primary" industries tend to be progressively supplemented in a developing economy by "secondary" (manufacturing, mining, and building) and then by "tertiary" industries (commerce, transportation, and services). Looked at in another way, the preindustrial economy may move, in a succession of steps, from more or less pure reliance on the exploitation of natural resources to the more advanced processing of raw materials; from there to the manufacture of simple consumption goods (e.g., low-grade textiles); thence to more complex, heavier manufactures and public utilities; then (perhaps because of limitations imposed by scarcities of resources) to heavy industrial complexes; and finally to the development of extensive service industries.

Of course, the above process of development is oversimplified, since primary, secondary, and tertiary industries may (and to some extent must) improve together. Moreover, development depends in great part upon the adjustability of going institutions, rising internal demand based on increasing income, and the opportunity for advantageous external trade.

Those who argue in favor of agricultural development to the exclusion of industrial development generally base their case on the law of comparative costs.[8] Why, it is argued, should a nation divert some of its productive resources away from agriculture and into industry if, at current international prices, a given agricultural output has a greater value than the value of the industrial output which could be produced with the shifted resources? The result of such a shift would be only a reduction of the national income of the country.

Of course, this argument is basically sound, and underdeveloped countries would do well to consider it when contemplating protective devices designed to stimulate the domestic production of goods which, given realistic foreign exchange rates, could really be imported at lower costs.[9]

7/ This is a problem of price elasticities and the terms of international trade, the basic question being what will happen to the prices and costs of agricultural products if agriculture output is increased by the application of modern techniques? See also the discussion infra, p. 10.

8/ In nontechnical terms this law simply states that, given an equilibrium in its international accounts, a nation should import those items which would be more expensive to produce at home.

9/ See Jacob Viner, International Trade and Economic Development (Glencoe, Ill.: The Free Press, 1952).

On the other hand, if all nations were to follow the dictates of free trade, many (particularly those with relatively small productive capacities) would be dependent upon imports for a greater part of their supplies. They would suffer fluctuations in national income resulting from the vicissitudes of international trade. 10/ To insure greater national economic stability, many nations may prefer to forgo some of the advantages of international trade.

Of course, the industrialization of underdeveloped countries may not conflict with the law of comparative costs. The familiar infant-industry argument has been emphasized in recent years along with a corollary, though somewhat more modern, argument. In a number of countries the marginal physical product of agricultural labor is zero--that is to say, some agricultural labor could be shifted off the land without any consequent reduction in agricultural output. 11/ In such a case, particularly if agricultural output can be increased substantially only by the use of labor saving machinery, it is desirable that the marginal physical productivity of workers engaged in industry be raised through training and through provision of more and better instruments of production.

The important point is that industrial development and agricultural development need not be regarded as alternatives, although the correct ratio between expenditures will obviously vary from country to country.

10/ See Robert W. Oliver, "An Aspect of Economic Nationalism," World Affairs Interpreter 26 (Spring, 1955), pp. 61-79.

11/ It has been estimated, for example, that 70 million Chinese, 27 million Indians, and 2 million Japanese could be moved off the land without decreasing agricultural output; if 15 percent of the working populations of India and China could be moved off the land and into industry, per capita incomes would double; and additional shifts of 10 percent or less would treble per capita incomes. See L. H. Bean, "Industrialization, The Universal Need for Occupational Adjustment Out of Agriculture" (unpublished), quoted in Eugene Staley, World Economic Development: Effects On Established Industrial Countries, Studies and Reports Series B. No. 36. 2nd ed., 1945 (Montreal: International Labour Office, 1944), pp. 5-6, footnote.

The Direction of Industrialization

In many underdeveloped countries industrialization as such is regarded as being more or less synonymous with development, and it is possible that worthwhile development along other lines will be consequently neglected. There is still another danger. Granted that industrialization is desirable and that it will occur, there is a danger that it will not proceed along the lines which will foster the most rapid and useful economic growth. Aside from the problems of capital formation and international trade, there are other considerations: Which specific manufacturing industries should be promoted? And what should be the scale of those industries which are promoted?

While industrialization properly carried out can greatly increase a country's real income, not all industrialization efforts have this result.[12] Industries may be instituted that are poorly adapted to the country's circumstances in terms of the market for the product, the resources required, the feasible scale of operation, or the timing. Industries may be inefficiently managed, or their purpose may be to support military and political power rather than to advance the country's economic well-being.

The concern of this manual is more specific. Being impressed by the large-scale manufacturing units of the advanced industrial countries, officials in underdeveloped countries may overestimate the advantages of mass production on a very large scale. Some may even be so impressed by the prestige of huge establishments that such establishments are promoted even though their uneconomic nature is understood.

There are undoubtedly countries in which the conjunction of raw materials, markets, labor force, and managerial skill is such that a given industry may be suited to large-scale operation. A country-by-country analysis of underdeveloped areas would undoubtedly reveal many instances where large-scale plants would be economically feasible. Nevertheless, the waste of an ill-advised giant plant is obviously much greater than the waste of an ill-advised small- or medium-scale plant, and there is a greater tendency to compound any initial error through continuing and perhaps increasing subsidies.

These issues will be discussed in more detail in subsequent chapters, but it is well to make clear at this point the primary conclusion of this manual: since economic development is most useful

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12/ See Stanford Research Institute, Manual of Industrial Development with Special Application to Latin America, prepared for The Institute of Inter-American Affairs, Foreign Operations Administration, United States Government (Stanford, California: Stanford Research Institute, October, 1954), pp. 18-19.

when a proper balance is achieved between alternative investments, those who are responsible for guiding the economic development of underdeveloped areas should take care not to overemphasize the construction of giant plants.

Modern Industry and Plant Size

Understandably, underdeveloped nations are anxious to employ modern industrial techniques whenever possible. Indeed, it is only because underdeveloped nations may use the technical knowledge acquired by the more advanced industrial nations that the prospects for their rapid economic growth are at all encouraging. To some extent, the trial and error which characterized the industrial development of, say, Great Britain, Germany, Japan, and the United States may now be avoided by nations seeking to realize their potential.

An industrial development program should not be based on the illusion that rapid economic growth requires the almost exclusive encouragement of large manufacturing establishments. Such an illusion might arise from an acceptance of any one or a combination of the following erroneous propositions:

1. That manufacturing industries in advanced industrial countries, particularly the United States, are composed almost wholly of large establishments

2. That modern technology is incompatible with small- and medium-sized establishments

3. That existing small-scale enterprises (including handicraft specialities) in underdeveloped areas should not be encouraged because they are doomed in the long-run.

The first two of these propositions are the particular concern of this manual. Thus, the greater part of this manual will be devoted to a description and analysis of the structure of manufacturing in certain industrially advanced countries, particularly the United States. It is hoped that the experience of industrially advanced countries will be generally instructive for newly developing countries. It is also hoped that the findings of this manual may be applied in underdeveloped countries on a country-by-country basis and that subsequent studies may be made of the structure of manufacturing in specific underdeveloped countries.[13/]

13/ Based on the available statistics, a study of small- and medium-scale industries in underdeveloped areas is being prepared for the International Cooperation Administration by the Bureau of Applied Social Research of Columbia University. A preliminary mimeographed report based on statistics for Colombia, Costa Rica, Egypt, Pakistan, and Puerto Rico was submitted to the International Cooperation Administration in June 1956.

Characteristics of Underdeveloped Countries

It would be unrealistic to pretend that all underdeveloped countries fall into the same mold, for there are significant differences among them. Some countries are large, while others are small. Some have large or potentially large internal markets, while some do not. Some have abundant natural resources, while others apparently do not. Some have a surplus of agricultural labor, while others may be underpopulated relative to the available land.

There are, however, a number of significant characteristics which are common to most underdeveloped countries and which distinguish them from countries in more advanced stages of industrial development. Per capita income is low, while birth rates are high. Health conditions are poor, and workers are ill suited to long hours of factory employment requiring considerable physical strength. Educational opportunities are limited, and industrial skills are virtually nonexistent. Consumers' goods, which might provide incentives for production, are either not available or are priced beyond the reach of most workers. Managerial know-how is scarce, as is entrepreneurial initiative. Frequently, customs are incompatible with business income and with the techniques of standardized mass production. Money markets are primitive or nonexistent. Capital is scarce and therefore expensive. In many instances business profits are unduly restricted by taxation. Foreign investment is often suspect. Imports may be excluded as much by unncessarily complex procedures as by rational protection. Governments are frequently unstable; some are even corrupt. Transportation and communication systems are inadequate. Power and other utilities are not widely available. In short, many of the social and institutional prerequisites to industrial growth are absent in underdeveloped countries.

Nevertheless, the will to develop, generally lacking in underdeveloped areas as recently as a quarter century ago, is today evident almost everywhere. Social and institutional changes are taking place and are being hastened by economic development. There is thus a good prospect that human suffering will be reduced in the years ahead.

Chapter III

SOME DEFINITIONS AND CONCLUSIONS OF OTHER STUDIES

A study of the industrial structure of any country must depend heavily on the statistics which are available, and statistics on the size of manufacturing establishments have been developed in detail in few countries. Probably the most detailed statistics are those available for the United States, although even these are inadequate for some purposes. Statistics for most underdeveloped countries are extremely sketchy and must be improved if analyses of the problems of these countries are to be based on empirical evidence.

Any analysis of the size of manufacturing units is further complicated by problems of definition. What is an industry? What is a plant? What is a firm? What is a "small" plant? What is a "large" plant? On the basis of what unit may plant size be measured? How can plant efficiency be measured?

A Contribution by M. M. Mehta

One of the best discussions of these various questions is included in a recent study of the structure of seven Indian industries. 1/ In this study Dr. M. M. Mehta has defined an industrial unit as "a plant or group of plants or any manufacturing or productive group which is under one ownership and which is situated in a single industrial center or area". 2/ In this manual Dr. Mehta's definition will apply to the terms "manufacturing unit," "manufacturing establishment," and "manufacturing plant."

The definition of a "product" or an "industry" will follow the usage of the census of manufactures of the country in question, though this approach presents some problems which will be mentioned as they arise. A business "firm" or "company" will be identified as a unit of ownership. Since a firm may consist of more than one plant, it is not, however, as significant for our purposes as a plant and will be mentioned only when statistics on plants must be supplemented by additional information.

1/ M. M. Mehta, Structure of Indian Industries (Bombay: Popular Book Depot, 1955), pp. 11-18. On pp. 7-10 of this book, Dr. Mehta has also provided a good survey of the available statistical studies of plant size.

2/ Ibid., p. 12.

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The unit by which plant size is to be measured cannot be rigidly defined because the appropriateness of a unit depends upon the purpose for which it is being used as well as the statistics which are available. The sizes of various plants can be compared in terms of employees, assets, sales, fixed assets, value added, and/or horsepower per employee. In this manual, plants have been compared in various ways so that conclusions as to the relative advantages and characteristics of large plants and small plants may not be based on insufficient evidence. Nevertheless, employees per plant is the unit of measurement most often used, since the available statistics most often compare plants on this basis.

The definition of "large plant" as distinct from "small plant" is even more arbitrary. Dr. Mehta chose technical equipment as the best unit for comparing the size of various plants in India. For the cotton industry, he used spindles and looms installed; for the jute industry, looms installed; and for the sugar, paper, cement, iron and steel, and coal industries, tonning capacity. Such units of measurement would be difficult to use for many industries, however, and would preclude interindustry comparisons of plant size. The definition used in this manual will be discussed below on page 18 and in the note at the end of the Chapter IV.

A discussion of the measurement of plant efficiency may also be found below, although it may be mentioned here that Dr. Mehta compared the establishments of seven Indian industries in terms of profitability and costs of production. On the basis of the second of these tests, Dr. Mehta concluded: "Broadly speaking, we find that in all seven industries, the large-sized units seemed to be more economical in working and conducive to greater efficiency than small- and even medium-sized units". 3/ In general, Dr. Mehta substantiated this conclusion by the profitability test, although in the cotton, jute, and sugar industries, the highest rate of return was not achieved by the largest plants (see Table III-1). Moreover, as Dr. Mehta would undoubtedly agree, definitive general conclusions as to the relative efficiency of all large and small plants should be based on a larger sample than seven industries.

The Studies of P. Sargent Florence

The most useful, pioneering, empirical investigations of various aspects of plant size were those of P. Sargent Florence, Professor of Commerce at the University of Birmingham. Since a number of

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3/ Ibid., p. 146.

concepts developed by Professor Florence will be used in this manual, it is desirable to summarize his work on this subject.[4]

Industry Similarities between Countries

Particularly significant are Professor Florence's statistical comaprisons of the manufacturing industries of Great Britain and the United States. From these he concluded:

> ...that in the given state of knowledge in an industrialized country the investment of fixed capital is a function of the type of materials used and product made; and that whatever the government and the policy developed by or imposed upon the industry, the physical and technological factors are likely to remain constant in determining structure and organization.[5]

In short, the structure and organization of a given industry in one country are likely to be similar to the structure and organization of that same industry in another country. If, for example, the iron and steel industry is composed primarily of geographically concentrated, giant plants in the United States, it is likely to be similarly composed in Great Britain and in India.

Using the statistics of the 1930 British Census of Production and the 1929 American Census of Manufactures, Professor Florence discovered a number of significant correlations[6] which are pertinent to this manual, though they require some explanation.

Horsepower per Worker

Professor Florence has shown that particular industries in Great Britain and the United States tend to require the same relative amounts of horsepower per worker.[7] In both countries, for example, there was less horsepower per worker in the tailoring and dressmaking (clothing) industry than in all other industries tested. At

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4/ In particular, see P. Sargent Florence, Investment, Location, and Size of Plant (Cambridge: at the University Press, 1948); and The Logic of British and American Industry (Chapel Hill: The University of North Carolina Press, 1953).

5/ The Logic of British and American Industry, pp. 14-15.

6/ In particular, see Professor Florence's statistical compilation, Table A, Investment, Location, and Size of Plant, pp. 178-83.

7/ Of course, horsepower per worker in an industry is a simple average and may conceal significant differences in horsepower per worker per plant within an industry.

the other extreme, there was more horsepower per worker in the cement industry than in all other industries tested. The correspondence in the rank of other industries in the two countries was generally similar despite the fact that the average horsepower per worker for all industries in the United States in 1929 was about twice as great as that in Great Britain in 1930. Since Professor Florence regards horsepower per worker as a good indication of the capital intensity of a plant,[8] he has concluded that industries which require relatively large amounts of plant and equipment in one country are likely to require relatively large amounts in other countries as well.

Representative Plant Size

Professor Florence has also found that the prevalent or representative plant size is remarkably similar in respective British and American industries. Florence has defined the representative plant size of an industry as small, smallish, medium, largish, or large, according to a classification which is summarized in Table III-2 and discussed in a note at the end of Appendix A. This classification will be used throughout the manual.

This concept is based on the number of employees per plant, but it is a good deal more useful than a simple average for the industry. Although frequently used to indicate the "typical" plant size of an industry, a simple average gives an incorrect impression when most of the plants in the industry are not average in size. This difficulty is largely overcome through the use of the concept of representative plant size, since this concept depends upon the size distribution of the plants of an industry.

A warning is necessary, however, on the interpretation of representative plant size. As Professor Florence has shown, virtually all of the important industries in Great Britain in 1935 and in the United States in 1939 were composed of plants ranging all the way from small to large.[9] Indeed, many industries cannot be regarded as having any representative plant size. It may be added that the average number of employees per plant would have little if any meaning for an industry having no representative plant size.

8/ See ibid, Chapter 5. Professor Florence also regards horsepower per worker as a good measure of whether the plant is engaged in "heavy" as opposed to "light" industry; see ibid, pp. 8-9.

9/ See The Logic of British and American Industry, pp. 24-25. Professor Florence has commented: "The pure economist might (and occasionally does) argue as though there were normally an optimum (minimum-cost, maximum-gain) size to which most plants (and firms) must conform on pain of bankruptcy. The statistics of the situation do not show this clear-cut profile..." --ibid, p. 26.

Coefficient of Localization

Professor Florence has also shown that there is a close correspondence between the coefficients of localization of particular industries in the United States and Great Britain. The coefficient of localization of an industry is an indication of the extent to which the employees of that industry are, or are not, distributed throughout the country in a manner which corresponds to the geographic distribution of the workers of all industries. Specifically, it is the sum of the plus deviations of the regional percentages of workers in the particular industry from the corresponding regional percentages of workers in all industries. Complete coincidence, region by region, of the particular industry with all industries would give a coefficient of zero. Extreme differentiation (all the workers of the particular industry being concentrated in one region) would give a coefficient approaching 1.

Professor Florence's calculation of the coefficient of localization from British Census of Production data is illustrated in Table III-3. An additional illustration and a further discussion of the concept is included in a note at the end of Appendix A.

Of particular significance is the correlation between the representative plant size and the coefficient of localization of a given industry. Industries composed predominantly of small plants tend to be less localized than industries composed predominantly of large plants. This has been demonstrated by Professor Florence for 86 British and American industries, and it has been indicated for 452 American industries in Appendix A of this manual.

The Rationale of Plant Size

In the case of both plant dispersion and plant size, Professor Florence has concluded that the cost of transportation is a crucial factor. Other things being equal, the higher the transportation costs, the more dispersed and the smaller are likely to be the plants of any industry.

With the cost of transportation given, any plant will tend to be smaller the more dispersed are its sources of supply and/or its markets. Sources of supply may be dispersed because the material used is a product of dispersed domestic agriculture (as in leather tanning, grain milling, and food processing), of nature (as in bricks and lumber), or of dispersed industry (wholesale bottling). Markets may be dispersed if the product is used in agriculture generally (e.g. livestock feed), or manufacturing generally (e.g. wood crates and cardboard boxes), or by the general population (e.g. paints, building materials, furniture, clothing, and bread). The obverse of this is that the more localized the supply (iron and steel, and iron and steel products) or the market (shipbuilding), the larger the plants

will tend to be. Finally, with given dispersions of the sources of supply and the markets, the plants of a given industry will tend to be smaller as the total demand for the product is smaller. Thus, if there is a widely dispersed and small total demand for a product (umbrellas), the plants producing it will tend to be small. 10/

If transportation costs are not taken into account, large plants may tend to be more efficient than small plants. Up to a point, the larger the plant the better the use which can be made of specialized machines and people, the greater the probability that short-run deviations in demand (otherwise requiring relatively larger inventories) will cancel out, and the less the per-unit-of-output expense of those fixed costs which must be incurred regardless of the volume of output. (A corollary to this proposition is that, up to a point, a plant of a given size is more efficient the more specialized it is, i.e., the greater the fraction of its total output which is devoted to a single product.)

On the other hand, operating inefficiencies may increase with increasing plant size, since management becomes less and less able to oversee and to coordinate the entire operation. Moreover, small plants may make some collective use of specialized machines and people. As Professor Florence has pointed out:

> A small firm may be relieved of its marketing by large wholesale houses, and of its finances and capital-raising by banks, by landlords (e.g., rented shops and farms), or in other ways such as free roads for road transport, or the shoe industries' rental of machines; may be relieved of earlier or later processes by neighboring factories and a localized production center, of research by trade associations, universities or the state. In short, a group of specialists may grow up around the small firm either locally, or (like publishers of trade journals) nationally, yielding external economics, which allow that firm to operate a single process or product on a large scale. 11/

10/ One familiar with neo-Marshallian demand and cost analysis may find the preceding discussion more understandable if it is presented in the following terms. A given plant may be small because, since a greater output would require that supplies of materials be obtained from a greater distance, the added transportation expense would cause its average (and therefore marginal) costs of production to rise more rapidly than the average costs of competitors who are content to remain small. It may also be small because, since a greater output could only be sold if the product were sent farther from the plant, the added transportation expense would cause its marginal revenue to decline more rapidly than its marginal operating costs.

11/ The Logic of British and American Industry, p. 65.

In any event, the efficiencies of large-scale plant operations will vary considerably from industry to industry. Maximum technological efficiency in one industry may require much less costly and/or specialized machines and/or people than in other industries. Furthermore, it is important to remember that economic efficiency depends not only upon engineering techniques but also upon the money costs of the factors of production. In physical terms, efficiency is the provision of a maximum volume of goods and services of a given quality with a minimum use of materials, equipment, and workers' time. But if this given volume of goods and services can be obtained with varying relative amounts of equipment and workers' time, the most economic type of production clearly depends upon the relative amounts available (and hence money costs) of equipment and workers' time. For this reason, even if transportation costs, sources of the supply of materials, markets, and engineering knowledge were the same in different countries, there still might be a difference among countries in the economically most efficient representative size of plant for manufacturing that product.

Table III-1

RATE OF RETURN IN SELECTED INDUSTRIES, INDIA
1938-1947

Size Class[1/]	Rate of Return (percent)						
	Cotton	Jute	Sugar	Coal	Paper	Cement	Iron and Steel
Group I	7.7	4.6	1.5	2.2	--	--	--
Group II	13.2	8.8	3.3	4.8	4.6	--	--
Group III	16.3	12.8	6.8	8.2	6.4	--	--
Group IV	21.2	16.3	9.7	12.4	8.5	3.7	6.40
Group V	26.0	22.3	12.0	15.9	18.8	4.0	18.63
Group VI	17.2	13.2	8.0	19.4	29.8	6.2	30.10

1/ Size is based upon fixed assets, as explained in this chapter. Group I includes the smallest sized plants.

Source: M. M. Mehta, Structure of Indian Industries, p. 103.

Table III-2

BASIS OF CLASSIFICATION OF REPRESENTATIVE PLANT SIZE

Grade of Size	Great Britain		United States	
	Percent of Total Wage Earners Employed	Size of Establishment (in number of workers)	Percent of Total Wage Earners Employed	Size of Establishment (in number of workers)
Small	50 or 60	Less than 50 Less than 100	50 or 60	Less than 50 Less than 100
Smallish	50 or 60	50-199 25-199	50 or 60	51-250 21-250
Medium	50	100-499	50	101-500
Largish	50	500 or more but not qualified for Grade 5	50	More than 500, but not qualified for Grade 5
Large	50	1,000 or more	50	More than 1,000
Bias toward smaller plant	60	Under 200	60	Under 250
Bias toward larger plant	75	Over 200	75	Over 250

Source: P. Sargent Florence, Investment, Location, and Plant Size, p. 17.

Table III-3

CALCULATION OF COEFFICIENT OF LOCALIZATION
(Based on British Census of Production, 1930)

Region of Great Britain	Total Employed in Production	Percentage of All Workers			Deviations from Total Employed in Production		
		Woolen and Worsted	Cocoa	Brush	Woolen and Worsted	Cocoa	Brush
All regions	100.0	100.0	100.0	100.0			
Greater London	17.2	*	27.2	44.4	*	+10.0	+27.2
Lancashire, etc.	17.9	4.3	9.6	3.7	-13.6	- 8.3	-14.2
West Riding, etc.	11.1	73.4	18.1	2.6	+62.3	+ 7.0	- 8.5
Northumberland, Durham, etc.	5.9	*	3.6	0.7	*	- 2.3	- 5.2
Warwickshire Worcestershire Staffordshire	11.5	4.8	14.1	12.6	- 6.7	+ 2.6	+ 1.1
Rest of England	21.3	5.9	18.1	34.4	-15.4	- 3.2	+13.1
Glamorgan Monmouthshire Carmarthemshire	4.2	*	1.1	0.0	*	- 3.1	- 4.2
Rest of Wales	0.8	*	0.0	0.0	*	- 0.8	- 0.8
Lanarkshire Renfrewshire Dumbartonshire	5.0	2.4	5.6	n.a.	- 2.6	+ 0.6	n.a.
Rest of Scotland	5.2	8.7	2.7	n.a.	+ 3.5	- 2.5	n.a.
Lumped regions*		2.5		n.a.	-27.5		n.a.
Total Deviations:					+65.8 -65.8	+20.2 -20.2	+41.4 -41.4
Coefficient of Localization:					0.66	0.20	0.41

n.a. means not available.

Source: P. Sargent Florence, Investment, Location and Size of Plant, p. 36.

Chapter IV

THE STRUCTURE OF MANUFACTURING IN THE UNITED STATES

The illusion that economic development requires giant plants may be partially based on the erroneous notion that most of the plants in industrially advanced nations, particularly the United States, are very large. For this reason it is pertinent to consider relevant statistics for the United States. In addition, since the United States manufactures most of the products which can be manufactured, and since statistics on American manufacturing are reasonably detailed, it may be possible to develop some useful generalizations regarding the structure of manufacturing.

Sources of Information

Table IV-1 presents a summary of the broad lines of industrial activity in the United States. Table IV-2 shows the percentage distribution of firms and employees engaged in manufacturing.

Most of the large firms in the United States are engaged in manufacturing. For this reason, any study of American industry which is limited to manufacturing overemphasizes the importance to the economy of large-scale industry. Nevertheless, we are less concerned with the organization than with the scale of industry, and the most detailed American statistics concerning plant size are those provided by the censuses of manufactures. These are compiled by the United States Department of Commerce.

Using the 1947 census data[1/] Stanford Research Institute has prepared a detailed statistical summary of 452 American manufacturing industries. This compilation is designed to supplement the basic census data by indicating variations in plant size among these industries and is presented as Appendixes A and B.

Unfortunately, it is not possible to compare these industries on the basis of such financial ratios as sales to equity, income to equity, assets to equity, fixed capital to sales, and so on. Such financial data as are available are published annually by the Office of Internal Revenue as Statistics of Income, but the business unit used in these statistics is the incorporated firm. Financial data for unincorporated firms are unavailable, and data for those individual establishments which are parts of multiplant firms cannot be determined. These statistics do give some indication of company size by asset classes, but there is no way of comparing these figures with the employees-per-plant classification used by the Department of Commerce. Moreover, the classification of the Office of Internal Revenue is considerably less detailed than that of the Department of Commerce.

1/ The census taken in 1954 will not be available until late in 1957 or early in 1958.

Nevertheless, Stanford Research Institute has computed various financial ratios for the 21 manufacturing classifications listed in the 1947 Statistics of Income. These are included in this manual as Appendix C.

The Scale of Manufacturing Industries

On the basis of the information set forth in Appendix A, Tables IV-3a through IV-3h have been prepared. Tables IV-3a through IV-3g list the industries whose representative plant sizes in 1947 were, respectively, "small," "smallish," "bias-smaller," "medium," "largish," "bias-larger," and "large."[2] Table IV-3h lists those industries for which no representative plant size could be found. Significantly, 99 industries (one out of every five) were in this category, although this number might have been smaller had more information been available.[3]

Table IV-4 summarizes some of the characteristics of the industries listed in Tables IV-3a through IV-3h. Among other things this table indicates the close correlation between three possible measures of plant size: representative plant size, average number of employees per plant, and average value added per plant. An industry which is small scale by any one of these three standards is likely to be small scale by the other two.

This table also indicates the extent to which the categories of representative plant size merge. Furthermore, it supports the conclusion that giant plants appear to be necessary to efficient production in only 54 out of 452 industries. In all industries except those having a "largish" or a "large" representative plant size (54 industries), at least 75 percent of the plants employed fewer than 500 workers.

Tables IV-5, IV-6, and IV-7 show the relationship between representative plant size and, respectively, coefficients of localization, percentage relationships of nonproduction employees to all employees, and ratios of firms to plants. In general, these figures show that, as compared with all other industries, those industries which are predominantly composed of large plants are more concentrated, both geographically and from the standpoint of ownership, and require higher percentages of nonproduction employees. At the same time, as a study of Appendix A will demonstrate, each manufacturing industry has a profile of its own; the geographic and ownership concentration and the percentage of nonproduction employees in any industry are influenced by many factors in addition to representative plant size.

2/ For a discussion of the definition of plant size used by the United States government, see the note at the end of this chapter.

3/ See note at end of Appendix A.

Efficiency, Plant Size, and Value Added per Employee

The statistics presented in Table IV-8 have been developed[4] to support the argument that large plants are more efficient than small plants. But there are many specific American industries to which these summary figures are not applicable. Moreover, the relatively low per-unit-of-output labor costs of large plants may be more than offset by relatively high capital costs--a consideration which is particularly important in those countries where capital is extremely scarce.

In Appendix B the value added per employee has been computed by size of plant for the 452 industries listed in the 1947 Census of Manufactures. In 81 industries the value added per employee was greatest for those plants having the greatest numbers of employees. In 189 industries the value added per employee was greatest for those plants employing fewer than 20 workers (in a few cases, fewer than 50 workers). In the remaining 182 industries, the value added per employee was greatest for plants between these extremes.[5] These facts cast considerable doubt on the proposition that the largest plants are the most efficient regardless of the industry concerned.

Factor Proportions and Plant Size

Appendix B also shows, by industry and for various sized plants, the percentage relationship of wages and salaries to value added.

The value added by a plant is the difference between the value of what is produced (sales) and the cost of materials used (purchases). It is the amount available for paying wages and salaries and dividends and for meeting the costs of plant and equipment, advertising, rent, etc. Other things being equal, the greater the ratio of wages and salaries to value added, the smaller is the ratio of capital costs to value added. Thus, Appendix B gives some indication by industry of the relative capital and labor costs of various sized plants.

4/ See Joseph Steindl, Small and Big Business (Oxford: Basil Blackwell, 1945), p. 17.

5/ On the basis of the statistics presented in Appendix B, it would be possible to develop other interesting correlations. In 255 industries, for example, the value added per employee was highest for the size of plant for which the ratio of wages and salaries to value added was also the highest. For another example, in 107 industries the value added per employee was highest for the plant size which was "representative" for the industry. This latter correlation is based on the following definitions: "small," 0-25 employees; "smallish," 26-65 employees; "medium," 66-220 employees; "largish," 221-450 employees; and "large," over 450 employees. These designations follow from the overlaps indicated in Table IV-4. Correlations between the size of plants having the highest value added per employee and representative plant size are obviously impossible for those industries having a representative plant size of "bias-smaller," "bias-larger," or "none."

In 123 industries, the ratio of wages and salaries to value added was highest for plants employing fewer than 20 workers.[6] In 45 additional industries it was highest for plants employing between 20 and 50 workers. It was highest for the largest sized plants in 137 industries.

This evidence suggests no significant general correlation between plant size and the relative amounts of capital and labor employed in American manufacturing, although there may be important variations in this respect within given industries. One possible explanation is that there is relatively little difference between the production techniques employed by the various sized plants of a given industry. Large plants may be little more than small plants multiplied an appropriate number of times.

Another possible explanation is that highly mechanized plants require fewer employees per unit of value added than less mechanized plants. In other words, some plants may be small in terms of the number of workers employed precisely for the reason that their relative capital costs are high.

Additional evidence relating to this problem has been compiled by Stanford Research Institute in Appendix C. This appendix is designed to supplement the Statistics of Income which is published annually by the Office of Internal Revenue. As has been mentioned, these statistics do not provide information about the 452 industries listed in the 1947 Census of Manufactures, and the accounting unit is the incorporated firm rather than the individual plant. But the size of firms is measured by assets rather than by employees. Suitably qualified, therefore, this source may supply some additional information on the characteristics of various sized manufacturing units.[7]

For the 21 major categories of manufacturing listed in the 1947 Statistics of Income, Stanford Research Institute has computed ratios of gross sales to total assets, gross sales to fixed assets, and total assets to equity. For all but three major categories of manufacturing, the ratio of gross sales to total assets was highest for small firms--those having total assets of less than $100,000. In general, this ratio decreased as the size of firms increased. In six categories of manufacturing, the ratio of gross sales to fixed assets was highest for those firms having less than $100,000 of total assets; in four categories, it was highest for those firms having more than $10 million of total assets; and in the

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6/ This figure may understate the relative importance of labor to small plants, since the owner-managers of small plants may take their income as dividends or other capital withdrawals rather than as wages or salaries.

7/ The biggest difficulty in interpreting these statistics is that a large firm is not the same as a large plant. Nevertheless, as shown in Appendix A, large plants are more likely than small plants to be parts of multiplant, and therefore large, firms.

remaining eleven categories, it was highest for those firms between the extremes. While these results are not conclusive, an inspection of Appendix C will reveal a general tendency for the ratio of gross sales to fixed assets to decrease with increasing firm size. In all but two categories of manufacturing, the ratio of total assets to equity was highest for small firms. In general, it decreased consistently with increasing firm size. Thus, from the standpoint of both physical "capital" (total assets or plant and equipment) and financial "capital" (ownership equity), it appears that the relative capital requirements of American firms tend to increase with increasing firm size.

Additional evidence on this point is presented in Tables IV-9 and IV-10; Table IV-9 shows the ratios of various assets to gross sales by size of firm for all manufacturing corporations. Table IV-10 shows the capital-output ratios by major branches of industry for various sized firms. Both indicate that capital requirements are relatively greater for large than for small American firms.

Profitability and Efficiency

Appendix C also provides some information on the relative profitability of various sized firms. Averages by size of corporation for all major categories of manufacturing in 1947 indicate that the smallest firms operated at a loss and the medium-sized firms were the most profitable.

However, statistical measurements of the profitability of manufacturing establishments are subject to many qualifications if profitability is taken to be a measure of efficiency. Profitability may depend in part upon monopolistic control of the market. It may also depend upon business fluctuations or other factors external to the firm. Large plants with large reserves and/or good credit connections and/or diversified production may be able to survive downward business fluctuations better than small plants.

Because it is easier to start a small business than a large one, there are likely to be in existence at any moment a substantial number of small plants for which there is little economic justification. Moreover, these plants will decrease the average profitability and increase the average mortality of small plants even though many small plants are completely justified.

On the basis of Statistics of Income for the years 1931-1936, William L. Crum, Professor of Economics at Harvard University, has concluded that "on the average, large enterprise--in all or nearly all broad lines of industry, and in different stages of the economic cycle--is more profitable than small enterprise, especially very small enterprise."[8/] Of necessity Professor Crum based his findings on incorporated

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8/ William Leonard Crum, Corporate Size and Earning Power (Cambridge, Massachusetts: Harvard University Press, 1939), p. 7.

firms rather than individual establishments,and he has warned "that this investigation can give little, if any, definitive information on the existence and identity of an optimum scale of operations."[9]

One aspect of Crum's investigation may, nevertheless, be mentioned. Crum found, as shown in Table IV-11, that the rates of return on equity during the years 1931-1936 for corporations operating at a profit were the greatest for corporations in the smallest size class.[10] It was only when those corporations which operated at a loss were included that the average rates of return for the smallest enterprises were found to be lowest. In other words, there was a much greater variation in the profitability of small, than of large, corporations. Table IV-12, prepared by Stanford Research Institute for the year 1947, generally substantiates Crum's findings.

In 1940 the United States Federal Trade Commission completed a study for the Temporary National Economic Committee on the "Relative Efficiency of Large, Medium-Sized, and Small Business."[11] It sought to compare plants or companies or groups of companies of varying sizes (determined by assets) on the basis of costs of production and rates of return on invested capital. The sampling was limited and the conclusions have been criticized,[12] but they are nevertheless of interest.

> In the 53 individual plant-cost tests, the largest plant had the lowest cost in only two tests.
>
> A large plant, although not the largest, had the lowest cost in four tests.
>
> In 21 of the 53 tests, plants classified as medium-sized had the lowest cost.

9/ Ibid, p. 4. For an interesting case study of a small plant which discontinued operations in 1936 after one hundred years in business, see Theodore F. Marburg, Small Business in Brass Fabricating (Washington Square, New York: New York University Press, 1956). Of particular interest is the emphasis in this study on the role of management. For other case studies of small business, see Austin Grimshaw, Problems of the Independent Businessman (New York: McGraw-Hill Book Company, Inc., 1955). For case studies of the respective roles of big and small business in developing innovations, see Robert Schlaifer, "Big Business and Small Business: A Case Study," Harvard Business Review, 28 (July 1950), pp. 97-108.

10/ Crum used the value of assets as his measure of corporate size. His rate of return was determined by dividing annual earnings after taxes by the average equity book value for the year.

11/ Federal Trade Commission, "Relative Efficiency of Large, Medium-Sized, and Small Business," Temporary National Economic Committee, Investigation of Concentration of Economic Power, Monograph No. 13, 76th Congress, Third Session (Washington: United States Government Printing Office, 1941).

12/ See, for example, John M. Blair, "The Relation Between Size and Efficiency of Business," The Review of Economic Statistics, 24 (August 1942), pp. 125-35.

In 26 of the 53 tests, plants classified as small had the lowest costs.

In these 53 tests, over one-third of the plants in each cost array had on the average lower costs than the average plant.

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In the 233 combined tests, large size, whether represented by a corporation, a plant, a group of corporations, or a group of plants, showed the lowest cost or the highest rate of return on invested capital in only 25 tests. In these combined tests, medium size made the best showing in 128 tests and small size in 80 tests. Thus, large size was most efficient, as efficiency is here measured, in approximately 11 percent of the total tests, and medium size was the most efficient in approximately 55 percent of the tests, and small size was most efficient in approximately 34 percent of the tests. 13/

However, neither the Crum nor the T.N.E.C. study demonstrates a great deal about plant efficiency. In addition to the difficulties already mentioned, accounting profits may include owner-manager salaries and thus be overstated from an economic point of view. Alternatively, accounting profits may understate the true economic profit if owner-managers' salaries are unrealistically high. Such aberrations are, of course, particularly likely in the case of small plants and firms.

Furthermore, the ratio of equity to sales may vary considerably from firm to firm (see Table IV-13). The smaller the ratio of equity to sales the greater will be the rate of profit if the plant or firm is doing well, and the greater will be the rate of loss if the firm is not doing well. Thus, two plants or firms could be equally "efficient" on the basis of all factors of production and still show different rates of return.

To measure efficiency, the rate of return should ideally be computed on the inputs of all factors of production. At the very least, the rate of profit on equity should be compared only between plants which employ, at least roughly, the same relative amounts of ownership capital. However, as has been shown, small firms generally employ relatively less capital than do large firms. Thus, it is dangerous to draw any general conclusions as to which plant size is the most efficient

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13/ Federal Trade Commission, op. cit., pp. 12, 14.

for any given industry, let along for all industries.[14] It is perhaps reasonable to conclude only that efficiency is demonstrated in a competitive system by economic survival. It follows from this, as shown in Appendix A, that (1) in many manufacturing industries no plant size is the most efficient; (2) in many industries small- and medium-sized plants are probably the most efficient; and (3) in relatively few industries do large plants appear to be the most efficient.

Mortality and the Size of Firms

The mortality of small firms as measured by either discontinuances or liquidations tends to be relatively high (see Tables IV-14 and IV-15). Discontinuances and failures, however, are not the same. Small firms are extremely flexible, and they may discontinue operations for a variety of reasons other than business failure. Table IV-16 gives some indication of the relative importance of small business failures.

More significantly, however, the relative importance of small- and medium-sized manufacturing establishments in the United States has remained virtually unchanged during the last forty years (see Table IV-17). It must be remembered that, like deaths, the number of births of small establishments is relatively great; at any one moment many small firms are just on their way in or their way out (see Tables IV-18 and IV-19).

The Interdependence of Plants

The foregoing discussion has been primarily concerned with interpreting the published statistics on the industrial structure of the United States. Unfortunately, however, these figures cannot indicate the extraordinary interdependence of industrial establishments even though this interdependence is as significant for the purposes of this manual as the statistics. Large plants probably could not operate efficiently in the United States if their production were not integrated with the production of hundreds or even thousands of other plants, both large and small. It may be, moreover, that large plants are generally infeasible for underdeveloped areas for the reason that the necessary industrial environment does not yet exist.

For purposes of statistical compilations, "industries" are no more than aggregations of plants which are only roughly speaking engaged in the same sort of production. Statistics do not indicate whether a given

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14/ For an excellent analysis of the difficulties in drawing conclusions as to the relationship between size and profitability in the Indian cotton textile industry, see S. D. Mehta, The Indian Cotton Textile Industry (Bombay, India: The Textile Association, 1953), pp. 188-200. For a general discussion of this problem, see National Bureau of Economic Research, Cost Behavior and Price Policy, Conference on Price Research, Price Studies No. 4 (New York, 1943), pp. 219-66.

plant is turning out complete units (e.g., automobiles) or only parts (e.g., automobile batteries). In a sense every plant is an "industry" in itself.

The ten-man machine shop could not produce an automobile (or an airplane) except at astronomical cost, but the assembly line plant would also be less efficient (and much larger) if it produced all of the components of an automobile (or an airplane). Perhaps the most important reason why the full-scale production of automobiles is confined to a few American cities is that the plants which can produce specialty items for the larger automobile firms are located primarily in these cities.

Some appreciation of the interdependence of American industries may be gained from a study of input-output tables or matrixes. An illustration of a matrix is presented as Table IV-20.[15]

Stanford Research Institute has compiled Table IV-21 to show the supply relations of 16 well known American firms selected at random. The du Pont Company, for example, depends upon some 30,000 other companies for its supplies, and 93 percent of these 30,000 are small firms which happen to have the highly skilled manpower and know-how necessary to do special jobs. Ninety-five percent of du Pont's output goes to 75,000 other firms.[16]

In 1956 the Radio Corporation of America paid nearly $593.5 million for materials and services purchased from 10,000 suppliers, the majority of whom are small suppliers located throughout the country. Ninety percent of an estimated 42,000 suppliers of the General Electric Company are small businesses. Two-thirds of the 277 firms supplying the Monsanto Chemical Company employ fewer than 100 workers. During 1955 the western operations buyers of the Standard Oil Company of California made purchases from some 5,900 different vendors in western states. Nine thousand companies supply the Rochester plants of the Eastman Kodak Company. Of the 20,000 suppliers of the Aluminum Company of America, 16,675 are firms employing less than 500 workers. Over 10,000 of the 13,423 suppliers of the Firestone Tire & Rubber Company employ fewer than 250 workers. The General Foods Corporation has some 40,000 suppliers.

A good example of the interdependence of American industry is provided by the construction of the new United States Steel plant at Morrisville, New Jersey. Each of the 200 prime contractors subcontracted to

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15/ For a bibliography of interindustry studies, see Vera Riley and Robert Allen, Interindustry Economic Studies, Bibliographical Reference Series No. 4, Operations Research Office (May 15, 1955).

16/ For an interesting discussion of the place of big and small business in the United States, see This Is du Pont; The Story of Business: Large and Small (Wilmington, Delaware: E. I. du Pont de Nemours & Company, 1956).

10 other firms on the average, and each of these 2,000 subcontractors used one subcontractor. Sixty percent of the prime contractors and 75 percent of the subcontractors employed fewer than 500 workers.

There are advantages to plant specialization which are not unlike the advantages of the general division of labor, but plant specialization requires a degree of industrial interdependence which cannot develop overnight. The industrial structure of the United States developed over a reasonably long period of time. It developed, moreover, on a broad front, with many different industries and many types and sizes of plants being promoted more or less at the same time.

The Size of the Market

The size of the market is another factor upon which plant size depends. Indeed, an important reason why large American plants may be unsuited to underdeveloped countries is that no underdeveloped country has a market which can approach the American market in terms of size.

By way of illustration, a middle-sized integrated American steel plant is the Kaiser establishment near Los Angeles. In 1956 this operation consisted of a coke plant with an annual capacity of over one million tons of metallurgical coke; three blast furnaces, each with a daily capacity of 1,200 tons of pig iron; nine open hearth furnaces with a rated capacity per batch of 200 tons each; a foundry and pig casting plant; a blooming and rolling mill; a plate mill; a continuous hot strip mill; a structural mill; a continuous weld pipe mill; a cold rolling mill; an electric weld pipe mill; and a tin plate mill. The annual Kaiser steel ingot capacity of over 1.5 million tons was just over 1 percent of the steel ingot capacity of all the steel plants of the country. The value added by all Kaiser Steel operations was only about .01 percent of the gross national product of the United States.

The output of the Kaiser plant is small in terms of both the American market for all goods and the American market for steel, but this output would be enormous in terms of the domestic markets of most newly developing countries. To be sure, there are open hearth steel plants in the United States which are smaller than the Kaiser plant in terms of annual output capacity.[17] There are, moreover, a number of American plants which produce super-quality steel in electric furnaces which have much smaller capacities than open hearth furnaces. Accordingly, electric-furnace steel is more costly; it is a special product which

17/ The Torrance works of the Columbia-Geneva Division of the United States Steel Company has, for example, four open hearth furnaces and one electric furnace; its total annual capacity is 220,000 net tons of steel. The Gary steel works of the United States Steel Company has, on the other hand, 55 open hearth furnaces with a total annual capacity of over seven million tons of steel.

is not generally competitive with open hearth or Bessemer steel. Nevertheless, it is clear that the large American plants of those industries characterized by large plants are so large that they may be ill suited to the markets of newly developing countries.

To this conclusion should be added three qualifications.

1. An underdeveloped nation may be able to develop export markets which will justify the large-scale production of a given product. This has been done, for example, by the Japanese; and it might be done by other nations with small domestic markets, particularly if groups of countries could unite their markets by means of customs unions.

2. As development proceeds and as the level of income rises, plants which were not justified at lower income levels may become justified. This is, of course, the hope and expectation of those planners in underdeveloped countries who currently advocate the domestic production of products requiring large plants. Unfortunately, however, planners are frequently disappointed, either because income does not increase as rapidly as expected or because the requisite income (market) is underestimated in the first place. In any event, it is questionable whether it is wise to plan the output capacity of a plant on the basis of a market which can be but dimly anticipated. This is particularly true if innovations may render a plant obsolete before profitable operations become possible.

3. It may be possible to produce an item in an underdeveloped country at a low per unit cost by means of a small-scale process which is not widely used, if at all, in the United States.

Of these three qualifications, the third is the most promising. The primary justification for large-scale production is low per unit cost; but if the same degree of efficiency can be achieved by one (or several) small- or medium-sized plants as by a large plant, there is little reason for building a plant which is too large for the market.

A useful study could be made of the varying techniques used throughout the world in producing items which generally require large plants in the United States. It may be that processes are already known whereby steel, for example, can be produced at low, competitive costs on a small scale. For this reason we shall consider the available statistics on the manufacturing industries of several countries other than the United States.

A Note on the Definition of Plant Size

Throughout this manual plant size is usually delineated in terms of the number of paid employees per plant. Where possible, the representative plant size of an industry has been calculated on the basis of a classification (see Table III-2) which depends upon the number of paid employees per plant. This is a useful and convenient measure, but it is by no means the only one. Total assets, fixed investment, sales, and income are other common indicators of size, and for some purposes these financial variables may be of more interest than the number of paid employees. Although the number of employees does tend to be related to other measures of company size, this is not necessarily the case.

Furthermore, a firm that is relatively small in one industry might be relatively large in another industry, regardless of which measure is taken to be the criterion of size. It is for this reason that the United States government does not define small business for its purposes by any fixed number of employees per plant. Rather, it has sought to vary the maximum number of employees a plant might have and still be classified as small, depending upon the particular industry involved.

By way of illustration, since only about 11 percent of the output of the American aircraft industry is produced by plants employing fewer than 2,500 workers, a plant producing aircraft might be classified as "small" if it employed no more than 2,500 workers. On the other hand, 75 percent of the output of 50 American manufacturing industries is produced in plants employing fewer than 100 workers. In the case of these industries, only plants employing a maximum of 50 workers might be classified as "small."

In 1951 the following rules for the classification of small business in the United States were suggested. 18/

1. Any business concern operating an establishment with less than 50 employees is small in an industry in which one-half to all of the manufacturing is done in establishments of this size.

2. Any business concern operating an independent establishment with less than 75 employees is small in an industry in which one-half to two-thirds of the manufacturing is done in establishments of this size.

18/ See James I. Mills, "A Proposed System for Classifying Manufacturing Concerns by Size," Small-Business Programs of the National Production Authority, Hearing Before the Select Committee on Small Business, United States Senate, Eighty-Second Congress, First Session, October 4, 1951 (Washington: United States Government Printing Office, 1951), p. 27.

3. Any business concern operating an independent establishment with less than 100 employees is small in an industry in which two-fifths to two-thirds of the manufacturing is done in establishments of this size.

4. Any business concern operating an establishment with a given number of employees between 100 and 250 employees is small if it is no larger than the maximum size of establishments required to do one-third to two-fifths of the manufacturing in the same industry.

5. Any business concern with a given number of employees between 250 and 2,500 is small if it is no larger than the maximum size of establishments required to do one-third of the manufacturing in the same industry.

6. Any business concern with 2,500 or more employees is large.

7. A central office company, one which operates more than one establishment, is large unless the summation of the number of employees in all of its establishments does not exceed the number for a small manufacturer in the industry in which it is classified.

8. If the above standard should permit a choice of the number of employees in small business concerns for a particular industry, the lesser number is to be established.

To date, these recommendations have not been officially accepted by any branch of the United States government, although there is a congressional disposition to press for some such flexible classification of plant size. At a congressional hearing on July 5, 1956, the following statement was quoted with approval:

> This committee makes no attempt to formulate a rigid definition of small business. It believes that the concept of small business must remain flexible and adaptable to the peculiar needs of each instance in which a definition may be required. From the standpoint of general policy, the essential thing is to understand the problem of small business. This is to maintain the vigor of the competitive system, to assure free opportunity to establish a new business and to grow, to prevent oppressive and coercive tactics, in a word, to give the smaller concerns an even break.

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This committee is also convinced that whatever limits may be established to the category of small business, they must vary from industry to industry according to the general industrial pattern of each. Public policy may demand similar treatment for a firm of 2,500 employees in one industry as it does for a firm of only 50 employees in another industry. Each may be faced with the same basic problems of economic survival. This merely points to the desirability of granting to the administrative authority considerable discretion in classifying firms. For this reason, the committee does not view with favor the establishment of a fixed limit, such as 500 employees, to be universally applied to all industries. It believes this to be too precise and restrictive to meet the requirements of public policy. The provision in the Defense Production Act giving the Small Defense Plants Administration authority to determine which firms are small would seem to be much more appropriate.

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In summary, the concept of small business is an outgrowth of our public policy of preserving free competition and of maintaining the integrity of independent enterprise. It must be flexible and capable of adaptation to the requirements of that policy. The specific determination of the class of firms which are deemed to be small must vary from industry to industry although there are limits beyond which all firms in an industry may be either large or small. Within the scope of Congressional standards, the matter of precise definition should be left to administrative determination. 19/

On October 30, 1956, a subcommittee to the Select Committee on Small Business of the House of Representatives strongly recommended this approach. 20/

19/ This statement originally appeared as part of House Report 2513, 82nd Congress, 2nd Session, and is cited in Definition of "Small Business" within Meaning of Small Business Act of 1953, as Amended, Hearing Before Subcommittee No. 2 of Select Committee on Small Business, House of Representatives, Eighty-Fourth Congress, Second Session, Pursuant to H. Res. 114, July 5, 1956 (Washington: United States Government Printing Office, 1956), p. 15.

20/ See The Definition of "Small Business" Within the Meaning of the Small Business Act of 1953, as Amended, a report of Subcommittee No. 2 on Government Procurement, Disposal and Loan Activities to the Select Committee on Small Business, House of Representatives, Eighty-Fourth Congress, Second Session, Pursuant to H. Res. 114, October 30, 1956 (Washington: United States Government Printing Office, 1956), p. 10.

Table IV-1

NUMBER OF FIRMS IN OPERATION BY TYPE OF INDUSTRY AND SIZE OF FIRM, U.S.
January 1, 1951
(Thousands)

Industry	All Classes	Employee Size Class 0-3	4-7	8-19	20-49	50-99	100-499	500-999	1,000 or More
All Industries	4,067.3	3,040.0	513.2	311.8	124.7	40.7	30.34	3.38	3.18
Mining and quarrying	37.0	22.4	5.3	4.8	2.5	1.0	.89	.11	.11
Contract construction	377.3	264.9	57.4	35.3	13.2	3.9	2.40	.16	.08
Manufacturing	322.8	137.3	51.9	57.3	38.9	17.4	16.16	2.06	1.85
Food and kindred products	40.2	16.5	7.4	8.0	4.6	1.8	1.57	.18	.16
Textile mill products	9.3	2.1	.9	1.7	1.6	1.0	1.49	.28	22
Apparel and other finished textile products	38.9	14.2	4.4	7.2	7.4	3.2	2.22	.16	.08
Leather and leather products	6.3	2.3	.7	1.0	.9	.5	.72	.07	.04
Lumber and timber basic products	50.9	23.0	11.0	9.6	4.5	1.7	1.13	.08	.04
Furniture and finished lumber products	12.7	5.7	1.8	2.1	1.5	.7	.68	.06	.03
Paper and allied products	3.9	.7	.4	.7	.8	.5	.60	.09	.09
Printing and publishing	42.0	22.7	7.7	6.2	3.2	1.1	.92	.12	.09
Chemicals and allied products	12.0	5.6	1.7	2.1	1.4	.6	.48	.09	.10
Products of petroleum and coal	1.0	.3	.2	.2	.2	.1	.11	.02	.03
Stone, clay, and glass products	13.3	6.2	2.3	2.1	1.4	.6	.59	.09	.07
Primary metal industries	5.4	1.2	.6	1.0	1.0	.6	.69	.12	.14
Fabricated metals	22.6	8.6	3.4	4.3	3.1	1.5	1.38	.17	.13
Machinery, except electrical	24.2	9.2	3.9	4.7	3.1	1.3	1.46	.20	.24
Electrical machinery	5.1	1.7	.6	.8	.7	.4	.57	.13	.12
Transportation equipment	5.1	2.2	.7	.7	.6	.3	.38	.07	.13
Professional, scientific, and controlling instruments	4.3	2.1	.6	.7	.4	.2	.23	.03	.04
Rubber products	1.2	.3	.2	.2	.2	.1	.15	.03	.04
Miscellaneous 1/	24.3	12.5	3.6	3.9	2.3	1.0	.80	.08	.06
Transportation, communication, and other public utilities	180.7	139.2	17.9	12.8	6.0	2.1	1.95	.31	.45
Wholesale trade	268.6	169.2	44.5	34.9	13.9	3.8	1.95	.13	.08
Retail trade	1,820.9	1,436.0	233.4	110.7	30.4	6.5	3.19	.29	.35
General merchandise	74.2	57.8	8.9	4.4	1.7	.6	.61	.10	.16
Grocery, with and without meat	340.2	308.2	23.5	6.2	1.5	.4	.30	.03	.05
Meat and seafood	34.1	30.3	2.7	.8	.2	2/	.01	3/	3/
Other food	84.2	65.5	11.2	5.3	1.5	.4	.25	.03	.03
Motor vehicles	62.5	25.5	12.8	15.4	6.9	1.5	.28	3/	3/
Filling stations	221.9	197.3	19.8	4.2	.6	.1	.04	3/	3/
Automotive parts and accessories	26.1	20.7	3.4	1.5	.4	.1	.02	3/	3/
Apparel	89.0	63.7	13.4	8.0	2.7	.7	.43	.03	.03
Shoes	17.5	13.3	2.4	1.2	.4	.1	.10	.01	.01
Lumber and building materials	27.8	12.2	7.2	5.9	1.8	.5	.18	3/	3/
Hardware and farm implements	63.2	47.2	10.7	4.5	.7	.1	.04	3/	3/
Home furnishings	53.8	37.6	9.3	5.3	1.3	.3	.11	.01	.01
Eating and drinking places	364.8	266.7	61.1	28.6	6.7	1.2	.47	.03	.03
Drugs	54.2	30.2	16.5	6.1	1.0	.1	.10	.02	.02
Liquor	34.0	30.9	2.5	.5	.1	2/	3/	3/	3/
Miscellaneous retail 4/	273.3	288.8	28.0	12.6	3.0	.5	.24	.02	.01
Finance, insurance, and real estate	326.9	264.5	34.3	18.5	5.9	1.9	1.51	.16	.17
Service industries	733.0	606.5	68.5	37.5	13.9	4.0	2.29	.14	.10
Hotels and other lodging places	66.9	52.3	7.2	4.1	1.8	.7	.68	.07	.02
Laundry, cleaning, and garment repair	91.2	64.4	12.3	7.9	4.2	1.6	.69	.01	.01
Barber and beauty shops	175.5	165.5	8.0	1.6	.3	.1	.02	3/	3/
Other personal services	71.8	63.5	5.9	1.9	.4	.1	.04	3/	3/
Business services	99.7	78.7	10.6	6.8	2.4	.7	.41	.03	.03
Automobile repair	77.7	65.3	8.1	3.3	.7	.1	.03	3/	3/
Miscellaneous repair	84.0	76.4	5.0	2.0	.5	.1	.04	3/	.01
Motion pictures	14.5	4.9	3.5	4.0	1.4	.3	.20	.02	.03
Other amusements	51.8	35.5	7.8	5.7	2.2	.4	.17	.01	3/

1/ Includes tobacco manufactures.
2/ Less than 50 firms.
3/ Less than 5 firms.
4/ Includes appliances and radios.

Source: U.S. Department of Commerce, Office of Business Economics, estimates based primarily on data from the U.S. Department of Health, Education, and Welfare, Bureau of Old-Age and Survivors' Insurance; cited in Survey of Current Business, May 1954, pp. 23-24.

Table IV-2

DISTRIBUTION OF MANUFACTURING FIRMS
AND PAID EMPLOYMENT, U. S.
1947
(By Size of Firm)

Size Class (number of employees)	Number of Firms	Percent of Total Firms	Number of Employees	Percent of Total Employees
1 - 4	70,384	29.2	161.0	1.1
5 - 9	46,622	19.4	310.9	2.2
10 - 19	40,645	16.9	561.9	3.9
20 - 49	40,016	16.6	1,243.8	8.7
50 - 99	18,672	7.8	1,300.8	9.1
100 - 249	14,323	5.9	2,228.7	15.6
250 - 499	5,555	2.3	1,929.9	13.5
500 - 999	2,729	1.1	1,869.4	13.1
1,000 - 2,499	1,431	0.6	2,146.1	15.0
2,500 and over	504	0.2	2,541.8	17.8
Total	240,881	100.0	14,294.3	100.0

Note: The number of employees shown is an average for the year.

Sources: Bureau of the Census, computations by the Conference Board; cited in "Definition of 'Small Business' Within Meaning of Small Business Act of 1953, as amended," Hearing Before Subcommittee No. 2 of the Select Committee on Small Business, House of Representatives, Eighty-Fourth Congress, Second Session, Pursuant to H. Res. 114, July 5, 1956, p. 13.

Table IV-3a

INDUSTRIES WITH "SMALL" REPRESENTATIVE PLANT SIZE, U.S. 1947

Food and kindred products
- Natural cheese
- Vinegar and cider
- Creamery butter
- Manufactured ice
- Bottled soft drinks
- Wines and brandy
- Cured fish
- Prepared animal feeds
- Ice cream and ices

Textile mill products
- Knitting mills

Apparel and related products
- Fur goods
- Schiffli-machine embroideries
- Tucking, pleating, and hemstitching
- Canvas products
- Embroideries, except Schiffli-machine
- Hat and cap materials
- Women's neckwear and scarves
- Women's skirts
- Men's and boys' cloth hats and caps
- Trimmings and art goods
- Curtains and draperies
- Millinery
- Belts
- Suit and coat findings
- Blouses and waists
- Children's coats
- Children's outerwear, n.e.c.

Lumber and wood products, except furniture
- Mirror and picture frames
- Saw mills and planing mills, general

Furniture and fixtures
- Venetian blinds
- Restaurant furniture
- Partitions and fixtures

Printing, publishing, and allied industries
- Typesetting
- Miscellaneous bookbinding work
- Photoengraving
- Electrotyping and stereotyping

Chemicals and allied products
- Animal oils, n.e.c.
- Cleaning and polishing preparations
- Whiting and fillers
- Sulfonated oils and assistants
- Gum naval stores
- Fertilizers (mixing only)
- Grease and tallow
- Compressed and liquefied gases

Petroleum and coal products
- Paving mixtures and blocks
- Fuel briquettes and packaged fuel
- Lubricants, n.e.c.
- Petroleum and coal products

Leather and leather products
- Leather goods
- Saddlery, harness, and whips

Stone, clay, and glass products
- Cut-stone and stone products
- Statuary and art goods
- Concrete products
- Sand lime products
- China decorating for the trade

Fabricated metal products
- Enameling and lacquering
- Plating and polishing
- Sheet-metal work

Table IV-3a (Continued)

Miscellaneous manufactures
- Lapidary work
- Models and patterns, except paper
- Hand stamps and stencils
- Hair work
- Signs and advertising displays
- Lamp shades
- Artificial flowers
- Umbrellas, parasols, and canes

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n. e. c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-3b

INDUSTRIES WITH "SMALLISH" REPRESENTATIVE PLANT SIZE, U.S. 1947

Food and kindred products
- Flavorings
- Food preparations, n.e.c.
- Pickles and sauces
- Flour and meal
- Bread and other bakery products
- Prepared meats
- Macaroni and spaghetti
- Concentrated milk
- Poultry dressing, wholesale
- Rice cleaning and polishing
- Malt
- Raw cane sugar
- Special dairy products
- Frozen foods
- Liquid, frozen, and dried eggs

Textile mill products
- Knit outerwear mills
- Hatters' fur
- Processed textile waste
- Narrow fabric mills
- Full-fashioned hosiery mills
- Fabricated textile products, n.e.c.
- Apparel, n.e.c.
- Men's and boys' neckwear
- Suspenders and garters
- Women's outerwear, n.e.c.
- Robes and dressing gowns
- Women's coats and suits
- Dresses, unit price
- Waterproof, outer garments
- Children's dresses
- Women's and children's underwear
- Fabric and combination dress gloves
- Separate trousers
- Dresses, dozen price
- Men's and boys' underwear
- Fabric and combination work gloves

Lumber and wood products, except furniture
- Rattan and willow ware
- Excelsior mills
- Wood products, n.e.c.
- Cooperage
- Lasts and related products
- Cigar boxes
- Wooden boxes, except cigar boxes
- Prefabricated wood products
- Cooperage stock mills
- Fruit and vegetable baskets
- Wood preserving
- Veneer mills

Furniture and fixtures
- Furniture and fixtures, n.e.c.
- Reed and rattan furniture
- Household furniture, upholstered
- Household furniture, n.e.c.

Printing, publishing, and allied industries
- Envelopes

Chemicals and allied products
- Printing ink
- Marine animal oils
- Biological products
- Cyclic (coal tar) crudes
- Cottonseed oil milk
- Botanical products
- Soybean oil mills
- Natural tanning and dyeing materials
- Carbon black
- Vegetable oil mills, n.e.c.
- Fertilizers

Petroleum and coal products
- Beehive coke ovens

Table IV-3b (Continued)

Leather and leather products
- Small leather goods
- Handbags and purses
- Leather work gloves
- Footwear, cut stock
- House slippers

Stone, clay, and glass products
- Structural clay products, n. e. c.
- Minerals, ground or treated
- Lime
- Buck and hollow tile
- Clay refractories

Fabricated metal products
- Fabricated metal products, n. e. c.
- Galvanizing
- Oil burners

Transportation equipment
- Automobile trailers

Miscellaneous manufactures
- Buttons
- Musical instruments, n. e. c.
- Jewelers' findings
- Furs, dressed and dyed
- Morticians' goods
- Carbon paper and inked ribbons

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n. e. c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-3c

INDUSTRIES WITH "BIAS-SMALLER" REPRESENTATIVE PLANT SIZE, U.S. 1947

Food and kindred products
- Dehydrated fruits and vegetables
- Canning and preserving, except fish

Textile mill products
- Carpets and rugs, n.e.c.

Apparel and related products
- Handkerchiefs
- Leather and sheep-lined clothing

Lumber and wood products, except furniture
- Millwork plants

Paper and allied products
- Die-cut paper and board

Printing, publishing, and allied industries
- Commercial printing
- Engraving and plate printing
- Miscellaneous publishing
- Blankbook making and paper ruling
- Lithographing

Chemicals and allied products
- Chemical products, n.e.c.
- Essential oils
- Insecticides and fungicides
- Paints and varnishes
- Fatty acids

Leather and leather products
- Luggage

Stone, clay, and glass products
- Pottery products, n.e.c.
- Products of purchased glass

Fabricated metal products
- Screw-machine products
- Edge tools
- Structural and ornamental products

Machinery, except electrical
- Machine shops
- Cutting tools, jigs, fixtures, etc.
- Special-industry machinery, n.e.c.
- Woodworking machinery

Transportation equipment
- Boat building and repairing
- Transportation equipment, n.e.c.

Miscellaneous manufactures
- Jewelry (precious metal)
- Artists' materials
- Dolls
- Brooms and brushes
- Miscellaneous products, n.e.c.
- Games and toys, n.e.c.
- Soda fountain and bar equipment
- Fireworks and pyrotechnics

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n.e.c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-3d

INDUSTRIES WITH "MEDIUM" REPRESENTATIVE PLANT SIZE, U.S. 1947

Food and kindred products
- Blended and prepared flour
- Canned fish
- Shortening and cooking oils
- Oleomargarine
- Beet sugar

Textile mills products
- Paddings and upholstery filling
- Yarn mills, silk system
- Lace goods
- Felt goods, n. e. c.
- Seamless hosiery mills
- Yarn throwing mills
- Jute, except felt, and linen goods
- Yarn mills, wool, except carpet
- Yarn mills, cotton system

Apparel and related products
- Textile bags
- Men's and boys' clothing, n. e. c.
- Men's dress shirts and nightwear
- Work shirts

Lumber and wood products, except furniture
- Plywood plants

Furniture and fixtures
- Window and door screens
- Wood office furniture
- Wood house furniture, except upholstered

Paper and allied products
- Paperboard boxes
- Paper and board mills

Chemicals and allied products
- Hardwood distillation
- Glue and gelatins
- Linseed oil mills
- Salt
- Organic color pigments
- Synthetic rubber

Petroleum and coal products
- Roofing felts and coatings

Leather products
- Leather dress gloves
- Leather tanning and finishing
- Footwear, except rubber

Stone, clay, and glass products
- Gysum products
- Sewer pipe
- Nonclay refractories
- Cement, hydraulic
- Porcelain electrical supplies

Primary metal industries
- Secondary nonferrous metals
- Primary metal industries, n. e. c.
- Primary lead

Fabricated metal products
- Nails and spikes
- Steel springs
- Metal barrels, drums, and pails

Table IV-3d (Continued)

Machinery, except electrical	Miscellaneous manufactures
Industrial furnaces and ovens	Children's vehicles
Paper industries machinery	Organs

n.e.c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-3e

INDUSTRIES WITH "BIAS-LARGER" REPRESENTATIVE PLANT SIZE, U. S. 1947

Textile mill products
- Textile goods, n. e. c.

Petroleum and coal products
- By-product coke ovens

Stone, clay, and glass products
- Nonmetallic minerals products, n. e. c.
- Vitreous plumbing fixtures

Primary metal industries
- Welded and heavy riveted pipe

Fabricated metal products
- Files
- Tin cans and other tin ware
- Vitreous-enameled products

Electrical machinery
- Communication equipment, n. e. c.
- Telephone and telegraph equipment

Miscellaneous manufactures
- Matches

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n. e. c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-3f

INDUSTRIES WITH "LARGISH" REPRESENTATIVE PLANT SIZE, U.S. 1947

Food and kindred products
- Distilled liquor, except brandy
- Chewing gum
- Chewing and smoking tobacco

Textile mill products
- Rayon and related broad-woven fabrics
- Woolen and worsted fabrics

Furniture and fixtures
- Metal office furniture

Chemicals and allied products
- Pharmaceutical preparations
- Soap and glycerine
- Plastics materials

Rubber products
- Rubber industries, n. e. c.

Stone, clay, and glass products
- Graphite, ground and blended
- Asbestos products
- Earthenware food utensils
- Pressed and blown glassware
- Vitreous-china food utensils

Primary metal industries
- Steel foundries
- Malleable-iron foundries
- Wire drawing
- Blast furnaces
- Electrometallurgical products
- Primary copper
- Primary zinc
- Primary aluminum

Fabricated metal products
- Hand saws and saw blades
- Cutlery
- Hardware, n. e. c.
- Metal plumbing fixtures and fittings
- Heating and cooking apparatus, n. e. c.
- Bolts, nuts, washers, and rivets
- Safes and vaults

Machinery, except electrical
- Printing trades machinery
- Elevators and escalators
- Farm machinery, except tractors
- Pumps and compressors
- Oil field machinery and tools
- Metalworking machinery, n. e. c.
- Power-transmission equipment
- Construction and mining machinery
- Valves and fittings, except plumbers'

Electrical machinery
- X-ray and therapeutic apparatus
- Electrical appliances
- Carbon and graphite products
- Primary batteries (dry and wet)
- Electric lamps

Transportation equipment
- Aircraft equipment, n. e. c.

Instruments and related products
- Scientific instruments
- Mechanical measuring instruments
- Ophthalmic goods

Miscellaneous manufactures
- Pens and mechanical pencils
- Silverware and plated ware
- Pianos

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n. e. c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-3g

INDUSTRIES WITH "LARGE" REPRESENTATIVE PLANT SIZE, U.S. 1947

Food and kindred products
- Meat packing, wholesale
- Cereal preparations
- Corn products
- Chocolate and cocoa products
- Cane-sugar refining

Tobacco manufactures
- Cigarettes

Textile mill products
- Thread mills
- Wool carpets, rugs, and carpet yarn
- Hard-surface floor coverings
- Cotton broad-woven fabrics

Chemicals and allied products
- Medicinal chemicals
- Organic chemicals, n.e.c.
- Alkalies and chlorines
- Synthetic fibers

Petroleum and coal products
- Petroleum refining

Rubber products
- Rubber footwear
- Tires and inner tubes

Stone, clay, and glass products
- Glass containers
- Flat glass

Primary metal industries
- Copper rolling and drawing
- Aluminum rolling and drawing
- Steel works and rolling mills

Machinery, except electrical
- Textile machinery
- Sewing machines
- Machine too
- Refrigeration machinery
- Measuring and dispensing pumps
- Domestic laundry equipment
- Vacuum cleaners
- Internal combustion engines
- Ball and roller bearings
- Tractors
- Computing and related machines
- Typewriters
- Steam engines and turbines

Electrical machinery
- Electrical measuring instruments
- Radios and related products
- Electrical control apparatus
- Transformers
- Engine electrical equipment
- Motors and generators
- Electronic tubes

Transportation equipment
- Motorcycles and bicycles
- Ship building and repairing
- Aircraft propellers
- Motor vehicles and parts
- Railroad and street cars
- Locomotives and parts
- Aircraft engines
- Aircraft

Instruments and related products
- Photographic equipment
- Watches and clocks

Miscellaneous manufactures
- Small arms
- Small arms ammunition

n.e.c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-3h

INDUSTRIES WITH NO REPRESENTATIVE PLANT SIZE, U.S. 1947

Food and kindred products
- Confectionery products
- Leavening compounds
- Biscuit, crackers, and pretzels
- Malt liquors
- Cigars
- Tobacco stemming and redrying

Textile mill products
- Knit fabric mills
- Straw hats
- Coated fabrics, except rubberized
- Wool-felt hats and hat bodies
- Fur-felt hats and hat bodies
- Finishing wool textiles
- Cordage and twine
- Knit glove mills
- Scouring and combing plants
- Finishing textiles, except wool
- Knit underwear mills

Apparel and related products
- Housefurnishings, n. e. c.
- Corsets and allied garments
- Men's and boys' suits and coats

Furniture and fixtures
- Mattresses and bed springs
- Window shades
- Metal house furniture, except upholstered
- Professional furniture
- Public building furniture

Paper and allied products
- Fiber cans, tubes, drums, etc.
- Converted paper products, n. e. c.
- Pulp goods, pressed and molded

Paper and allied products (Continued)
- Wallpaper
- Paper coating and glazing
- Paper bags
- Pulp mills

Printing, publishing, and allied industries
- Newspapers
- Periodicals
- Bookbinding
- Books, publishing and printing
- Loose-leaf binders and devices
- Book printing
- Greeting cards

Chemicals and allied products
- Toilet preparations
- Inorganic chemicals, n. e. c.
- Explosives
- Softwood distillation

Rubber products
- Reclaimed rubber

Leather and leather products
- Industrial leather belting

Stone, clay, and glass products
- Gaskets and asbestos insulations
- Abrasive products
- Mineral wool
- Floor and wall tile

Primary metal industries
- Nonferrous foundries
- Gray-iron foundries
- Nonferrous metal rolling, n. e. c.
- Iron and steel forgings
- Primary nonferrous metals, n. e. c.

Table IV-3h (Continued)

Fabricated metal products
- Engraving on metal
- Lighting fixtures
- Hand tools, n. e. c.
- Wirework, n. e. c.
- Metal doors, sash and trim
- Metal stampings
- Boiler shop products
- Metal foil
- Collapsible tubes

Machinery, except electrical
- Fabricated pipe and fittings
- Food-products machinery
- Service and household machines, n. e. c.
- Industrial trucks and tractors
- Laundry and dry-cleaning machinery
- Blowers and fans
- General industrial machinery
- Scales and balances
- Mechanical stokers
- Office and store machines, n. e. c.
- Conveyors

Electrical machinery
- Electrical industrial apparatus, n. e. c.
- Electrical welding apparatus
- Storage batteries
- Electrical products, n. e. c.
- Phonograph records
- Wiring devices and supplies
- Insulated wire and cable

Transportation equipment
- Truck and bus bodies
- Truck trailers

Instruments and related products
- Surgical appliances and supplies
- Dental equipment and supplies
- Surgical and medical instruments
- Optical instruments and lenses
- Watchcases

Miscellaneous manufactures
- Costume jewelry
- Sporting and athletic goods
- Tobacco pipes
- Plastics products, n. e. c.
- Candles
- Jewelry and instrument cases
- Beauty and barber shop equipment
- Cork products
- Needles, pins, and fasteners
- Piano and organ parts
- Lead pencils and crayons

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n. e. c. = not elsewhere classified.

Source: Compiled by Stanford Research Institute from Appendix A.

Table IV-4

CORRELATION BETWEEN REPRESENTATIVE PLANT SIZE AND OTHER INDICATORS OF PLANT SIZE, 452 MANUFACTURING INDUSTRIES, U. S. 1947

Indicators of Plant Size	Representative Plant Size															
	Small		Smallish		Bias-Smaller		Medium		Bias-Larger		Largish		Large		None	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Average number of employees per plant	5.4	37.2	17.4	108.9	16.2	83.4	25.1	383.2	48.5	845.2	56.4	810.8	96.8	2,528.0	15.7	235.9
Average value added per plant (thousands of dollars)	$27	$601	$67	$1,016	$63	$1,072	$95	$4,868	$272	$4,271	$333	$5,933	$454	$13,158	$74	$1,840
Percent of value added by plants with under 100 employees	55.0	100	22.3	92.1	25.6	64.0	1.4	53.3	0.6	30.8	0.1	22.0	0.0	20.1	7.0	47.4
Percent of plants with under 100 employees	92.9	100	60.4	96.6	62.5	97.8	6.2	93.4	6.7	93.2	0.0	90.6	6.0	87.3	42.5	95.5
Percent of employees in plants with under 100 employees	60.3	100	23.2	88.3	36.1	61.7	2.4	47.0	0.8	23.6	0.0	23.7	0.1	17.8	7.8	43.0
Percent of value added by plants with under 500 employees	83.3	100	68.0	100	68.7	100	60.3	100	15.1	60.5	3.9	53.5	2.4	42.5	42.7	100
Percent of plants with under 500 employees	99.0	100	97.6	100	98.5	100	89.6	100	79.8	98.0	27.3	97.8	31.2	96.8	86.3	100
Percent of employees in plants with under 500 employees	84.7	100	79.1	100	67.8	100	56.0	100	50.5	57.4	20.8	49.4	0.2	38.0	50.2	100

Source: Compiled by Stanford Research Institute on the basis of Appendix A.

Table IV-5

RELATIONSHIP BETWEEN COEFFICIENT OF LOCALIZATION AND REPRESENTATIVE PLANT SIZE[1/]

Range of Coefficient of Localization	Representative Plant Size of Industry					
	Smallish[2/]		Largish[3/]		Large	
	Number of Plants	Percent of Total	Number of Plants	Percent of Total	Number of Plants	Percent of Total
0 - 40	79	42.0	48	43.6	10	19.2
41 - 60	81	43.1	47	42.7	27	51.9
61 - 100	28	14.9	15	13.6	15	28.9
Total	188	100.0	110	100.0	52	100.0

1/ Does not include industries having no representative plant size or industries for which representative plant size cannot be determined.
2/ Includes small, smallish, and bias-smaller.
3/ Includes medium, largish, and bias-larger.

Source: Appendix A.

Table IV-6

RELATIONSHIP BETWEEN REPRESENTATIVE PLANT SIZE AND NONPRODUCTION EMPLOYEES AS A PERCENT OF ALL EMPLOYEES

Nonproduction Employees as a Percent of All Employees	Representative Plant Size of Industry							
	Smallish[1/]		Largish[2/]		Large		None[3/]	
	Number of Plants	Percent of Total	Number of Plants	Percent of Total	Number of Plants	Percent of Total	Number of Plants	Percent of Total
0 - 10	56	29.8	25	22.5	4	7.4	16	16.2
11 - 15	57	30.3	43	38.8	17	31.5	34	34.4
16 - 20	39	20.7	19	17.1	18	33.3	24	24.2
Over 20	36	19.2	24	21.6	15	27.8	25	25.2
Total	188	100.0	111	100.0	54	100.0	99	100.0

1/ Includes small, smallish, and bias-smaller.
2/ Includes medium, largish, and bias-larger.
3/ Includes 63 industries which have no representative plant size and 36 industries for which representative plant size cannot be figured.

Source: Appendix A.

Table IV-7

RELATIONSHIP BETWEEN REPRESENTATIVE PLANT SIZE AND PLANT-TO-COMPANY RATIO

Plant-to-Company Ratio	Representative Plant Size of Industry							
	Smallish 1/		Largish 2/		Large		None 3/	
	Number of Plants	Percent of Total	Number of Plants	Percent of Total	Number of Plants	Percent of Total	Number of Plants	Percent of Total
1.00 - 1.10	133	70.7	51	46.0	24	44.4	76	76.8
1.11 - 1.20	21	11.2	23	20.7	9	16.7	12	12.1
1.21 - 1.50	20	10.6	18	16.2	12	22.2	7	7.1
Over 1.50	14	7.5	19	17.1	9	16.7	4	4.0
Total	188	100.0	111	100.0	54	100.0	99	100.0

1/ Includes small, smallish, and bias-smaller.
2/ Includes medium, largish, and bias-larger.
3/ Includes 63 industries which have no representative plant size and 36 industries for which representative plant size cannot be figured.

Source: Appendix A.

Table IV-8

NUMBER OF EMPLOYEES PER UNIT OF OUTPUT FOR VARIOUS SIZED PLANTS, U. S.
1937

Size Class[1/]	Number of Employees per $100,000 of Value Added
$ 5	49.5
20	46.3
50	43.8
100	42.4
250	41.3
500	39.8
1,000	36.5
2,500	31.4
5,000	26.7
25,000	26.0

1/ Lower limit of size class in thousands of dollars of value of product.

Source: Joseph Steindl, Small and Big Business, p. 17.

Table IV-9

RATIO OF VARIOUS ASSETS TO GROSS SALES FOR MANUFACTURING CORPORATIONS, U. S.
1937 and 1947

Size Class[1/]	Percent of Gross Sales							
	Capital Assets[2/]		Inventories		Cash, Notes, and Accounts Receivable		Total	
	1937	1947	1937	1947	1937	1947	1937	1947
$ 0	13	12	8	8	13	13	34	33
50	17	13	11	10	14	14	42	37
100	21	13	13	11	15	14	48	38
250	24	13	15	12	15	14	53	39
500	27	13	17	13	15	14	59	40
1,000	31	15	20	15	17	15	68	45
5,000	59	17	22	17	18	16	99	50
10,000	42	20	23	18	19	17	85	55
50,000	46	18	26	19	19	16	91	53
100,000	48	29	20	16	19	17	87	62

1/ Lower limit of size class in thousands of dollars of total assets.
2/ Land, buildings, plant, and equipment.

Sources: 1937: Statistics of Income, cited in Joseph Steindl, Small and Big Business, p. 23.
1947: Statistics of Income, computed by Stanford Research Institute.

Table IV-10

RATIO OF FIXED CAPITAL TO OUTPUT FOR MAJOR BRANCHES OF MANUFACTURING INDUSTRIES, U. S.
1937 and 1947
(Firms with Less Than $100,000 Assets = 100)

Branch of Manufacturing	Index of Fixed Capital-Output Ratio for Firms with Assets of $100,000 to $999,999	$1,000,000 to $9,999,999	$10,000,000 and Over
All manufacturing			
1937	162	260	360
1947	118	157	226
Food and kindred products			
1937	136	157	175
1947	99	96	90
Liquors and beverages			
1937	127	149	--
1947	113	90	57
Tobacco products			
1937	154	136	201
1947	56	146	65
Textile mill products			
1937	249	455	--
1947	127	160	214
Apparel			
1937	165	535	492
1947	80	126	257
Leather and leather products			
1937	159	274	--
1947	98	140	155
Rubber products			
1937	161	221	245
1947	98	135	115
Forest products			
1937	181	415	--
1947	137	253	616
Pulp, paper, and products			
1937	176	406	612
1947	136	233	383

Table IV-10 (Continued)

Branch of Manufacturing	Index of Fixed Capital-Output Ratio for Firms with Assets of $100,000 to $999,999	$1,000,000 to $9,999,999	$10,000,000 and Over
Printing, publishing, and allied industries			
1937	147	187	191
1947	131	194	354
Petroleum refining			
1937	101	222	414
1947	86	113	289
Chemicals and allied products			
1937	167	272	390
1947	117	162	275
Stone, clay, and glass products			
1937	152	310	302
1947	132	205	215
Metals and metal products, except motor vehicles			
1937	153	206	418
1947	109	113	175
Motor vehicles, complete or parts			
1937	218	260	288
1947	102	133	173

Source: Daniel Creamer, "Capital and Output Trends in Manufacturing Industries, 1880-1948," Occasional Paper 41, Studies in Capital Formation and Financing, pp. 65-66.

Table IV-11

RATES OF RETURN FOR MANUFACTURING CORPORATIONS, U. S. 1/
1931-1936
(Percent)

Size Class 2/		1931	1932	1933	1934	1935	1936
$ 0	All	-22.55	-30.07	-19.23	-13.48	-11.21	- 6.90
	Income	11.95	9.43	9.00	11.25	11.35	13.68
	Deficit	-41.38	-37.79	-30.93	-30.63	-30.12	-29.90
50	All	-10.89	-14.95	- 5.92	- 2.27	- 0.33	3.07
	Income	9.05	7.21	8.05	9.67	10.23	12.10
	Deficit	-22.55	-20.46	-14.64	-14.12	-13.29	-14.11
100	All	- 8.01	-10.84	- 2.95	- 0.09	1.83	5.90
	Income	8.04	7.12	8.45	9.68	10.52	12.44
	Deficit	-17.68	-15.85	-11.50	-11.08	-11.28	-10.57
250	All	- 5.75	- 8.41	- 0.39	1.56	3.67	7.32
	Income	7.97	6.83	8.52	9.84	10.65	12.37
	Deficit	-10.04	-13.44	- 8.35	- 9.36	- 8.45	- 8.79
500	All	- 4.08	- 6.61	0.33	2.31	4.67	8.18
	Income	7.91	6.99	8.79	9.83	11.08	12.40
	Deficit	-11.30	-11.32	- 8.02	- 8.15	- 7.94	- 8.79
1,000	All	- 3.32	- 5.48	0.72	3.01	5.60	8.80
	Income	7.67	6.75	7.76	8.70	10.32	11.83
	Deficit	- 9.64	- 9.48	- 6.73	- 6.01	- 5.34	- 6.71
5,000	All	- 1.52	- 3.97	1.59	3.98	5.92	9.26
	Income	8.72	7.39	8.43	9.22	10.29	11.52
	Deficit	- 7.72	- 8.61	- 5.41	- 4.70	- 5.12	- 4.56
10,000	All	- 0.75	- 4.00	1.11	3.37	6.48	8.63
	Income	7.35	6.11	7.53	7.86	10.08	10.02
	Deficit	- 6.95	- 7.87	- 6.08	- 3.96	- 2.56	- 4.57
50,000	All	1.71	- 0.23	1.72	3.84	6.68	9.53
	Income	7.92	5.33	4.33	7.50	9.12	10.06
	Deficit	- 2.47	- 2.92	- 4.44	- 0.66	- 0.02	- 5.10
100,000	All	n.a.	n.a.	n.a.	n.a.	n.a.	7.38
	Income	n.a.	n.a.	n.a.	n.a.	n.a.	8.09
	Deficit	n.a.	n.a.	n.a.	n.a.	n.a.	- 1.25
Combined Sizes	All	- 0.96	- 3.45	0.68	3.01	5.68	7.94
	Income	7.87	6.00	6.19	8.31	9.85	10.06
	Deficit	- 6.78	- 7.33	- 5.35	- 4.34	- 4.18	- 6.77

n.a. means not available.

1/ Rate of return is the ratio of profit (or loss) after taxes to estimated average equity.

2/ Lower limit of size class in thousands of dollars of total assets.

Source: William Leonard Crum, Corporate Size and Earning Power, p. 62.

Table IV-12

RATES OF RETURN FOR MANUFACTURING CORPORATIONS, U. S. 1947

Size Class[1/]		Net Income or Deficit Before Taxes	Net Income or Deficit After Taxes	Capital Stock Plus Surplus or Minus Deficit	Rate of Return Before Taxes (percent)	Rate of Return After Taxes (percent)
$ 0	All	$ - 24,169	$ - 59,805	$ 421,127	- 5.739	-14.201
	Income	78,013	61,987	295,862	26.36	2.095
	Deficit	-102,182	-102,18[illegible]	125,265	-81.572	-81.57
50	All	88,784	5,189	722,532	12.442	0.718
	Income	152,469	115,575	581,477	26.220	19.876
	Deficit	- 63,685	- 63,685	141,055	-45.149	-45.149
100	All	372,191	225,775	1,976,660	18.829	11.422
	Income	468,194	321,778	1,697,097	27.587	18.960
	Deficit	- 96,003	- 96,003	279,563	-34.340	-34.340
250	All	561,183	330,109	2,406,142	23.322	13.719
	Income	640,887	409,813	2,149,619	29.813	19.064
	Deficit	- 79,704	- 79,704	256,523	-31.070	-31.070
500	All	887,040	528,762	3,301,996	26.863	16.013
	Income	967,458	609,180	3,037,141	31.854	20.057
	Deficit	- 80,418	- 80,418	264,855	-30.363	-30.363
1,000	All	2,989,730	1,818,766	10,488,283	28.505	17.338
	Income	3,147,498	1,976,534	9,896,817	31.803	19.971
	Deficit	-157,768	-157,764	591,466	-26.674	-26.674
5,000	All	1,635,760	1,014,495	5,942,151	27.528	17.072
	Income	1,671,120	1,049,855	5,671,632	29.464	18.510
	Deficit	- 35,360	- 35,360	270,519	-13.071	-13.071
10,000	All	3,402,081	2,118,452	13,774,758	24.697	15.379
	Income	3,479,869	2,196,240	13,278,776	26.206	16.539
	Deficit	- 77,788	- 77,788	495,982	-15.683	-15.683
50,000	All	1,294,545	804,493	5,842,019	22.159	13.770
	Income	1,351,723	861,671	5,676,537	23.812	15.179
	Deficit	- 57,178	- 57,178	165,482	-34.552	-34.552
100,000	All	5,266,454	3,379,606	31,797,750	16.562	10.628
	Income	5,342,108	3,455,260	31,213,117	17.114	11.069
	Deficit	- 75,654	- 75,654	584,633	-12.940	-12.940
Combined Sizes	All	$16,473,599	$10,232,153	$76,673,418	21.485	13.345
	Income	17,299,339	11,057,893	73,498,075	23.537	15.045
	Deficit	-825,740	-825,740	3,175,343	-26.004	-26.004

1/ Lower limit of size class in thousands of dollars of total assets.

Source: Computed by Stanford Research Institute from Statistics of Income.

Table IV-13

EQUITY AS A PROPORTION OF GROSS SALES FOR ALL MANUFACTURING CORPORATIONS, U. S.
1947

Size Class[1/]	Equity	Gross Sales	Equity as a Percent of Gross Sales
$ 0	$ 421,127	$ 2,367,514	18
50	722,532	3,175,242	23
100	1,976,660	7,933,034	25
250	2,406,142	8,804,246	27
500	3,301,996	11,277,012	29
1,000	10,488,283	30,155,674	34
5,000	5,942,151	14,055,101	42
10,000	13,774,758	29,882,449	46
50,000	5,842,019	12,870,441	45
100,000	31,797,750	55,136,500	57
Total	$76,673,418	$175,657,213	43

1/ Lower limit of size class in thousands of dollars of total assets.

Source: Computed by Stanford Research Institute from Statistics of Income, 1947.

Table IV-14

BUSINESS DISCONTINUANCES IN 1940-42 AS PERCENTS OF BUSINESSES OPERATING IN 1939, U.S.

Size Class (number of employees)	Mining	Construction	Manufacturing	Wholesale Trade	Services	Retail Trade
1 - 3	72	29	29	17	44	11
4 - 7	28	16	14	10	40	7
8 - 19	26	21	16	8	27	9
20 - 49	18	9	11	8	29	10
50 or more	6	13	6	4	10	4

Source: Wimsatt, G. B., "Business Discontinuances, 1940-42," Survey of Current Business, 23, (November 1943).

Table IV-15

BUSINESS LIQUIDATIONS AS PERCENTS OF TOTAL BUSINESS DISCONTINUANCES IN 1940-42, U. S.

Size Class (number of employees)	Mining	Construction	Manufacturing	Wholesale Trade	Services	Retail Trade
1 - 7	64	81	47	56	34	41
8 - 19	60	73	47	40	31	37
20 - 49	51	72	42	40	31	37
50 or more	50	78	38	29	28	20

Source: Wimsatt, G. B., "Business Discontinuances, 1940-42," Survey of Current Business, 23, (November, 1943).

Table IV-16

NUMBER OF FAILURES OF MANUFACTURING FIRMS
1940-1949

Size Class[1/]	1944	1945	1946	1947	1948	1949
$ 0	56	50	48	86	107	280
5	159	116	195	489	664	994
25	100	82	144	432	468	751
100	34	29	74	248	223	294
1,000	3	3	5	20	19	12

1/ Lower limit of size class in thousands of dollars of liabilities.

Source: Compiled by Stanford Research Institute from Statistical Abstracts of the United States.

Table IV-17

RELATIVE IMPORTANCE OF VARIOUS SIZE CLASSES, MANUFACTURING, U. S.
Selected Years, 1914-1947

Size Class (number of employees)	Percent of Total Employees								
	1914	1919	1921	1923	1929	1933	1935	1937	1947 1/
1-5	2.8	2.9	3.3	2.6	3.3	2.7	2.6	2.0	1.1
6-20	9.1	7.1	9.0	7.3	7.0	7.6	7.1	6.0	6.1
21-50	11.2	9.5	11.7	9.7	9.5	10.1	9.4	8.8	8.7
51-100	11.8	10.2	11.7	10.4	10.3	10.9	10.3	9.9	9.1
101-250	19.5	17.8	19.3	18.2	18.0	19.2	17.9	17.8	15.6
251-500	15.4	13.7	14.2	15.1	14.8	15.6	15.1	15.9	13.5
501-1,000	12.7	12.8	11.5	13.4	12.9	12.9	13.6	13.2	13.1
Over 1,000	17.5	26.0	19.3	23.3	24.2	20.9	24.0	26.4	32.8

1/ For 1947 the size class divisions are the same as for earlier years except that the first class is for 1-4 employees and the second class is for 5-20 employees.

Sources: 1914-1937: T. N. E. C. Monograph 27, The Structure of Industry, cited in Joseph Steindl, Small and Big Business, p. 55.
1947: Census of Manufactures, compiled by Stanford Research Institute.

Table IV-18

NUMBER OF NEW AND DISCONTINUED BUSINESSES, U.S.
1945-1948
(Thousands)

Industry Division and Size Class (number of employees)	New Businesses				Discontinued Businesses			
	1945	1946	1947	1948	1945	1946	1947	1948
All industries	429.8	619.8	472.8	394.6	202.6	226.4	291.8	373.6
0-3	379.3	535.5	409.1	339.8	177.6	197.0	250.5	326.8
4-7	33.0	56.5	43.4	37.7	13.1	16.0	23.6	27.0
8-19	12.2	20.8	15.4	12.8	7.8	9.1	12.2	14.2
20 or more	5.3	7.1	4.9	4.2	4.2	4.3	5.5	5.7
Mining and quarrying	4.0	5.0	5.0	5.9	3.7	3.2	4.0	5.1
0-3	2.4	3.0	2.7	3.2	2.7	2.2	2.8	3.8
4-7	0.9	1.2	1.4	1.6	0.4	0.4	0.5	0.7
8-19	0.5	0.6	0.8	0.8	0.3	0.3	0.4	0.5
20 or more	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Contract construction	56.0	94.9	74.3	64.8	18.1	26.6	36.5	45.1
0-3	47.3	78.1	60.7	53.2	15.5	22.1	29.0	36.4
4-7	6.3	12.1	10.0	8.6	1.3	2.6	4.5	5.0
8-19	1.7	3.6	2.8	2.2	0.8	1.4	2.2	2.8
20 or more	0.6	1.1	0.8	0.7	0.4	0.5	0.8	0.9
Manufacturing	48.3	76.7	49.9	39.7	26.7	29.2	41.1	49.7
0-3	33.5	52.8	36.2	29.0	20.8	22.8	31.3	39.8
4-7	8.1	13.8	8.2	6.4	2.2	2.7	4.2	4.4
8-19	4.4	7.0	3.8	3.0	2.0	2.1	3.3	3.4
20 or more	2.3	3.1	1.6	1.3	1.6	1.6	2.3	2.2
Transportation, communication, and other public utilities	27.9	40.0	28.4	23.2	11.1	14.3	17.2	19.7
0-3	25.6	36.8	26.3	21.5	9.9	12.9	15.5	18.0
4-7	1.4	2.2	1.6	1.2	0.6	0.7	0.9	1.0
8-19	0.5	0.7	0.4	0.4	0.4	0.4	0.5	0.5
20 or more	0.3	0.3	0.2	0.1	0.3	0.3	0.2	0.2
Wholesale trade	22.4	31.9	23.3	18.3	7.3	8.9	13.1	16.1
0-3	19.1	26.8	19.5	15.5	6.1	7.3	10.5	13.1
4-7	2.3	3.8	2.7	2.1	0.7	0.9	1.6	1.7
8-19	0.7	1.1	0.8	0.6	0.4	0.5	0.7	0.8
20 or more	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.4
Retail trade	150.1	216.4	169.2	139.9	75.6	79.1	102.7	141.1
0-3	138.0	195.5	152.9	126.1	66.9	70.0	90.9	126.8
4-7	8.7	14.9	11.7	10.1	5.2	5.5	7.8	9.4
8-19	2.7	4.9	3.6	2.9	2.6	2.7	3.2	4.0
20 or more	0.8	1.0	0.9	0.8	0.8	0.8	0.9	0.9
Finance, insurance, and real estate	25.3	26.7	19.9	18.3	13.8	14.1	16.3	18.0
0-3	23.6	24.1	17.8	16.4	13.1	13.0	14.8	16.4
4-7	1.2	1.8	1.4	1.3	0.5	0.6	0.9	1.1
8-19	0.4	0.6	0.5	0.4	0.2	0.3	0.4	0.4
20 or more	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2
Service industries	95.8	128.3	102.8	84.4	46.4	51.2	60.9	78.9
0.3	89.8	118.3	92.9	74.9	42.6	46.6	55.7	72.6
4-7	4.1	6.7	6.5	6.4	2.1	2.6	3.1	3.8
8-19	1.3	2.4	2.7	2.4	1.1	1.3	1.5	1.9
20 or more	0.7	0.9	0.7	0.7	0.5	0.6	0.6	0.7

Source: Survey of Current Business, 30 (May 1950), p. 15.

Table IV-19

ENTRY AND DISCONTINUANCE RATES, U.S. 1/
1945-1948

Industry Division and Size Class (number of employees)	Entry Rate				Discontinuance Rate			
	1945	1946	1947	1948	1945	1946	1947	1948
All industries	134	176	123	99	63	64	76	94
0-3	155	206	143	115	72	76	88	111
4-7	86	124	88	75	34	35	48	53
8-19	55	74	51	41	35	32	41	46
20 or more	33	38	26	22	26	24	29	29
Mining and quarrying	129	157	151	171	118	99	120	148
0-3	130	166	142	179	148	125	152	209
4-7	205	247	273	277	91	78	103	115
8-19	131	143	160	153	87	74	88	87
20 or more	45	40	45	42	46	42	42	35
Contract construction	332	415	265	207	107	116	130	144
0-3	382	514	317	253	125	145	152	173
4-7	272	319	221	166	58	68	101	96
8-19	122	141	95	68	54	56	75	84
20 or more	87	83	56	42	61	41	55	54
Manufacturing	186	263	151	121	103	100	124	151
0-3	334	441	245	198	207	190	211	271
4-7	194	300	160	123	54	58	82	84
8-19	92	132	66	54	42	40	58	60
20 or more	33	43	22	18	24	22	31	29
Transportation, communication, and other public utilities	203	254	159	124	81	91	96	106
0-3	252	315	193	150	97	110	114	126
4-7	92	126	84	60	37	41	50	51
8-19	53	52	32	27	42	33	37	38
20 or more	28	26	16	13	24	25	19	22
Wholesale trade	143	181	120	91	46	51	68	80
0-3	213	287	188	143	68	79	101	121
4-7	72	101	64	50	22	24	40	41
8-19	33	37	26	18	16	17	23	26
20 or more	21	19	16	8	13	12	17	22
Retail trade	104	140	102	82	52	51	62	83
0-3	120	164	119	95	58	59	71	95
4-7	49	71	53	45	29	26	35	42
8-19	33	49	34	27	33	26	30	37
20 or more	26	29	22	20	26	23	22	23
Finance, insurance, and real estate	78	80	58	53	43	42	47	52
0-3	87	87	63	57	48	47	52	57
4-7	40	57	42	39	16	19	27	33
8-19	27	35	28	23	15	19	21	20
20 or more	15	22	21	20	11	15	20	21
Service industries	137	170	125	99	66	68	74	92
0-3	152	189	136	105	72	75	81	102
4-7	70	94	86	83	37	37	41	49
8-19	42	63	67	58	37	35	38	44
20 or more	34	42	34	32	29	28	25	30

1/ Number of new and discontinued firms each calendar year per one thousand firms in operation on March 31.

Source: Survey of Current Business, 30 (May 1950), p. 17.

Table IV-20

INTERINDUSTRY PRODUCTION REQUIREMENTS
(Each Entry Shows, per Million Dollars of Output by Industry Named at Left, the Total Dollar Production Directly and Indirectly Required from Industry Named at Top)

	Steel Works and Rolling Mills	Iron Foundries	Machine Tools and Metalworking Machinery	Special Industrial Machinery	Structural Metal Products	Metal Stampings
Fabricated wire products	629,456	7,485	1,573	853	4,018	5,780
Tin cans and other tin ware	610,488	5,726	2,300	833	9,369	14,912
Iron and steel forgings	523,351	26,725	2,441	808	683	843
Metal barrels, drums, etc.	490,937	5,824	2,830	833	3,138	103,064
Boiler shop products and pipe bending	321,932	13,702	6,987	5,760	42,341	9,167
Heating equipment	146,035	34,736	4,957	2,980	17,123	26,888
Motors and generators	103,521	48,394	2,771	2,455	1,157	11,170
Ships and boats	99,860	8,593	5,771	2,218	42,095	3,573
Motor vehicles	102,851	33,970	4,135	2,105	2,506	39,594
Farm and industrial tractors	118,682	91,132	7,936	11,807	2,259	21,748
Special industrial machinery	72,853	55,619	21,519	1/	2,267	3,981
Machine tools and metal-working machinery	60,574	60,801	1/	18,751	2,870	4,226
Machine shops	72,352	78,516	9,378	43,668	1,227	1,406
Pumps and compressors	84,907	76,163	20,904	18,838	4,107	4,262
Automobile trailers	75,330	9,683	3,169	2,445	50,134	11,380
Internal combustion engines	80,347	105,381	8,959	14,992	1,990	8,504
Cutting tools, jigs, and fixtures	83,348	22,647	76,398	12,747	2,401	47,127

1/ $1 million by definition.

Source: Based on "Table III" published by Bureau of Labor Statistics, U.S. Department of Labor, applying to the 1947 Interindustry Relations Study; cited in Monthly Business Review, Federal Reserve Bank of Cleveland, October 1, 1953, p. 5.

Table IV-21

NUMBER OF SUPPLIERS OF VARIOUS MAJOR FIRMS, U.S.
1956

Firm	Number of Suppliers
Union Carbide & Carbon Corporation	40,000
Radio Corporation of America	10,000
E. I. du Pont de Nemours & Company	30,000
Ford Motor Company	20,000
The Texas Company	11,000
General Foods Corporation	40,000
International Business Machines Corporation	13,000
United States Steel Corporation	50,000
General Electric Company	42,000
United States Rubber Company	14,000
Monsanto Chemical Company	277
Eastman Kodak Company	3,500
Firestone Tire & Rubber Company	13,423
Aluminum Company of America	20,000
Standard Oil Company of California	66,000
American Can Company	13,000

Source: Stanford Research Institute.

Chapter V

THE ECONOMIC DEVELOPMENT OF THE UNITED STATES

Some Characteristics of the United States

It is dangerous to assume that the development experience of any given country is appropriate as a model for the economic growth of any other given country. There are too many dissimilarities among countries in terms of both time and place.

Analogies based on history are particularly hazardous because of changes over time in technical knowledge. It is certainly unlikely, for example, that the economic development of the United States would have proceeded as it did if the technical knowledge of 1957 had been available in 1757.

Moreover, the economic development of the United States may have been unusual in that, until quite recently, a vast area of virgin land was available--land which could be acquired virtually without cost and which could be made highly productive with a minimum of effort. From the time of the earliest settlements in the new world, not land but labor--even unskilled labor--was the factor of production which was relatively scarce, and this has remained true in spite of the great increase in population. It may be added that the United States has been blessed not only with an abundance of land as such but also with a bountiful supply of natural resources.

The economic development of the United States also may have been unusual because the mores and institutions of the people greatly encouraged the acquisition and increase of productive personal property; they discouraged the unproductive consumption of wealth and guaranteed the social recognition of individuals on the basis of the wealth acquired by them as a consequence of production.

Furthermore, production in the United States has generally remained unhampered by restraints of trade, whether imposed by governments or by private monopolies. Aside from the great struggle between the states (1860-1865), moreover, the territory of the United States has not been subjected to the widespread destruction of war, nor has its political stability been interrupted by revolution.

Nevertheless, for purposes of this manual, it is useful to summarize the economic history of the United States, particularly as it relates to the question of plant size. Such a summary may be encouraging for those societies which stand on the threshold of rapid economic development, since useful economic growth has occurred in the United States without the detailed direction of the state and within the framework of democratic political institutions. Such a summary may also be

instructive insofar as it illustrates the proposition that the complex economic interrelationships which are inherent in an integrated industrial system cannot be established quickly. Time is an ingredient of economic development which can be ignored only with peril.

The specific purposes of this chapter are (1) to illustrate the fact that large manufacturing establishments developed gradually in the United States, in harmony with the entire economy, and in response to market conditions; and (2) to indicate some of the factors which contributed to the development of American industry. It is unnecessary, however, to describe recent events: it was the pre-1900 American economy which had much in common with the economies of those nations which are beginning to industrialize today.

The American Revolution to the Civil War

At the time of the American Revolution, less than 200 years ago, the United States was an underdeveloped country in the sense that resources were untapped, even though the potential for economic growth was clearly present. On the other hand, per capita income was already higher in America at that time than it was in England. 1/ From the standpoint of per capita income, relative to other nations, the United States has never been an underdeveloped country.

Cottage Industries

In 1776 the United States was underindustrialized. Almost all of the 2,250,000 people who had settled in English America were directly dependent upon the soil for their livelihood. Families one hundred miles or more inland were entirely self-sufficient. There were a few cottage industries in the towns of the Atlantic Seaboard, although these were relatively unimportant. These industries produced hardware, farm tools, furniture, clothing, shoes, hats, and bedding for sale in local markets. They produced for export--mostly to the West Indies--processed raw materials (lumber, iron, pitch, tar, turpentine, flour, salt, potash, rum, and whale oil) and simple manufactured goods (soap, candles, hats, and pottery). Their principal export to England was ships. The volume of this trade was, however, small. 2/

1/ See Chester W. Wright, Economic History of the United States (New York: McGraw-Hill Book Company, 1948), p. 98. This chapter is based substantially on this work and on V. S. Clark, History of Manufacturers in the United States, 3 Vols. (New York: McGraw-Hill Book Company, 1929).

2/ During the eleven years ending in 1773, American Colonial exports to England (primarily raw materials) totaled about $60 million--less than $6 million annually, though prices at that time were probably less than 10 percent of what they are today.

With few exceptions cottage operations were carried on by individuals, each owning his own workshop (his home), his tools, and his kitchen garden. Each individual was engaged part time in agriculture, fishing, and hunting. He worked more or less as and when he pleased. He was a good deal more akin to those engaged in handicraft in the underdeveloped areas of today than to modern American factory managers or wage earners.

There may have been a dozen or so factories in the United States in 1776. We know, for example, of a linen factory in New York which employed 300 workers. Most of the manufacturing which did exist was small scale, however, and was organized on the basis of the domestic or putting-out system. Merchants would purchase raw materials, hire cottage producers (who owned their own plant and equipment) to manufacture finished products, and then sell the products themselves.

It was not until about 1820 in the case of textiles and after 1860 in the case of other manufactures that factory production became important in the United States. 3/

Some Obstacles to Industrialization

The main deterrents to factory production were the lack of technical knowledge, the lack of power, and the small markets of the day. The small markets, in turn, were primarily the consequence of the high costs of transportation.

The industrial revolution (the rapid invention of machines and the discovery of new processes of production) began in England and reached its peak in that country in the late eighteenth century. There was, of course, a lag before these new techniques were introduced into the United States. Nevertheless, by the turn of the century (the cotton gin was invented in 1793) American inventors were participating in the industrial revolution, particularly as they adapted English machines for American purposes.

At least until 1840 water power was the primary factor influencing the location and size of manufacturing establishments. At Easton, Pennsylvania in 1839, for example, the relative annual costs per horsepower for water and steam, respectively, were $23 and $105,

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3/ However, cf. Clark, op. cit., Vol. I, pp. 170-171.

and at Lowell, Massachusetts, $12 and $90. But this disparity was reduced rapidly after 1840.[4] A summary of the historical increase in use of nonhuman power in the United States is presented in Table V-1.

For at least 50 years following the American Revolution the transportation of commodities by land was prohibitively expensive, and communities without access to the sea were, of necessity, almost totally self-sufficient. The cost of land transportation may be observed in the following comparison. In 1810 the average price of a barrel of flour was 75 cents higher in Boston than in New York where it was milled; but in 1813, when intercolonial ocean shipping was disrupted by the Napoleonic Wars, the average price of a barrel of flour was $5.03 more in Boston than in New York.

The period from about 1815-1840 was an era of canal building, and it appeared that an extensive system of inland water transportation would significantly enlarge the various markets for manufactured goods. In 1825 the Erie Canal, which linked Buffalo and Albany, New York, made cheap transportation possible between New York City and the area west of the Allegheny Mountains. It was the network of railroads initiated in 1840, however, which reduced the cost of inland transportation to about 10 percent of what it had been and made possible the expansion of markets and the consequent development of manufacturing.

Textile Manufacturing

American textile manufacturing developed first in New England, primarily because of the availability of water power and because agricultural output was so costly that exports were inadequate to pay for imports of European manufactured goods. In 1820, two-thirds of the textiles used in the United States were made in family work shops.

4/ The census of 1820 mentioned a dozen plants powered by steam. In 1831 all of the 124 mills in New England, outside of Massachusetts and Rhode Island, were run by water. Of 169 plants in Massachusetts, 39 used steam, 32 of which were printing offices. In Rhode Island 128 textile mills used water and 4 used steam. The water wheels of that state developed 12,000 horsepower and the steam engines 800. Practically all of the factories enumerated in New York and New Jersey used water, but in Pennsylvania 57 out of 161 plants were propelled by steam. These included 4 cotton and 2 woolen factories and numerous rolling mills and forges. The use of steam for power occurred first in areas where markets were available, sources of water power were not, and the high cost of transportation provided protection.

By 1830 most of the cloth used in New England was made in factories, whereas homespun cloth continued to be used predominantly in the other states until the outbreak of the Civil War in 1861.

In 1840 the nine large textile mills operating in Lowell, Massachusetts ran 160,000 spindles and 4,000 looms and developed 5,000 horsepower. At Lawrence, Massachusetts, shortly thereafter, the then-largest textile factory in the world was constructed.

In 1827, $1 million worth of cotton textiles was exported from the United States. By 1857 the value of these exports was $6 million. Manufactured goods constituted 5 percent of American exports in 1800 and 11 percent in 1850. Even by 1860, however, the value of manufactured imports exceeded exports.

Tariff Protection

Prior to the Civil War, the growth of manufacturing was not significantly encouraged by tariff protection. Most tariff rates remained at 5 percent *ad valorem* from 1789 to 1814. Following the Napoleonic Wars, the American market was flooded by European goods, and war taxes on imports were extended. In 1824 tariff rates were established at 30 percent, and in 1828 tariff rates rose as high as 50 percent; but the tariff act of 1833 provided for the gradual reduction of rates until none should exceed 20 percent. Rates were raised a bit in 1842 and reduced again in 1846. In general, from 1833 to 1860 American tariffs were established for the purpose of obtaining revenues rather than providing protection.

Even after the Civil War when tariffs were levied more for protection than for revenue, it is doubtful that the growth of American manufacturing was significantly stimulated by tariffs. As the domestic market moved inland from the Atlantic Coast, the cost of transportation gave domestic producers a competitive advantage over European producers.

Skilled Labor

Prior to the Civil War immigration provided an increasing supply of skilled labor. Between 1840 and 1860 the increase in population due to immigration was at the highest rate in the entire history of the nation. However, labor remained the scarce factor of production, and real wages continued to be the highest in the world.

Capital

Capital was less scarce. Even at the time of the American Revolution, though organized capital markets were still in the future,

money could be borrowed from individuals at interest rates of 8 percent. As the putting-out system gave way to the factory system, moreover, wealthy merchants made funds available to the new entrepreneurs, most of whom were independent farmers already familiar with cottage manufacturing. Banks were frequently initiated in this way. It may be added, however, that a tremendous volume of domestic savings flowed into unproductive land speculation and canal building.

The domestic supply of capital was substantially augmented by funds from European investors. The French and the Dutch extended loans to the American government during and following the American Revolution, although the British supplied the greater part of the foreign capital which financed the private economic development of the United States.

The extensive building of canals would have been impossible without funds from overseas. Most of the bonds of the Erie Canal were bought up by English investors. The story is the same in the case of American railroads. The Baltimore and Ohio, the Illinois Central, and the Union Pacific were heavily financed by the British. As late as 1914, British stock ownership amounted to $1 million or more in each of 16 American railroads.

Not until after the American Civil War did foreigners become interested in financing American industrial development. In 1875, for example, the London market bought up a $5.2 million issue of the new Western Union Telegraph Company. At the outbreak of World War I, 25 percent of the common and 9 percent of the preferred stock of the United States Steel Corporation were held abroad.

Profits

Before the Civil War profits were high during periods of prosperity. During depressions many establishments failed, but owners of shares were already protected by the limited liability characteristic of the modern corporation.

During the 50 years preceding the Civil War, manufacturing profits generally averaged between 5 and 20 percent. During the 11 years ending in 1849, 24 New England textile companies averaged 10 percent per year on an aggregate nominal capital in excess of $20 million. The highest average profit (14 percent) was earned by the Merrimac Company, the largest corporation reporting; but the next highest average profit (11.5 percent) was earned by the smallest of the 24.

Although the records are incomplete, it appears that the smaller enterprises sustained the greatest profits and the greatest losses, just as is true today. Ocassionally, the gains were phenomenal. The Springfield Satinet Company averaged 87 percent net profit per year for the years 1835-37. On a nominal capital of $40,000, the Masonville

Textile Company of Connecticut averaged 50 percent net profit per year for the five years ending in 1831. Of course such profits were a tremendous incentive for entrepreneurs, particularly since there were no personal or corporation income taxes at that time!

Scope and Scale of Manufacturing

It should not be inferred from this discussion, however, that American manufacturing was particularly important before the Civil War. The total capital invested in manufacturing in the entire United States in 1820 was only $50 million; in 1840 it was $250 million; in 1850, $500 million; and in 1860, $1 billion. Moreover, factory manufacturing was virtually limited to textiles. Generally speaking, all other manufactured goods were produced in small family-owned and -operated workshops.

A notable exception was the Great Western Iron Company, which was organized in 1839 At one time this company employed 538 workers and had a capital investment of $1 million. Its fixed assets included four blast furnaces, a foundry, and a rolling mill, and it was equipped for all production processes from the mining of ore to the delivery of finished rails and other metal shapes.

Incidentally, this particular company illustrates the degree to which the manufacturing establishments of the day tended to be integrated and self-sufficient. Even the smaller units were integrated. In the case of an iron works, for example, the owner would cut the fuel for his furnace, mine his ore, and quarry his limestone on his own land. He would maintain a small store, a blacksmith shop, and a mill. He would probably own the houses of his workers and would provide the credit to finance their purchases.

1860 to 1900

The over-all economic development of the United States from 1869 to 1954 is summarized in Table V-2. This shows that the net national product in constant prices increased over 1500 percent during this period while the population was increasing by less than 400 percent. Thus, net national product per capita nearly quadrupled. For the purposes of this manual, however, the most significant period of American economic history was the last 40 years of the nineteenth century; it was during this time that the United States became an industrial power.

The Development of Manufacturing

By 1899 cottage industries had given way to factories. As shown in Table V-3, over four-fifths of the $5,656 million value added by

all manufacturing establishments in the United States was added by factories; and 4,712,763 of the 5,306,143 persons engaged in manufacturing worked in factories.

Between 1849 and 1869 the number of manufacturing establishments doubled; it doubled again between 1869 and the turn of the century. In terms of value added at current prices, manufacturing output more than doubled between 1859 and 1879 and again between 1879 and 1899. In constant prices, both the value added by and the capital invested in manufacturing increased by roughly ten times between 1859 and 1899. The number of wage earners quadrupled during these 40 years, while the horsepower per worker doubled.

By 1890 the net value added by manufacturing exceeded the value of agricultural products, and the excess has tended to increase since then. By 1898, for the first time, manufactured exports exceeded manufactured imports.

Capital Formation and Technological Advance

Of particular significance during the period following the Civil War was the high rate of capital formation and technological advance. It has been estimated that the output per worker in manufacturing increased by 150 percent during the last 40 years of the nineteenth century.

Manufacturing in the Northern States of the United States was indirectly stimulated by the Civil War. Excise taxes encouraged more integrated and hence larger-scale production. There was a large governmental demand for such standardized consumers' goods as clothing and shoes. The wartime shortage of labor made the increasing use of labor saving machinery all the more necessary.

For the first time, the newly invented sewing machine was used in the manufacture of boots and shoes. Food preserving, both by canning and by the use of manufactured ice, became important between 1860 and 1865. The construction of railroads continued during the war, and the national capacity for iron production increased. During the early 1860's the Bessemer steel process was introduced into the United States. The petroleum industry was founded at about the same time, and by 1865 there were 194 petroleum refineries in the United States. The value of the annual output of chemical fertilizers rose from $900,000 in 1860 to $6 million in 1870. At the Paris exposition in 1867, 2 years after the conclusion of the Civil War, American manufacturers won gold medals for their small arms, agricultural machinery, machin tools, steam engines, sewing machines, locomotives, and, surprisingly, their pianos.

New industries as well as processes were developed. Aluminum began to be produced in 1883, lead in 1878, zinc in 1873, and copper

in 1890. Tin plating began in 1872 when skilled tin platers were induced to emigrate from Wales to the United States. Electric lamps were first used in 1878, the telephone in 1876, the electric street railway in 1884, and the electric elevator in 1882. Between 1875 and 1893 the American consumption of raw rubber increased from 10 million pounds to 33 million pounds per year. The annual value of the lumber consumed in the United States increased from $168 million in 1870 to $404 million in 1890. Two million barrels of natural cement were consumed in 1876 as compared with 8 million barrels in 1893; consumption of Portland cement increased from 5,000 to 600,000 barrels. Between 1880 and 1890 the capital investment in brick and tile works increased from $28 million to $83 million. Petroleum output increased from 10 million barrels in 1873 to 48 million in 1893.

Improvements continued in cotton growing and textile manufacturing. The price of cotton fell from about 20 cents to 8 cents a bale between 1875 and 1895; by the latter year about two-thirds of the world's annual cotton crop was raised in the United States. Between 1870 and 1890 the number of frame spindles in the United States increased from 3,695,000 to 8,825,000; the number of mule spindles increased from 3,438,000 to 5,364,000.

The Development of Transportation

For some time following the Civil War, railroad construction was the key to the growth of American manufacturing, both because railroads increased the size of the domestic markets for manufactured goods and because they directly stimulated the metallurgical industries.

Between 1869 and 1873, 25,000 miles of new rail lines were laid, and the geographic specialization of production became possible. Population centers became specialized in the production of various items--New England, woolen and cotton textiles, fine paper, and boots and shoes; Philadelphia, carpet weaving; Milwaukee and Philadelphia, tanning; Pennsylvania, iron and steel; Connecticut, brass fabricating; Terre Haute, Indianapolis, Detroit, and Chicago, machinery; Grand Rapids, furniture; and Minneapolis, flour milling.

As railroads and people moved west, so did manufacturing. By 1875 there were 2,271 industrial establishments in Chicago, and their yearly output was valued at $268 million. The percentage of American manufacturing produced on the Atlantic coast declined from 80 percent in 1850 to 58 percent in 1890.

Throughout the nineteenth century American transportation and metallurgical industries advanced together. During the early decades of the century, small foundries and shops for the manufacture of steamboat machinery were to be found at every river town of the interior, while larger engine works were established at every seaport. Then came the railroads and the rapid development of the rolling mill.

For the remainder of the century the market for rails was the barometer which measured the prosperity or depression of iron and steel manufacturing.

In 1873, 124,000 of the 157,000 tons of Bessemer steel produced in the United States were used for steel rails. By 1892 annual Bessemer steel output had increased to 4,660,000 tons--by nearly 3,000 percent in two decades.

Costs and the Organization of Production

By 1880 American steel was cheaper than British steel in spite of higher wages and longer hauls in the United States for both ore and coal. This resulted primarily from the improved organization of production which permitted a much higher output per worker. As described by Clark:

> Machinery for making steel rails had been so perfected before 1890 that no more manual labor was involved in their production than that required to move a lever or to turn a wheel, from the time the ore, flux, and fuel were dumped into the charging buggies that fed the furnace until the finished rail was ready for the straightner or drill press. Steam, air, and water performed the severe work that made it possible for a modern mill to turn out every 25 seconds a 30-foot rail weighing 600 pounds, so perfect that variations of small fractions of an inch in thickness or contour were sufficient to insure rejection. The number of men and boys employed upon the rail, from the time it was delivered to the blooming train until it had reached the cooling bed, was 17, and the cost of this labor aggregated about eight cents per ton. At North Chicago approximately a mile of finished rail was completed every hour of the working day. 5/

The rapid increase in productivity which resulted from invention, capital formation, and the improved organization of production was generally characteristic of all American industry. The cost of railroad transportation declined more than 50 percent during the decade ending in 1880. In 1893 it was estimated that the cost of steam power had been cut in half during the previous few years. The labor cost of producing a pair of shoes declined from 75 cents to 3 cents as a consequence of the introduction of the McKay machine sewing. The number of shoes turned out on the McKay machine increased from 25 million in 1870 to 120 million in 1895.

5/ Clark, op. cit., Vol. II, p. 335.

The Development of Manufacturing Since 1900

It is unnecessary for our purposes to describe in detail the recent growth of manufacturing in the United States. At least by 1900 the United States had ceased to be a newly developing country; its economic problems had become those of an advanced industrial society.

This is not to say that growth slackened or that the economy became stagnant. Quite the contrary. The continued growth as well as the flexibility of the American economy is indicated in Tables V-4 through V-6. Table V-4 shows the decline between 1899 and 1937 in the number of wage earners required to produce various manufactured goods. Table V-5 indicates the number of wage earners, the book value of capital assets, and the capital assets per wage earner for the years 1904 and 1937. Table V-6 summarizes the percentage changes in the physical output of selected manufacturing industries between 1899 and 1937.

The Size of Manufacturing Establishments

Before the Civil War all manufacturing outside the textile mills of New England was carried on in small family workshops. Even in 1899, 304,677 of the 512,191 manufacturing establishments in the United States were classified as hand and neighborhood industries (see Table V-3), and few industries were large scale by modern standards. From the Census of Manufactures for the years 1880 and 1890 Stanford Research Institute has compiled Appendix D to show the average numbers of employees for the manufacturing industries of this period. In 1880, only 24 of 316 industries employed more than 100 workers on the average, and only the rubber boot and shoe industry engaged over 500 employees per plant. In 1890, only 31 of 358 industries employed more than 100 workers on the average, and only the rubber boot and shoe and iron and steel pipe industries engaged over 500 employees per plant.

Summary of the Early Industrial Development of the United States

Within a little more than a hundred years of its successful struggle for independence, the United States had become an advanced industrial nation. Its manufacturing had been transformed from cottage type, handicraft production of primitive consumers' goods to factory type, machine production of a great variety of products.

It cannot be over emphasized, however, that this growth was not unbalanced. Plants were constructed in response to demand. It was profitability which commanded the consideration of new establishments, and the average size of manufacturing plants increased only as prompted by the market.

In the opening paragraphs of this chapter some of the general factors which have contributed to the economic growth of the United States were mentioned. Five specific factors which have been illustrated by the discussion of this chapter are particularly relevant to the problems confronting underindustrialized countries. Their explicit enumeration is therefore desirable.

1. A large market. A function of (1) a large land area undivided by barriers to trade, (2) an increasing population, (3) a rising per capita income, (4) an extensive transportation and communications network, and (5) a popular desire for standardized products.

2. Skilled labor. A function of (1) immigration, (2) education, and (3) freedom of occupational choice.

3. Investment capital. A function of (1) domestic savings, (2) financial institutions, (3) the corporate form of business organization, (4) a high rate of return, (5) political and economic stability, and (6) funds from foreign investors.

4. Technological advance. A function of (1) high labor costs, (2) technical knowledge, and (3) high returns to innovators.

5. Efficient organization of production. A function of managerial skill.

These factors are, of course, related to each other and to the more general characteristics of the United States which have been mentioned previously.

Table V-1

POWER EQUIPMENT IN MANUFACTURING INDUSTRIES, U. S. 1/
Selected Years, 1849-1939

Year	Distribution of Total Horsepower: Steam Engines and Turbines: Horsepower (thousands)	Steam Engines and Turbines: Percent of Total	Internal Combustion Engines: Horsepower (thousands)	Internal Combustion Engines: Percent of Total	Hydroturbines and Water Wheels: Horsepower (thousands)	Hydroturbines and Water Wheels: Percent of Total	Equipment Driven by Purchased Energy: Horsepower (thousands)	Equipment Driven by Purchased Energy: Percent of Total	Total Horsepower (thousands)	Horsepower per Wage Earner
1849 2/	450	40.9			650	59.1			1,100	1.15
1859 2/	700	43.7			900	56.3			1,600	1.22
1869	1,216	51.8			1,130	48.2			2,346	1.14
1879	2,185	64.1			1,225	35.9			3,410	1.25
1889	4,586	77.2	9	0.2	1,255	21.1	89	1.5	5,939	1.40
1899	8,190	81.1	135	1.3	1,454	14.4	320	3.2	10,099	2.24
1904	10,918	82.1	289	2.2	1,647	12.4	442	3.3	13,296	2.56
1909	14,229	76.2	751	4.0	1,823	9.8	1,873	10.0	18,676	2.98
1914	15,591	69.9	989	4.4	1,826	8.2	3,885	17.5	22,291	3.37
1919	17,040	57.7	1,259	4.3	1,765	6.0	9,443	32.0	29,507	3.50
1923	16,701	50.5	1,224	3.7	1,803	5.4	13,365	40.4	33,093	4.03
1925	16,917	47.3	1,186	3.3	1,801	5.0	15,869	44.4	35,773	4.54
1927	16,924	43.6	1,171	3.0	1,599	4.1	19,132	49.3	38,826	4.94
1929	17,362	40.4	1,234	2.9	1,560	3.6	22,776	53.1	42,932	5.12
1939	17,860	34.9	1,813	3.5	1,604	3.1	29,888	58.5	51,165	6.48

1/ Variations in classification in different census years prevent these data from being perfectly comparable. The effect upon comparability of the United States totals, however, is insignificant, and has been neglected in this tabulation. For a discussion of this point, see W. L. Thorp, "Horsepower Statistics for Manufacturers," Journal of the American Statistical Association, 24 (December 1929), pp. 376-385.

2/ Estimated by C. R. Daugherty, in The Development of Horsepower Equipment in the United States, U. S. Geological Survey, Water Supply Paper 579 (1928), p. 49.

Source: National Industrial Conference Board, Industrial Location and National Resources, p. 171.

Table V-2

TOTAL AND PER CAPITA NET AND GROSS NATIONAL PRODUCT, U.S.
1869-1954
(Current and 1929 Prices)

Period	Population (millions)	Net National Product			Gross National Product		Net and Gross National Product per Capita (1929 prices)		
		Price Index (1929 = 100)	Current Prices (billions)	1929 Prices (billions)	1929 Prices (billions)	1929 Prices Including Government Service (billions)	Net	Gross	Gross Including Government Service
1869-78	44.6	69.1	$ 6.56	$ 9.49	$ 10.48	$ 10.73	$213	$ 235	$ 241
1874-83	49.8	60.9	8.36	13.72	15.12	15.48	276	304	311
1879-88	55.6	55.6	9.88	17.77	19.70	20.17	320	354	363
1884-93	62.1	52.0	10.84	20.83	23.42	23.96	336	377	386
1889-98	68.4	48.4	11.59	23.96	27.25	27.87	350	398	407
1894-1903	74.7	48.3	14.50	30.02	33.97	34.80	402	455	466
1899-1908	81.8	52.9	19.92	37.64	42.41	43.58	460	518	533
1904-13	90.2	58.3	26.25	45.02	50.84	52.40	499	564	581
1909-18	98.6	71.2	35.74	50.22	57.24	59.07	510	581	599
1914-23	105.9	95.6	54.29	56.78	65.19	67.57	536	616	638
1919-28	113.5	104.2	72.16	69.28	79.03	82.20	610	696	724
1924-33	121.2	95.6	70.14	73.39	83.91	87.22	606	693	720
1929-38	126.7	85.4	61.27	71.72	82.46	87.31	566	651	689
1934-43	131.7	88.8	76.32	85.90	98.06	112.50	652	745	854
1939-48	138.5	114.6	121.46	105.95	123.53	149.90	765	892	1,082
1944-53	148.9	147.6	185.90	125.94	150.17	175.90	846	1,009	1,182
1950-54	157.5	164.1	234.20	142.74	169.80	193.40	906	1,078	1,228

Source: Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations," Economic Development and Cultural Change, V (October 1956), p. 82.

Table V-3

GROWTH OF FACTORIES, U. S.
Selected Years, 1849-1947

Year	Production Workers per Establishment	Number of Establishments	Number of Production Workers	Value Added by Manufacture (millions)
		Factory, Hand, and Neighborhood Industries		
1849	7.8	123,025	957,059	463,983
1859	9.3	140,433	1,311,246	854,257
1869	8.1	252,148	2,053,996	1,395,119
1879	10.8	253,852	2,732,595	1,972,756
1889	11.7	353,864	4,129,355	4,102,301
1899	10.0	509,490	5,097,562	5,474,892
		Factory Industries Only		
1899	22.0	204,754	4,501,919	4,646,981
1904	24.3	213,444	5,181,660	6,019,171
1909	23.6	264,810	6,261,736	8,160,075
1914	24.6	268,436	6,602,287	9,385,622
1919	31.3	270,231	8,464,916	23,841,624
1921	33.7	192,059	6,475,474	17,252,775
1923	42.7	192,096	8,194,170	24,569,487
1925	42.8	183,877	7,871,409	25,667,624
1927	41.8	187,629	7,848,070	26,325,394
1929	40.5	206,663	8,369,705	30,591,435
1931	35.9	171,450	6,163,144	18,600,532
1933	41.5	139,325	5,787,611	14,007,540
1935	42.9	167,916	7,203,794	18,552,553
1937	51.4	166,794	8,569,231	25,173,539
1939	44.9	173,802	7,808,205	24,487,304
1947	49.5	240,881	11,916,188	74,425,825
		Index Numbers, Factory Industries Only (1899 = 100)		
1899	100	100	100	
1904	112	104	116	
1909	108	129	140	
1914	112	133	149	
1919	138	140	193	

Source: United States Census, 1947, p. 23.

Table V-4

PERCENTAGE CHANGES IN PHYSICAL OUTPUT AND OUTPUT PER WAGE EARNER, SELECTED MANUFACTURING INDUSTRIES, U.S. 1899-1937

Industry Group and Industry	Physical Output	Number of Wage Earners	Number of Wage Earners per Unit of Product
Foods			
Meat packing	66	85	12
Flour	-8	-18	-10
Rice	416	241	-34
Fruits and vegetables, canned	792	213	-65
Butter, cheese, and canned milk	460	157	-54
Beet sugar	1,690	375	-73
Cane sugar	86	29	-30
Ice	668	173	-64
Beverages			
Liquors, malt	60	19	-26
Liquors, distilled	315	153	-39
Tobacco products			
Cigars	0	-44	-44
Chewing and smoking tobacco	-6	-65	-63
Textile products			
Cotton goods	101	42	-30
Woolen and worsted goods	60	25	-22
Silk and rayon goods	512	79	-71
Knit goods	506	177	-54
Carpets and rugs, wool	52	8	-29
Cordage and twine	38	7	-23
Jute goods	134	45	-38
Linen goods	-44	-43	0 1/
Hats, fur-felt	26	-16	-33
Hats, wool-felt	90	92	2
Leather products			
Leather	61	-3	-40
Shoes	87	52	-19
Gloves	29	-3	-25
Rubber products			
Shoes	59	28	-20
Paper products			
Paper and pulp	518	177	-55
Printing and publishing	494	78	-70

Table V-4 (Continued)

Industry Group and Industry	Physical Output	Number of Wage Earners	Number of Wage Earners per Unit of Product
Chemical products			
Industrial chemicals including compressed gases and rayon	2,500	693	-70
Cottonseed products	63	51	-8
Wood distillation products	259	184	-21
Explosives	267	20	-67
Fertilizers	248	80	-48
Paints and varnishes	391	228	-33
Salt	82	-3	-47
Tanning and dye materials	292	71	-56
Petroleum and coal products			
Petroleum refining	1,920	583	-66
Coke-oven products	380	21	-75
Stone, clay, and glass products			
Glass	553	50	-77
Forest products			
Lumber-mill products	-32	-20	19
Turpentine and rosin	-32	-22	15
Iron and steel products			
Blast furnace products	171	-41	-78
Steel mill products	313	162	-36
Nonferrous metal products			
Copper	272	28	-66
Lead	51	-51	-68
Zinc	318	132	-45
Transportation equipment			
Automobiles, including bodies and parts	180,000	21,300	-88
Carriages, wagons, and sleighs	-95	-96	-33
Cars, railroad	-22	9	39
Locomotives	-79	-53	126
Ships and boats	-17	33	61

1/ Less than one percent.

Source: Solomon Fabricant, Employment in Manufacturing, 1899-1939, pp. 84-85.

Table V-5

VALUE OF MANUFACTURING INDUSTRIES, U. S.
1904 and 1937

Industry Group	Number of Wage Earners (thousands) 1904	1937	Capital Assets (excl. land) Net Book Value (millions) 1904	1937	Capital Assets (excl. land) per Wage Earner 1904	1937
Foods	359	789	$ 525.9	$ 2,269	$1,465	$ 2,876
Beverages	68	86	299.2	562	4,400	6,535
Tobacco products	159	92	29.7	84	187	913
Textile products	1,179	1,834	740.4	1,703	628	929
Leather products	266	332	112.4	142	423	428
Rubber products	44	130	26.4	235	600	1,808
Paper products	125	264	204.8	1,272	1,638	4,818
Printing and publishing	230	353	223.0	651	970	1,844
Chemical and coal products	154	335	319.5	1,415	2,075	4,224
Petroleum products	17	83	65.2	3,554	3,835	42,819
Stone, clay, and glass products	297	330	270.6	982	911	2,976
Forest products	757	709	370.5	1,142	489	1,611
Iron and steel products	478	954	759.6	3,284	1,589	3,442
Nonferrous metal products	190	331	201.2	537	1,059	1,622
Electrical machinery	64	309	50.7	396	792	1,282
Machinery other than electrical	436	802	436.8	1,128	1,002	1,406
Automobiles, incl. bodies and parts	12	479	8.0	982	667	2,050
Transportation equipment other than automobiles	200	150	141.0	434	705	2,893
Miscellaneous products	136	220	60.4	467	444	2,123
Total	5,173	8,584	$4,845.3	$21,238	$ 937	$2,474

Source: Solomon Fabricant, Employment in Manufacturing, 1899-1939, p. 257.

Table V-6

PERCENTAGE CHANGES IN PHYSICAL OUTPUT OF SELECTED MANUFACTURING INDUSTRIES, U.S. 1899-1937

Industry	Percentage Change	Industry	Percentage Change
Automobiles	180,100	Cotton goods	101
Cigarettes	4,226	Cane sugar refining	101
Petroleum refining	1,920	Fish, canned	96
Milk, canned	1,810	Hats, wool-felt	90
Beet sugar	1,686	Shoes, leather	87
Hoisery, knit	1,202	Salt	82
Cement	838	Cane sugar not elsewhere made	67
Fruits and vegetables, canned	792	Meat packing	66
Chemicals, n.e.c.	741	Cottonseed products	63
Ice	668	Leather	61
Silk and rayon goods	512	Woolen and worsted goods	60
Pulp	505	Liquors, malt	60
Printing and publishing	494	Underwear, knit	52
Paper	465	Carpet and rugs, wool	52
Rice	416	Lead	51
Outerwear, knit	393	Cordage and twine	38
Paints and varnishes	391	Hats, fur-felt	26
Coke oven products	380	Gloves, leather	16
Zinc	318	Cigars	0
Liquors, distilled	315	Pianos	-5
Steel-mill products	313	Tobacco products, n.e.c.	-6
Butter	309	Flour	-8
Tanning and dyeing materials	292	Clay products	-15
Copper	272	Ships and boats	-17
Explosives	267	Cars, railroad, not elsewhere made	-22
Wood distillation products	259	Lumber mill products, n.e.c.	-[illegible]2
Fertilizers	248	Turpentine and rosin	-32
Blast furnace products	171	Linen goods	-44
Cheese	158	Locomotives not elsewhere made	-79
Jute goods	134	Carriages, wagons, and sleighs	-95
Wool shoddy	116		

n.e.c. = not elsewhere classified.

Source: Solomon Fabricant, Employment in Manufacturing, 1899-1939, p. 89.

Chapter VI

THE SCALE OF MANUFACTURING IN OTHER INDUSTRIALLY ADVANCED COUNTRIES

Chapters IV and V have been concerned with the current and the historic structure of manufacturing in the United States. The primary purposes of Chapter IV were (1) to list the manufacturing industries which appear to require large plants for efficient production in the United States; (2) to show how much of American manufacturing is produced by small- and medium-sized establishments; (3) to discuss the relative profitability and efficiency of large and small establishments; (4) to illustrate the interdependence of small and large establishments, both within and between industries; and (5) to indicate the relation in the United States between large-scale production and the size of the market.

The primary purposes of Chapter V were (1) to illustrate the fact that large manufacturing establishments in the United States developed gradually, in harmony with the entire economy, and in response to market conditions; and (2) to suggest some of the factors which made possible the development of American manufacturing.

This discussion has illustrated some of the aspects of economic development. However, it would hardly be reasonable to suppose that the pattern of American economic development is exactly applicable to those areas of the world which are newly developing today. Furthermore, products which require large-scale production in the United States may not require large-scale production in other countries. It is relevant in this chapter, therefore, to describe (1) the economy and (2) the manufacturing industries of representative industrially advanced nations--Switzerland, Japan, Sweden, Australia, and the Soviet Union. 1/ Special discussions of a cement process recently developed in Switzerland and of the history of Japan are also included in this chapter.

Switzerland

Although Switzerland is one of the smallest nations of the world and the least well endowed with natural resources, this country is among the most wealthy nations from the standpoint of per capita income. Per capita net national product in 1954 amounted to just under 5,000 Swiss francs (about $1,200 at current exchange rates). While the population of Switzerland has been increasing during the past 50 years at a per decade rate of nearly 8 percent, national product per capita has been

1/ For an analysis of the scale of manufacturing in Great Britain, see the various studies of P. Sargent Florence, two of which are cited in Chapter III. See also W. Arthur Lewis, "The Industrialization of the British West Indies," The Caribbean Economic Review, II (1950), pp. 1-57.

increasing at a per decade rate of over 15 percent.[2/] However, while Switzerland is becoming increasingly industrialized, her industries are generally characterized by small- and medium-sized establishments.

The Economy

With a total land area of only about 16,000 square miles (compared with about 3 million square miles in the United States) and a population of about 5 million, Switzerland has a population density of over 300 inhabitants per square mile. In 1950 the working force was occupied as follows: 16 percent in agriculture, 47 percent in industry, 12 percent in trade and banking, 5 percent in transport, and 8 percent in civil service and the professions. Some idea of the relative importance of Swiss industries may be gained from Table VI-1 which shows the number of employees and enterprises in the major classes of industry in 1954.

Most of the prerequisites to successful manufacturing are present in Switzerland. This country has a railway system of approximately 3,900 miles and a well-knit system of roads and highways covering approximately 10,300 miles (5,800 miles surfaced).

In 1953 Switzerland possessed more than 401 banking establishments, not including their many branches. Switzerland is, moreover, one of the insurance centers of the world.

A complete educational system has resulted in high intellectual and professional standards. Elementary schooling is compulsory and free. The country is further endowed with numerous secondary and high schools and commercial and technical training colleges. The nation as a whole has kept abreast of modern scientific and technical progress.

Since World War I, the Swiss have regulated their foreign trade to some extent by the use of quantitative trade restrictions. In principle, however, Switzerland has supported a policy of free trade. The Swiss franc, it may be added, has never ceased to be fully convertible.

Because Switzerland lacks natural resources and has a small domestic market, it is logical that its industry should be directed toward export. Furthermore, as one of the few countries in the world with no direct access to the sea, Switzerland must develop products capable of being transported at negligible costs--hence the preponderance of factories producing articles of high value and small volume. At the same time, because of low interest rates and high wage rates, production is concentrated on the manufacture of goods requiring large capital investments and small amounts of highly skilled labor.

2/ See Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations," Economic Development and Cultural Change, V (October 1956), p. 10.

Switzerland is essentially a processing nation. She imports raw and semifinished materials for processing into finished goods for export. In many industries almost all of the production is exported; in watchmaking, for example, about 95 percent of the product is exported and in chemicals, about 90 percent.

The total value of Swiss exports in 1954 can be broken down by major industrial groups as follows: machinery and metallurgy, 33.4 percent; watches, 19.7 percent; chemicals, 16.4 percent; textiles, 16.1 percent; and all others, 14.4 percent. In 1954 the total value of Swiss exports amounted to approximately 25 percent of net national income.

The annual Swiss production of silk, nylon, and rayon fabrics, two-thirds of which is regularly exported, is estimated at 150 million Swiss francs. Over 1.5 million spindles are distributed among about 100 mills.

The annual value of yarn production is estimated at several hundred million francs; most of this output is absorbed in the home market for weaving and embroidery. Most of the output of the embroidery industry is exported. About 330,000 spindles are employed in the spinning and twisting of wool yarn (combed and carded). Thirty power factories employ some 3,000 workers in the production of linen. In 1954 some 600 firms employed 20,000 workers in the production of ready-made clothing; another 4,000 workers prepared garments in their own homes. On a seasonal basis, from 2,500 to 3,000 people are employed in the production of millinery braid, and about 98 percent of this production is exported.

In normal times two-thirds of Swiss engineering products are sold in foreign markets. In 1901, 899 metallurgical engineering establishments employed 45,378 workers comprising 18.7 percent of all Swiss industrial workers. By 1954 the number of factories had increased to more than 2,800, and with the employment of 205,300 workers, the proportion of metallurgical to all Swiss industrial workers rose to 36.4 percent.

The Swiss specialize in the production of equipment for the transmission, distribution, and utilization of electrical energy. A second, equally important product is textile machinery. Other important industrial products made in Switzerland are refrigerating plants and machinery; compressors; pumping plants; machines for flour mills, foodstuff factories, and paper mills; printing machinery; packaging machines; agricultural machinery; scientific appliances and instruments for the testing of materials; medical appliances and instruments; optical and surveying instruments; meters; calculating machines; and typewriters.

Watchmaking has probably contributed the most to Switzerland's reputation as an industrial nation. For a long time watchmaking remained one of the crafts, but during this century it has developed into an industry. Today nearly 35 million watches and watch movements

are made in Switzerland each year, and almost all of these are exported. The annual production is the work of 56,000 men and women employed by more than 2,000 concerns.

The products of the chemical industry accounted for about 16 percent of the total value of Switzerland's export trade during 1953 and 1954. The most characteristic of these chemical products were synthetic coal-tar dyes, pharmaceutical preparations, materials for perfumes, and electrochemical products such as aluminum. This industry also produces acids, salts and alkalies, explosives and manures, insecticides, dyestuffs, and varnishes and soaps.

The foodstuff industries constitute another important industrial group. Miscellaneous industries of some importance are the following: wood products and plastics, building materials, linoleum, ceramics and glass, paper and paper products, office machines, and sports goods and toys.

The Scale of Manufacturing

Stanford Research Institute has compiled Appendix E from the Swiss Factory Statistics of 1949 to indicate the representative plant sizes of various Swiss industries.

For 196 industries, representative plant size was small for 81, smallish for 54, bias-smaller for 5, medium for 32, largish for 13, and "none" for 11. Twenty-eight industries had an average of 100 or more employees per plant (see Table VI-2). The following nine industries had an average of over 200 employees per plant: artificial silk, combined textile finishing equipment, coal-tar dyes, iron and steel rolling mills, copper and brass works, aluminum, cables, railroad cars, and munitions weapons.

Appendix E includes the horsepower per employee and the size of plant with the greatest horsepower per employee for each industry. In 59 of 196 industries, the horsepower per employee was greatest for plants having over 100 employees, but there does not appear to be any well defined, general correlation between representative plant size and horsepower per employee. Appendix E also indicates those industries which do not require large plants in terms of either employees per plant or horsepower per employee.

The de Roll Vertical Cement Kiln

In Chapter IV it was suggested that the large plants which are suited to the domestic American market may be unsuited to the smaller domestic markets of many underdeveloped countries. For this reason, those industries which require large plants for efficient operations in the United States may be inappropriate for newly developing countries.

To this conclusion, however, three qualifications were suggested: one was that the products which require large plants in the United States may not require large plants in other industrially advanced countries. Different, though efficient, alternative processes may be known. A good example is the production of cement in Switzerland.

In the United States the annual capacity of a typical Portland cement plant is about 2 million barrels. (In 1955 the average annual capacity of the 28 Portland cement plants of the eleven western states of the United States was nearly 3 million barrels, although 8 of the 28 plants each had an annual capacity under 1 million barrels.) In terms of employees per plant, the representative plant size for the American cement industry is medium, and the average number of employees per plant is 230. In terms of either value added or fixed assets per plant, however, most American cement plants should probably be regarded as large.

In 1947 the total value added by 155 hydraulic cement plants in the United States was less than .01 percent of gross national product; but few underdeveloped countries have domestic markets which could absorb the output of many American-type cement plants at profitable prices. It would appear, therefore, that because of small domestic markets and high domestic transportation costs, many underdeveloped countries must (1) do without cement, (2) import cement at high costs, or (3) produce cement domestically at costs which are high either because domestic plants cannot operate at capacity or because the cost of transporting cement to remote sections of the country is high.

Fortunately, however, a cement plant has been developed which can produce as little as 150,000 barrels of high quality cement annually at competitive prices.[3] Engineers are confident, moreover, that 80 to 90 percent of the first cost can be recovered if a plant is relocated after its need in its original location has ended.

This plant was perfected in the years following World War II by a subsidiary of the Louis de Roll Iron Works, S. A. Gerlafingen, Switzerland. The innovation of this plant is the kiln, which is vertical, requires only two men per shift, and can maintain proper and constant clinkering conditions as the charge moves downward. With this kiln it is possible to produce low-cost cement in plants which are smaller than the typical cement plants of the United States, and apparently better suited to the markets of most underdeveloped countries.[4]

3/ See H. Herbert Hughes, "The de Roll Vertical Kiln," Mining Engineering, December 1956, pp. 1-6.

4/ For some details of the engineering aspects of this kiln, see Equipment and Machinery for the Cement Industry, L. de Roll S. A., Zurich, Switzerland.

Additional research into the production processes employed in other industrially advanced countries might uncover many other examples of plants which, unlike the typical plants of the large-scale American industries, are both efficient and small.

Japan

In many respects Japan is a more relevant model for newly developing countries than the United States or the nations of Western Europe. The land area of postwar Japan is only one-twentieth as great as that of the United States, and the Japanese have not been blessed with abundant natural resources. Japan is probably the most overpopulated nation in the world. Most significantly, perhaps, the traditions and the mores of the Japanese have been different from those of the people of Western Europe or the United States.

The Economy

At the same time, many of the prerequisites to economic growth have been present or have been developed in Japan. By law, every citizen is entitled to an education; the first nine years of school are compulsory. Japan has a large reservoir of skilled labor which is capable of being trained in modern methods of production.

Banking and insurance are both well developed in Japan. A distribution network of electric power covers the entire country. The number of telephones in use in Japan rose from 1.2 million in December 1947 to 2.8 million in September 1954.

The country has approximately 17,000 miles of working railroad track. The present road system totals about 86,000 miles, with 15,000 miles being improved roads. Trucks now transport over 40 percent of the nation's cargo. Japan's prewar merchant fleet, aggregating some 6 million gross tons in 1941, ranked third in the world in total tonnage. By the middle of 1954, the fleet had been restored to over 3 million tons.

The Economic History of Japan

Because the Japanese situation is unusually relevant for newly developing countries, it is desirable to indicate a few of the highlights of Japanese economic history. 5/

5/ The following account is substantially taken from William W. Lockwood, The Economic Development of Japan (Princeton, New Jersey: Princeton University Press, 1954).

Economic Growth. The national income of Japan has increased enormously since 1878 (see Table VI-3). Indeed,the rate of increase of national income in Japan over the last eight decades probably has not been exceeded by that of any other country (see Table VI-4). At the same time, because population has increased by nearly 13 percent per decade, the increase of per capita income probably has been retarded. In 1956 the per capita net national product of Japan was only about $200.

In 1867-68 the Tokugawa Shogunate was overthrown by the western clans of Japan. In 1869 the clans were induced to surrender their land registers. In 1871 came the abolition of fiefs. As in France after 1789, feudal proprietary rights were swept away by decree. In Japan, however, government pensions (later commuted to national bonds) were issued to the feudal nobility in return for the surrender of their revenues, and the government assumed the debts of the lords to the merchants. This minimized resistance to the new regime and enabled many of the more enterprising aristocrats to metamorphose themselves into the leading financiers of the new Japan.

The land tax reform of 1873 created a unified revenue system in the form of a fixed money tax collected from land owners in proportion to the newly assessed value of their land. Through this device the state financed itself through the early critical years.

Freedom of movement and occupation, the abolition of clan tariff barriers and tolls, free transfer of property rights and land, unification of the monitary and banking system, the growth of population, steady improvements in agricultural methods, better transport--such new conditions and new forces brought a slow expansion of the internal market and a rise in productivity. As late as 1898, however, an estimated 82 percent of the people still lived in communities of under 100,000 population. The new growth in population was still being absorbed mainly in rural areas.

By 1893 Japan had acquired her first 2,000 miles of operating railway, her first 100,000 tons of steam vessels (mostly purchased abroad), and her first 4,000 miles of telegraph lines. The first modern silk filature was opened in 1870 with a French expert as superintendent. Cotton spinning mills were build or re-equipped with machinery which was largely imported from England. Experimental factories were set up to produce cement, sugar, beer, lath, chemicals, and a variety of Western-type goods.

Mineral production increased sevenfold from 1876 to 1896. In the latter year the consumption of coal reached 36 million tons. Nearly half of this tonnage was consumed in factories which already numbered 7,640 and employed 435,000 workers.

A Japanese iron and steel industry was launched in 1901 when the government-owned Yawata Iron Works commenced operations. In

general, however, the expansion of Japan's basic economy--agriculture and small-scale industry built on traditional foundations--accounted for most of the growth of national productivity and national income before 1900.

The electrical equipment industries advanced in the early 1900's as new thermoelectric and hydroelectric generating plants were built.

The factory system in cotton textiles became firmly established in Japan during the 20 years before World War I. At the end of this period there were nearly 400,000 independent and piecework establishments.

While exports and imports both tripled in value from 1913 to 1919, volume increased by only one-quarter. Manufacturing output is estimated to have risen as much as 78 percent in total volume. By 1929 the value of both exports and imports had more than tripled the 1913 figure. About one-third of this increase represented higher prices which now averaged 50 percent above the 1913 level. Thus, the volume of imports and exports approximately doubled through the war and post-war decades.

By 1929 steel production exceeded 2 million tons--eight times the output of 1913. Yet the steel industry, long dominated by the state-controlled Yawata Iron Works, still failed to meet the country's requirements, in either quantitative or qualitative terms.

The increase in manufacturing production from 1895 to 1938 is summarized in Table VI-5.

Factory employment increased from nearly 1.9 million in 1930 to nearly 2.9 million in 1936. By the latter date one out of every three Japanese lived in a city of 30,000 or more and one in four in a city of over 100,000. Manufacturing, including handicraft as well as factory industries, accounted for 5 billion yen, or nearly one-third of the total national income.

The physical output of the Japanese factory worker rose spectacularly between 1910 and 1938, with the average annual output being well over twice as much at the end of the period as at the beginning. The horsepower of electric motors installed in Japanese factories increased from 279,000 horsepower in 1914 to nearly 6.3 million horsepower in 1937--more than twentyfold.

Despite physical and social handicaps in agriculture, Japan was able to increase food and raw material production perhaps as much as 200 percent in the course of the five decades ending in 1938. This point is fundamental in considering the lessons of Japan's experience for other Far Eastern countries.

Although the economic growth of Japan has been spectacular,

> emphasis must be placed on what seem today to be very modest improvements: the rickshaw and the bicycle; the rodent-proof warehouse; elementary sanitation; better seed and more fertilizer; the kerosene and then the electric lamp; the simple power loom; the gas engine and the fishing boat; the divorce of personal from business accounts; the principle of limited liability. Big and dramatic innovations, like railways and great banks and holding companies, might provide the scaffolding, but the structure itself was built, brick upon brick, by myriads of individual experiments and commitments.6/

The energies, the skills, the ambitions which provided the real motive power of Japanese industrialization found expression in the activities of millions of small industrialists, tradesmen, technicans, farmers, and workers--as well as in the superstructure of big business. It is significant that as late as 1930 one in every three persons gainfully employed in Japan was still in some sense an entrepreneur, carrying some risk and responsibility for business enterprise.

The Growth of the Market. The rise of productivity in Japan involved more than the acquisition of machinery and a corps of technicans. It rested upon broader changes in economic life, including especially the growth of the market, for the use of power equipment in production becomes profitable only as it becomes possible to move out of the sphere of self-sufficient economic activity. The rise of productivity requires railways and banks and an efficient medium of exchange. It signifies the rise of an economy in which labor and capital are combined and concentrated in various specialized ways, with the resulting surpluses exchanged against each other in widely organized markets.

It was the export industries producing silk, cotton goods, chinaware, and other manufactures for Western consumption which led the way in standardization. Characteristically, therefore, it was the export branches of these industries which tended to be large scale and capitalistic in organization. At the same time foreign and colonial markets, then at their prewar peak (1927-35), took no more than 25 to 35 percent of Japan's manufacturing output and no more than 20 percent of her entire national product. The national demand represented the growing requirements of the civilian economy expressed through private expenditures for goods and services.

Japan is smaller than Sweden or Thailand, and most of the land area is within 100 miles of a port city. Short land distances and communication by sea were great advantages in achieving political order and fostering the easy movement of goods and people within the framework of a growing national market. However, no single industry has

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6/ Ibid., p. 584.

played a more essential role in Japan's economic growth than transportation. Even as late as 1884 the cost of transport doubled the price of a bushel of rice in 20 miles. In one generation, 1888 to 1913, freight traffic on Japan's spreading railways rose from 848,000 tons to 40.6 million tons; and the total tonnage of all merchant vessels over five tons increased from 494,000 to 2.4 million gross tons.

The structure of the domestic demand for Japanese goods has undoubtedly been changed by the growth of population. For at least 100 years before 1850, a population of from 28 to 30 million pressed close to the limits of subsistence. However, between 1875 and 1955 the Japanese population increased from 35 million to nearly 90 million. Between 1865 and 1955 population density per square mile increased from 225 to over 600. Only about 16 percent of the entire country is arable, and population pressure in Japan is probably greater than in any other country in the world.

The Role of Government. The problem of the modernization of Japan was, first, to establish a broad highway of contact with Western learning, and second, to adapt and develop this learning on an indigenous basis. The government led in both tasks. It dispatched group missions and individual students in large numbers abroad to study Western science, administration, and industrial arts. It hired hundreds of Western experts in almost every branch of technical skills from silkworm breeding to shipping and central banking.

A department of education was created in 1887. Drawing on French models, it blueprinted a national system of education with a primary school envisaged for every 600 children. Highly technical schools were organized in such fields as medicine, military science, navigation, agriculture, commerce, and fishery. Tokyo Imperial University became a training school for the civil service and the leading center of university education and research. By the turn of the century, substantial progress had been made toward a compulsory system of four-year primary education with 5 million children receiving some instruction in 27,000 elementary schools. By 1903 some 240 technical schools of higher and lower grades had been organized. In addition there were technical colleges and universities and 1,000 elementary schools offering part-time instruction in the simpler skills required for industry, commerce, agriculture, and fishing.

Initially, the state spearheaded the industrialization process by pioneering and financing new undertakings on a broad front. In the decade after 1868 it built and operated railways and telegraph lines. It opened new coal mines and agricultural experiment stations. It established iron foundries, shipyards, and machine shops. It imported foreign equipment and experts to mechanize silk reeling and cotton spinning. It set up model factories to manufacture cement, paper, and glass. Although public expenditures for such purposes were not large (excluding transportation and communications), this leadership had a

catalytic effect. From 1866 to 1900 the state shouldered the early risks, surveyed the path of technical advance, and patronized the many private ventures which followed.

In 1896 the government undertook a general subsidy of ocean shipping. In 1889 a differential subsidy in favor of Japanese-built ships was introduced to stimulate domestic construction. In 1901 the government established the Yawata Iron Works, largely for military reasons. In 1906 the government nationalized all the trunk railways of the country. Thereafter, however, state capitalism in the sense of public ownership of industry played a declining role until its revival in the war economy of the late 1930's. The government retained possession of the telephones and telegraphs and much of the forest domain, but the census of national wealth in 1930 credited national and local governments in Japan with properties valued at only 18 billion yen. This was approximately one-sixth of the total national wealth of 110 billion yen--about the same proportion as prevailed in the United States.

Government plants employed only 12 percent of the total number of factory workers in 1914. Over the next 25 years, their share was rarely more than 8 percent. In 1933, for example, only 188,000 out of 2.3 million factory operatives were employed in state-owned enterprises.

Tariff protection was barred by the treaty agreements of 1858 and 1866. The latter agreement bound Japanese import and export duties unilaterally at very low rates for the next 30 years. Even after the recovery of tariff autonomy in the 1890's, rates were generally no higher than 10 to 15 percent until the general tariff revision of 1911. After World War I, tariff policy became protectionist. High protection was extended to industries of strategic importance like iron and steel and dyestuffs, to other industries which mushroomed during World War I, and even to natural resources industries like lumber, tobacco, and copper. Nevertheless, until 1933 the Japanese government adhered to the principle of multilateral, nondiscriminatory trade. Japan was thus able to buy in the cheapest markets and to sell wherever she could get the best price.

External Economic Relations. Except in electric utilities, foreign investment in Japanese business enterprise was rather insignificant in amount. It took the form mainly of purchases of corporate bonds and debentures. In this respect Japanese business retained the independence from foreign control which it had enjoyed from the early days.

Both Japan's imports and exports approximately doubled between 1893 and 1903. They doubled again in the ensuing decade. The expansion of exports provided foreign exchange which, supplemented by borrowings abroad, made it possible for Japan to buy a growing volume of foreign machinery, equipment, and raw materials.

From 1904 to 1913 the merchandise exports of the Japanese Empire fell short of paying for imports by 707 million yen. This large deficit was financed by capital imports. By 1915, however, orders began to pour in for Japanese goods. Almost overnight the country began to be embarrassed by the surfeit of riches in its international account.

Textiles of all kinds made up two-thirds of Japan's total exports which were valued at over 2 million yen in 1929. Next to silk, cotton-piece goods constituted the largest item. Imports of wholly or partly manufactured producers' goods were paid for mainly by exports of consumers' goods rather than by foreign borrowings.

By 1936 imports from overseas sources, both foreign and colonial, provided 20 percent of Japan's net supply of rice and beans, 35 percent of her fats and oils, 60 to 80 percent of her iron and steel materials, 90 percent of her phosphate fertilizer, and 100 percent of her cotton, wool, and rubber. During the period 1935-38, exports to foreign countries were 85 percent manufactures, and imports were 62 percent raw products. It is clear, in short, that the economic development of Japan depended heavily upon international trade.

The Historic Role of Small-Scale Industry. Because of the notoriety of the Zaibatsu, bigness has been overemphasized in descriptions of the industrial structure of Japan. Through an intricate, pyramidal structure of intercorporate, personal, and political ties, the larger combines (notably Mitsui and Mitsubishi) developed into huge conglomerations of heterogeneous enterprises--trading, shipping, banking, insurance, real estate, mining, manufacturing, and colonial undertakings. Financial power centered increasingly in a handful of great private banks and trust companies and such semiofficial institutions as the Bank of Japan, the Industrial Bank, and the Yokohama Specie Bank. These private banks with their numerous branches were largely owned or controlled by the Zaibatsu. Probably no other modern industrial society organized on the basis of private property has offered a comparable display of the unrestrained use of the power of bigness or the devices of monopolistic control.

On the other hand, a striking aspect of Japanese industrialization has been the strength and staying power of the small industrialists. 7/

7/ For an industry-by-industry description of small-scale production in Japan, see Economic Commission for Asia and the Far East, Committee on Industry and Trade, Report of the Study Group of Small-Scale Industry Experts on Their Visit to Japan, United Nations Economic and Social Council, E/CN. 11/I &T/108, 1 February, 1955. See also Edwin Reubens, "Small-Scale Industry in Japan," Quarterly Journal of Economics, LXI (August 1947), pp. 577-604; and Chaman Lal, Cottage Industries and Agriculture in Japan (Hornby Road, Bombay: New Book Company, Ltd., 1949).

In 1930, after half a century of industrial development, industrial work places too small to be classified as factories (5 operatives or more) still afforded upwards of 50 percent of all manufacturing employment in Japan. By comparison, factories of over 100 workers furnished no more than one-third--perhaps as little as one-quarter--of all industrial employment.

From small industrial plants came most of the traditional necessities and luxuries of the people--foodstuffs, straw mats, footgear, silk fabrics, pottery, lacquer ware, and so on. Small industrial plants had also sprung up in newer trades producing for foreign or domestic markets such Western-style manufactures as bicycles, rubber shoes, toys, electric lamps, and machine parts. In such major industries as textiles and pottery, small plants mushroomed along with the larger factories, either specializing in particular types of goods or serving as feeder or finishing plants for the big enterprises. In 1932, for example, Osaka's 211,500 workers were distributed among as many as 31,800 industrial plants, with some 80 percent of these establishments having less than five employees. The same situation prevailed in Nagoya, also a center of textiles, foodstuffs, chemicals, and metal manufactures.

As Professor William Lockwood has pointed out:

> If Japan's experience teaches any single lesson regarding the process of economic development in Asia, it is the cumulative importance of myriads of relatively simple improvements in technology which do not depart radically from tradition or require large units or new investments. The big, modern establishment with its concentration of capital in advanced forms of technology was essential in many fields, of course. It provided a framework of economic growth in the form of railways and steam shipping, coal and electric power, the metallurgical industries, banking and insurance. It enlarged the opportunities of foreign trade; it was indispensable to the building of industrial war potential. Much of the real substance of Japanese economic growth, however, is found in the more modest types of improvements which were easily and pervasively adopted, more economical in cost, and often more productive of immediate returns in income. For any poor country beginning to industrialize, one of the crucial problems is to introduce and spread such innovations as widely as possible. 8/

8/ Ibid, p. 199.

The Scale of Manufacturing

Some indication of the pre-World War II scale of Japanese industry is given in Tables VI-6 and VI-7. More recent data suggest no decrease in the importance of small establishments. Statistics for 1951 show that 99.4 percent of all manufacturing establishments employed less than 200 workers while accounting for 68.2 percent of the total number of manufacturing workers. In the commercial enterprise sector of the Japanese economy, 99.6 percent of nearly 1.5 million shops employed less than 30 persons.

On the basis of data from the Japanese Statistical Year-Book for 1954, Stanford Research Institute has prepared Appendix F to give some indication of plant size for 19 major branches of industry. This appendix is summarized in Table VI-8.

Unfortunately, these statistics include only those establishments with four or more workers. Moreover, the breakdown by industry is less detailed than that used for either the United States or Switzerland. Nevertheless, the importance of small establishments is clear.

In 1953, 92.6 percent of all manufacturing establishments employed less than 50 operatives, and 98.4 percent employed less than 200. In 1954 only five major categories of manufacturing averaged more than 50 employees per plant. These were electrical machinery, equipment, and supplies; transport equipment; primary metal; rubber products; and chemical and related industries.

The small-scale industries of Japan can be roughly classified into three categories:

1. The intrinsically small-scale industries which require a high degree of skill--for example, embroidery and ceramics

2. The industries which remain small because of limited demand--for example, furniture and toys

3. The industries which have been subordinated to or integrated into large-scale industries--for example, casting and machinery parts.

Small- and medium-sized enterprises produce nearly 100 percent of domestic furniture and accessories and occupy a prominent position in the production of such consumer goods as wood products, textiles, and foodstuffs. These enterprises also supply roughly 60 percent of all of the export articles manufactured in Japan. (Such items as toys, pigments, umbrellas, fishing rods, imitation pearls, and magnets are manufactured exclusively by small- and medium-sized enterprises. Silk and rayon fabrics, woolen fabrics, sundries, pencils, binoculars, and telescopes for export are for the most part the products of small- and

medium-sized enterprises.) Moreover, the products of many large enterprises are manufactured in part by the small- and medium-sized enterprises.

As in the American economy, small- and medium-sized enterprises are important in the Japanese economy in that they are associated with or incorporated into the key, large-scale industries. Large enterprises have sought to reduce working capital and costs by distributing orders to subcontractors. At the same time they have used the small- and medium-sized enterprises as a safety valve in the fluctuation of business. This relationship between the large and small enterprises is conspicuous in such cases as the machinery and metals industries. The machinery industry in particular is based on the subcontract system and depends to a great extent upon small-scale enterprises.

Domestic Industries. An outstanding characteristic of the small establishments of Japan is their relation to the family. Most small establishments depend, for example, upon the labor of family members rather than upon employed labor. As a consequence, the individuals who work in small establishments generally have relatively low incomes, although small establishments are extremely flexible in terms of both working time and volume of output.

It is also characteristic of small establishments that they require little plant and equipment and have a very high ratio of labor cost to total cost.

Cooperatives. Small enterprises are greatly handicapped as compared with large enterprises in terms of credit and finance, sales systems, and production equipment and techniques. These handicaps are being substantially overcome by means of cooperatives. Cooperativ action enables small- and medium-sized enterprises to turn out product of better quality at lower cost and to share the expenses of storage and warehousing, transportation, inspection, research and experimentation, purchasing of necessary materials, sales of finished articles, advertising, and loans.

To achieve these purposes, the establishment of cooperatives is being encouraged in conformity with the Act for Smaller Enterprises Cooperatives. Four categories of cooperatives have been established: (1) enterprise cooperatives in which individual entrepreneurs can main tain autonomy but cooperate in fields where further rationalization is n essary; (2) enterprise cooperatives in which members pool necessar capital and labor; (3) cooperative credit unions which receive deposit and extend loans; and (4) federations of cooperatives.

The government provides an annual subsidy for the establishment of facilities for cooperative production, processing, storage, and transportation. The subsidy for fiscal 1954 amounted to 300 million yen.

The government also places emphasis on providing funds to be loaned exclusively to small- and medium-sized establishments. The following financial agencies aid small enterprises.

1. Small Business Finance Corporation. Established in September 1953, this agency is capitalized in full by the government and extends long-term loans to small enterprises at low interest rates. Loans are made through 405 chartered banks throughout the country. A total of 19 million yen was made available for fiscal 1954. Loans approved as of the end of February 1955 amounted to 31.7 million yen.

2. People's Finance Corporation. Established in June 1949, this agency took over the business of the People's Bank and Pension Fund. This is a government agency which supplies operating funds to small businesses not eligible for loans from general city banks. This corporation is also capitalized in full by the government. Funds on hand at the end of January 1955 totaled 39 million yen, and loans extended aggregated 38.7 million yen.

3. Central Bank for Commercial and Industrial Cooperatives. Established in December 1936, this agency finances the cooperative unions and small- and medium-sized establishments. Funds on hand at the end of January 1955 totaled 34.1 billion yen, and loans extended aggregated 54.2 billion yen.

4. Credit Security System. Under this system the government insures indemnification of the losses incurred by financing agencies or the credit security associations. The credit security associations are established chiefly by local governments to facilitate loans to small enterprises which do not have adequate security.

In addition to providing financial assistance, the government has inaugurated a system which provides the management of small enterprises with expert analyses of their operations and with suggestions for improving managerial techniques. Training courses in accounting and production practices are offered as the occasion demands, and literature on these subjects is made available.

The Small Enterprises Stabilization Law is enforced to regulate the activities of small enterprises in the interests of avoiding undue competition.

Thus, it is clear not only that small enterprises continue to be important to the Japanese economy but also that their importance is recognized by the Japanese government.

Sweden

Newly developing countries, particularly those with low population densities, would do well to investigate the economy of Sweden. The rate of increase of per capita income probably has been greater in Sweden over the last eight decades than in any other country. In 1956 per capita net national product was about $1,000. Like Switzerland and Japan, however, Sweden lacks the resources for a well-rounded, self-sufficient economy.

The Economy

Sweden is the third largest country in Western Europe, with a land area (160,000 square miles) about the same as that of Japan. As of January 1, 1956, 49 percent of the total population (7,290,112) was urban. According to the 1950 census, the total labor force (3,108,756) was distributed as follows: agriculture, 631,529; mining, 13,379; industry and handicraft, 1,253,942; transportation, 250,569; trade, 497,372; public administration and the free occupations, 344,531; domestic service, 90,250; and unspecified occupations, 27,184.

School attendance is compulsory, and illiteracy is virtually non-existent. Of the 904,422 children of school age (7 to 14 years) in 1953, over 85 percent (774,064) were attending school. In 1954 enrollment in high schools was 166,807, and university enrollment was 14,750.

Agriculture in Sweden is carried on chiefly by small family-owned farms. Of the 363,000 farm units reported in 1954, about 74 percent were of 25 acres or less. Owners of large farms of over 250 acres cultivated little more than 1 percent of the total arable land.

The forests cover 57.3 million acres, more than half of the land area of Sweden and are probably the nation's greatest single source of wealth. Ownership of the forests is divided as follows: private owners, 54 percent; corporations, about 25 percent; the state, 19 percent; and the church and other public bodies, about 3 percent.

Mining, chiefly iron ore extraction, is carried on in two widely separated regions. Iron ore deposits in central Sweden are estimated at about 220 million tons, and those in Lapland are estimated at over 2 billion tons and considered among the richest in the world. Most Swedish ores are rich in iron, those in central Sweden containing between 50 and 60 percent and those in Lapland containing between 60 and 70 percent. Approximately 18 million tons of iron ore were extracted in Sweden in 1955; of this amount 16 million tons were exported.

Sweden's main industries--lumber, pulp, and paper; iron and steel; machinery and shipbuilding; and chemicals--are all geared for export. The forest products, metalworking, machinery, and shipbuilding industries account for about three-fourths of all Swedish exports; the forest products industry alone supplies 41 percent of total exports.

In 1955 Swedish production of pig iron and steel ingots ran at average monthly rates of 100,000 and 177,000 tons, respectively. Annual tonnage figures for production of selected other commodities in 1954 were as follows: cement, 2.4 million; cotton yarn, 27,000; wool yarn, 15,000; staple fiber, 12,000; cotton piece goods, 25,000; sulfide wood pulp, 1.6 million; mechanical pulp, 800,000; lumber, 6.8 million (cubic meters); plywood, 24,000; wallboard, 368,000; paper board, 190,000; newsprint, 343,000; wrapping paper, 561,000; passenger cars, 44,716; trucks, 15,941; ball and roller bearings, 11,386; and matches, 19,600.

Sweden is among the few industrially advanced countries with no resources of high-grade solid fuel, and has concentrated on developing water power resources for the production of electricity. Electric energy output has expanded rapidly. In 1954, 22,302 million out of 23,701 million kilowatt-hours were produced by water power. Industry used 13,631 million kilowatt-hours, or about 65 percent.

Sweden has an extensive rail network, about 80 percent being state-owned. The total trackage in 1954 was 9,992 miles, of which 4,099 were electrified. Sweden has a well developed system of roads and highways, and has given considerable attention since the war to improving and expanding both primary and secondary roads. The total network of roads and highways extends over 56,000 miles. At the end of 1954, vehicle registrations totaled 535,851 for passenger automobiles, 8,364 for buses, 108,100 for trucks, and 313,805 for motorcycles.

Sweden's merchant fleet plays an important part in carrying goods in foreign trade and in earning foreign exchange. On January 1, 1956 it consisted of 1,794 vessels totaling 2,811,958 gross tons; 881 of this number were motor ships totaling 2,252,590 gross tons.

Swedish imports, while covering a wide range of commodities, consist mainly of raw materials and fuel necessary for the country's agriculture and industries. Exports, though fairly diversified, are composed mostly of a few major classes of goods (wood pulp, paper, wood products, iron ore, and iron and steel).

The Scale of Manufacturing[9/]

Using data from the Statistical Abstract of Sweden for 1956, Stanford Research Institute has prepared a table of information on 94 Swedish industries, giving the average number of employees per plant, horsepower per wage earner, value added per wage earner, and salaried employees as a percent of all employees. This information appears as Appendix G.

9/ Because of the statistical source, this discussion will include references to a few nonmanufacturing industries.

Unfortunately, the Statistical Abstract does not include information on a large number of small businesses. More complete data are available only in the Swedish census. On the basis of limited information, however, a striking similarity appears between those industries in Sweden and in the United States which have a high average number of employees per plant. Table VI-9 lists the 24 Swedish industries having an average of more than 100 employees per plant. Fifty-two industries, it may be noted, have an average of less than 50 employees per plant.

The Swedish statistics show a significant correlation between the average number of employees per plant and the horsepower per wage earner. Of the 14 industries having 20 or more horsepower per wage earner, 10 have an average of 100 or more employees per plant. This tends to corroborate the conclusion that the cost of capital per unit of output is greater for large plants than for small ones.

Interesting correlations may also be observed between value added per wage earner on the one hand and horsepower per wage earner and salaried employees as a percent of all employees on the other hand. Half of those industries having a high value added per wage earner (over 30,000 crowns) have a large amount of horsepower per worker (over 20). In all but two (alcohol and tobacco) of the industries having a high value added per wage earner, salaried workers are a large percentage (over 25 percent) of all employees. This suggests that output per wage earner is generally great in only those industries requiring either a relatively great amount of capital or a relatively large number of skilled and/or managerial employees.

Contrasts and Similarities: Switzerland, Japan, and Sweden

Switzerland is a small country, lacking in most natural resources and having a high population density. Her high per capita income depends upon foreign trade and the production of those manufactured goods which require highly skilled labor and/or specialized equipment. In many respects, Japan is similar to Switzerland, although Japan is considerably larger in size, has an even higher population density, and tends to specialize in the production of goods which are particularly labor intensive. Sweden, which is only slightly larger than Japan, has an abundance of certain resources and is almost totally lacking in others. Sweden has a relatively low population density and depends substantially upon exports of a few primary products and the manufactured goods derived therefrom. In Sweden as in Switzerland, manufacturing is characterized by goods requiring highly skilled labor and modern equipment, although the Swedish economy is less dependent upon manufacturing than is the Swiss economy.

Data on these countries illustrate the fact that the industrial structure of a society depends upon those factors which are peculiar to it. At the same time they show similarities in the development of industrially advanced countries. All have good programs of education, good

transportation and communications networks, well developed systems of banking and finance, stable governments, and so on.

They are also similar, though not identical, in the scales of their manufacturing industries. Those industries which are characteristically large scale in one country are likely to be, though not inevitably, characteristically large scale in another. In all, there are relatively few large-scale industries. Those which are large scale depend substantially, moreover, upon export markets and are inextricably interrelated with the small establishments and small-scale industries of the country. Furthermore, the large-scale industries are generally, though not always, more capital intensive than the small-scale industries.

In these respects these countries are similar to the United States. Indeed, for our purposes they differ from the United States mainly in not having as much industrial variety and being more dependent upon foreign trade. These differences are clearly related to resource endowments and domestic markets.

Australia

Before we attempt to apply these findings to newly developing countries, however, it is desirable that we investigate two countries (Australia and the Soviet Union) whose land areas are as great as or greater than that of the United States.

The Economy

Australia has a land area of nearly 3 million square miles (twenty times that of Japan), although it has a population of only about 9 million (one-tenth that of Japan). On the average for the whole of Australia, there are less than three persons per square mile, although large areas of central Australia are uninhabitable, and nearly 70 percent of the population may be found in urban areas.

As recently as 1850 the population of Australia was less than 500,000. Since World War II the natural increase in population has been between 100,000 and 125,000 per year. Net permanent immigration has fluctuated from a low of 12,000 in 1947 to a high of 153,000 in 1950. Over the last 50 years the population of Australia has been increasing at a rate of about 17 percent per decade.

Over the last 50 years the per capita income of Australia has been increasing at a per decade rate of just under 10 percent. 10/ By 1956 it had reached an annual level of about $1,000.

10/ See Kuznets, op. cit., p. 10.

In 1947 the 3 million workers in Australia were employed in the following main lines of production: primary production, 17 percent; manufacturing, 26 percent; building and construction, 7 percent; transport and communication, 9 percent; finance and commerce, 15 percent; public and professional, 11 percent; and entertainment, service, and other, 15 percent. The industrial output of Australia is almost evenly divided between factories on the one hand and rural production and mining and other primary industries on the other hand.

Education is free and compulsory. There are nine universities and one university college in Australia.

The Australian railway system comprises about 27,000 route miles. There were nearly 2 million motor vehicles registered in Australia in 1954, including about 150,000 motorcycles and nearly 600,000 commercial vehicles. In addition some 50,000 tractors were used on farms, in factories, and on construction work. Roads available for general traffic totaled some 500,000 miles.

Wool is Australia's greatest primary industry. With an annual clip of more than 1 billion pounds, Australia produces 27 percent of the world's wool and 57 percent of its Merino wool. The continent also is one of the world's largest wheat producers (167 million bushels in 1954), and exports about one-third of this product. Other important primary industries are sugar, wine, fruit, vegetables, grain, and minerals including uranium, gold, coal, copper, iron, silver, tin, and zinc.

Principal manufactures include iron and steel, textiles, electrical and radio equipment, drugs, chemicals, paints, machinery, metalwork, clothing, motorcars and engines, and aircraft and ships.

The expansion of manufacturing industries has been particularly rapid since 1938-39. Between 1938-39 and 1951-52 the value of manufacturing production increased 403 percent while Australia's national income increased 316 percent; average factory employment increased 73 percent while total population rose 23 percent. The total rated horsepower of engines and motors installed increased from about 1.7 million in 1938-39 to 3.9 million in 1951-52, and horsepower per worker increased from 3.0 to 4.0.

More than one-fifth of Australia's national income accrues from exports which amounted to 850 million Australian pounds sterling in 1952-53. In 1950-51, wool earned 633 million Australian pounds sterling and constituted two-thirds of total exports. Exports of basic metals, especially lead, are considerable items. When other items such as sugar, fruit, and hides are included, practically all exports are accounted for by nonindustrial commodities. However, Australia is

developing exports of processed and manufactured goods derived from her own primary products.[11] These items are going to limited markets, especially in the near Asian and Pacific countries, including New Zealand.

The Scale of Manufacturing[12]

From information appearing in Secondary Industries, 1953-1954, the Australian census of production, Stanford Research Institute has compiled Appendix H which gives some indication of plant size for 163 Australian industries. Ninety-one, or well over half, of Australia's secondary industries had a representative plant size of small. (For reasons explained in Appendix H it is not possible to compute representative plant size for the remaining 72 industries.) As shown in Table VI-10, only 25 had an average number of employees per plant exceeding 100. Only 6 (nonferrous metals, railway car construction, glass bottles, papermaking, iron and steel, and shipbuilding) had an average of more than 300 employees per plant.

Of all plants producing secondary products, 96.9 percent had fewer than 100 employees. In 140 of the 163 industries at least 75 percent of the plants had fewer than 100 employees. Of all employees in secondary industries, over 50 percent worked in plants having fewer than 100 employees. In 108 of the 163 industries at least 50 percent of the employees worked in plants having fewer than 100 employees.

The pattern of plant size in Australia is somewhat different from that in Switzerland, Japan, and Sweden in that the industries which are characterized by relatively large plants are not as predominantly oriented toward export markets. As has been mentioned, Australia's exports are mostly primary products.

At the same time, the industries which are characteristically large scale in Australia are characteristically large scale in other industrially advanced countries. Moreover, since there are relatively few plants in these industries in Australia, it may be presumed that their coefficients of localization are high. Their contribution to national income is, in any event, relatively small.

11/ In 1952-53 Australian exports included the following manufactured goods: machines, A£7.5 million; chemicals and fertilizers, A£ 5 million; arms, ammunition, and explosives, A£6 million; paper, A£2 million; manufactured fibers, textiles, and apparel, A£4 million; and optical and similar instruments, A£1.3 million. The total value of Australia's merchandise exports in 1952-53 was A£850 million.

12/ Because of the statistical source, this discussion will include references to a few nonmanufacturing industries.

The Soviet Union

All of the industrially advanced countries we have examined thus far are similar to the United States in that their political and economic systems are characterized by individual freedom. Individuals are at liberty to elect the people who shall govern them. They are at liberty to work where, when, and for whom (including themselves) they please. They may spend or save their money incomes as they choose. And they may purchase or not purchase, as they prefer, whatever goods are available.

Prices, costs, and incomes, the allocation of resources, the division of production between producers' goods and consumers' goods--in short, the economic circumstances of society as a whole and of its individual members--are basically determined by the impersonal decisions of the market, that is, by millions of individual citizens acting freely in their capacities as producers and as consumers.

Any discussion of the scale of industry in industrially advanced countries other than the United States should include an investigation of the scale of industry in the Soviet Union, a country which has a different type of political and economic system. An investigation of the Soviet Union may also be instructive because this country is more similar to the United States in size and population than are the other industrially advanced nations so far considered.

In area, the Soviet Union is the largest country in the world. It is nearly three times as large as the United States. The population of the Soviet Union, now slightly over 200 million, is 20 percent greater than that of the United States, although per capita income is probably less than one-third as great.

Soviet economists assert that Soviet industry is characterized by the highest degree of concentration in the world. They claim that under centralized planning the Soviet economy has gone further than any other economy in taking advantage of the superior efficiency of large-scale plants. They further claim that this decision to concentrate on large-scale plants is one of the important explanations of the rapid economic growth of the Soviet--that, because of the efficiency of the large-scale plants which they have chosen to emphasize, capital investments and additions to the industrial labor force have resulted in the largest possible increments to the national output.

Available statistical data must first be examined to determine to what extent the Russians have really emphasized the construction of large-scale plants. Evidence may then be sought to determine what the Soviet experience has to offer regarding the economic rationality of emphasizing large-scale plants. To anticipate our conclusions: (1) Soviet industry has not been so strongly oriented in the direction of large-scale units as is commonly thought; and (2) the alleged advantages of emphasis on large-scale enterprises in the Soviet Union have not been

unequivocally demonstrated in practice. Indeed, it appears that the Soviet leaders have modified their earlier stand on large-scale enterprise and now favor a somewhat diminished emphasis on large-scale units as such.

The Statistical Picture

An interpretation of Soviet policy on plant size is difficult because of the limited amount of statistical material available. Detailed data of the type available for the United States have never been published for Soviet manufacturing. Most available information is in the form of distributions of industrial enterprises and industrial workers by size of plant, with the size of plant being measured in terms of labor force. Some information exists on distributions of plant size, with the size of classes defined in terms of the value of fixed assets or the value of output; but these are of little use as a basis for international comparisons since there is no way to translate the rubles of the Soviet distributions into, say, the dollars of the comparable United States figures. Furthermore, the data are usually in highly aggregated form and are given only for scattered years. Because of these limitations the following discussion will be restricted primarily to distributions of enterprises and of the work force among enterprises according to the number of workers. The available information of this type is summarized in Table VI-11, which gives the distribution of enterprises and workers for large-scale Soviet industry.

Several conclusions may be reached from a study of this table.

1. Even in the Soviet Union a large proportion of all large-scale enterprises are relatively small. In 1936, for example, 40.3 percent of all large-scale industrial enterprises in the Soviet Union employed less than 100 workers. Furthermore, the absolute number of such enterprises was quite large. Workers were distributed as follows:

Number of Workers per Enterprise	Number of Enterprises
1-50	2,894
51-100	3,743
101-500	6,672
501-1,000	1,542
1,001-3,000	1,166
3,001-5,000	243
Over 5,000	201

2. The large enterprises account for most of the workers in large-scale industry. In 1936 industrial enterprises employing more than 1,000 workers accounted for 62.9 percent of all workers in large-scale industry. Moreover, the very large enterprises, those with 10,000 or more, had 13.8 percent of all workers. In this respect there appears to be a striking contrast with the pattern of the other countries discussed in this manual.

3. A trend toward increasing concentration of industry between 1929 and 1936 when the Soviet Union was developing its policy of forced industrialization is apparent. The percentage of all workers employed in the smaller plants declined during this period, and the percentage employed in the larger plants increased. It should be noted, however, that this trend was most marked between 1929 and 1933, and that between 1933 and 1936 there was a decline in the percentage of workers in the largest plants. The average number of workers per plant was 357 in 1929. It grew to 373 in 1930, 469 in 1931, and 516 in 1933, but then declined to 473 in 1934, and 455 in 1936.

The statistics of Table VI-11 are the basis of the claims of Soviet economists that the Soviet Union has the largest-scale industry in the world. Closer examination of the Soviet figures indicates, however, that this impression of large-scale industry is largely illusory. It is primarily the result of certain definitional peculiarities of Soviet statistics. The Soviet data differ from the figures for other countries in both coverage and definition, and when these statistical differences are recognized and taken into account, it is clear that this contrast is an illusion. Five factors should be considered in evaluating Soviet statistical data.

1. Probably the most serious deficiency in the statistics cited is the exclusion of a large number of relatively small establishments. Intent on picturing their industry as the most advanced in the world, the Russians have frequently distorted their statistics to illustrate such claims. All of the figures in Table VI-11 relate to the Soviet concept of large-scale industry, which in general excludes all enterprises with less than 30 employees if no mechanical power is used. In 1933, for instance, there were 282,401 "small-scale" industrial enterprises (not included in Table VI-11) in which the average number of workers was slightly less than 4 per enterprise. These enterprises accounted for about 11 percent of all industrial employment and for about 8 percent of all industrial output.

Furthermore, a careful comparison of different statistical sources suggests that the distributions shown in Table VI-11 include only the enterprises in the main industrial ministries and exclude many enterprises which fit the Soviet definition of large scale but which are under the jurisdiction of other administrative organs. Thus it appears that, in 1933, there were some 25,000 "large-scale" industrial enterprises (not included in Table VI-11) in which the average number of workers was about 80 per enterprise.[13] These enterprises accounted for about 24.4 percent of all industrial employment and produced about 20 percent of all industrial output in 1933.

13/ The distribution given in Table VI-11 for 1933 covers 12,402 enterprises employing more than 5 million workers. These numbers are quite close to those which are given for the Union industrial commissariats and the republican industrial commissariats in the special census of industry made in 1933 (see TsUNKhU, Sotsialisticheskoe Stroitel'stvo, 1935, pp. 30-31). Census results show that these were only a fraction of all large-scale industrial enterprises.

These two peculiarities have been eliminated in one available distribution of plants and workers by number of workers per enterprise. This distribution is shown in Table VI-12. The origin of this data is the comprehensive census of industry of 1933. Hence, all industrial enterprises are included, whether large or small and whether in the main industrial ministries or not. It should also be noted that this table refers only to manufacturing. It presents a picture of far less concentration in large-scale plants than shown in Table VI-11. Indeed, on the basis of Table VI-12 it appears that the Soviet pattern of size of plant is not far different from the pattern for other industrially advanced countries.

It is unfortunate that 1933 is the only year for which such a comprehensive distribution of enterprises by size is available; it would be interesting to know whether a postwar distribution would show more or less concentration. The figures for the years after 1933 undoubtedly overstate the degree of concentration in Soviet manufacturing industry, but we do not know whether the exaggeration is as much as for 1933. It seems quite possible that the relative importance of the excluded enterprises has declined since 1933, but there is no statistical evidence to confirm this. It also seems significant that the most recent Soviet statistical handbook avoids disclosing any information which would indicate the relative importance of large-scale and small-scale industry or the relative importance of industrial enterprises outside the main industrial ministries. 14/

2. The figures of Table VI-11 refer to "industry," and in the Soviet sense industry is a broader category than the American concept of manufacturing. The principal difference is that the Soviet category includes electric power stations, mining enterprises, and forestry enterprises. Since the size of enterprises tends to be larger in these sectors than in manufacturing alone, the Soviet figures naturally indicate greater concentration than do the American figures. Unfortunately, the Russians have published little data referring to manufacturing alone, but it is possible to separate out manufacturing in the data for 1934. The degree of exaggeration resulting from the difference in concept may be judged by comparing the figures for the two definitions as is done in Table IV-13. The exclusion of nonmanufacturing enterprises greatly decreases the importance of large enterprises, especially at the upper end of the distribution. With nonmanufacturing industrial enterprises excluded, enterprises employing more than 5,000 workers accounted in 1934 for 17.4 percent of all workers as against 26.9 percent in the distribution for all "industry."

3. The apparent plant size differences between Soviet industry and industry in other countries may also be explained in part by differences in industrial structure. Because of differences in respective technologies, the producers' goods sector of any economy is generally characterized by larger plants than is the consumers' goods sector. In 1936, for example, the average number of workers per plant in the Soviet large-scale producers' goods industries was 554 whereas it was 341 in the large-scale consumers' goods industries. 15/ As a result of the heavy

14/ See TsSU Narodnoe Khoziaistvo SSSR, 1956, pp. 41-42.

15/ TsUNKhU, Trud v SSSR, 1936, p. 67. These figures reflect the same fairly restricted definition of industry as do those in Table VI-11. These averages are therefore far above those indicated by Table VI-12.

emphasis on investment in the Soviet economy, the producers' goods industries are relatively more important in the Soviet economy than in most other economies.[16] On the average, therefore, the Soviet Union would be expected to have relatively large plants even though in individual industries the size of plants might be the same as in other industrially advanced countries.

4. In interpreting the differences in plant size in the United States and the Soviet Union it must be remembered that the number of workers employed is an imperfect criterion for measuring plant size. Since labor productivity in Soviet industry is below that in American industry, a Soviet plant might be much larger than an American plant in number of workers employed and yet be considerably smaller than a comparable American plant in capacity or output. The importance of this quantitative difference is great. The most careful study made to date of comparative labor productivity in United States and Soviet industry concludes that output per worker in Soviet industry is probably of the order of 40 percent of the per-worker output in the United States.[17] This would imply that the Soviet size classes in terms of workers employed should be roughly cut in half in making any estimate of the relative size of plant in terms of output.

5. Finally, it should be mentioned in passing that the large size of many Soviet plants does not always imply specialization and large-scale technology. In many cases Soviet plants are large because of the agglomeration of many distinct functions in a single plant rather than because of the scale of any process requires such a large plant. This point will be discussed more fully below.

Postwar Changes in Size of Plant

Much less information is available on the size of Soviet plants for the postwar period than for the prewar period. The only data which

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16/ A comparison with the United States will illustrate this point. Soviet statisticians classify all industry into Group A (producing producers' goods) and Group B (producing consumers' goods). If we exclude from Group A mining enterprises and electric power stations, we have something very close to manufacturing industry engaged in producing producers' goods. In 1936 the number of employees in this sector was about 60 percent of employees in all manufacturing industry (see TsUNKhU, Trud v SSSR, 1936, pp. 64-67). It is of course an extremely complicated task to break down American manufacturing industry into the same classification as that used by Soviet statisticians, but a rough estimate based on the 1947 Census of Manufactures indicates that only about 43 percent of employment in United States manufacturing industry is in industry producing producers' goods.

17/ Walter Galenson, Labor Productivity in Soviet and American Industry, (New York: Columbia University Press, 1955), pp. 240, 247. The ratio of 40 percent is for the years 1937 to 1939.

have been published are two distributions--one for 1950 and one for 1954--of plants in large-scale "manufacturing industry." These are shown in Table VI-14 together with the comparable distributions for 1934. Two distinct trends are revealed by this comparison: both very large plants and quite small plants have been increasing in relative importance at the expense of plants in the middle of the distribution. It is not clear, however, whether the net result of these movements has been an increase or a decrease in the average number of employees per plant.

It is possible that these changes represent variations in definitions which are undisclosed by our sources. The peculiar size classes for which the postwar data are given and the rather abrupt shift in the distribution between 1950 and 1954 suggest some sort of statistical manipulation, but we are in no position to do anything but accept the figures at face value. Their implication is that the Russians have greatly increased the number of relatively small plants while continuing to build some very large plants.

It should be kept in mind that these figures are presumably comparable with those in Table VI-11--that is, they refer only to large-scale establishments in the main industrial ministries and exclude many large-scale enterprises in other jurisdictions as well as the thousands of small-scale enterprises which still exist. Since we have no way of knowing whether these excluded enterprises are relatively more or less important now than in the thirties or what has happened to their distribution by size, it is impossible to say with certainty whether there has actually been an increase or decrease in the scale of plants in Soviet manufacturing as a whole.

The Overemphasis on Giant Plants

It is important to ask whether the decision of the Soviet planners to emphasize large plants has been economically rational. Has Soviet experience shown that concentration of industry in large units is wise or unwise? This is an extremely complicated question, of course, and cannot be answered conclusively, but there is some evidence to suggest that the emphasis on large-scale plants has in some ways hindered rather than advanced Soviet industrialization.

As previously mentioned, it was official Soviet policy in the thirties to emphasize the construction of large-scale plants, and Table VI-11 indicates that the degree of concentration was indeed increasing during the first two Five Year Plans. By the late thirties, however, there was a sharp break in Soviet thinking on the advantages of large-scale plants. The previous infatuation with large-scale economies was labeled "gigantomania," and the planners were directed to give more attention to building smaller plants.

Articles began to appear pointing out the disadvantages of very large plants, and at the Eighteenth Party Congress in 1939, the switch to smaller plants was made a major theme in economic policy. One of the resolutions adopted at the Congress stated:

> . . . The Eighteenth Party Congress demands that the mania for building giant factories and works be resolutely combated and that a sweeping change be made in favor of building medium- and small-sized establishments in all branches of the national economy of the USSR. 18/

The discussion and explanation arising out of this reversal of policy followed three main lines of argument.

1. The principal difficulty seems to have been the effect on the transportation system. The very large-scale and highly specialized plants built in the thirties were so large that single plants served extremely large market areas. Consequently, the average length of haul for many important manufactured commodities increased during the first two Five Year Plans. The average length of haul for all railroad shipments had been 5^8 kilometers in 1928 but had risen by 1940 to 700 kilometers. 19/ Moreover, the volume of freight turnover rose much more rapidly than the volume of industrial output. This also suggests that the concentration of output in very large plants required a more than proportionate increase in transport costs. 20/

This big transport job required a greatly intensified utilization of the existing rail facilities, and the result was bottlenecks, the piling up of unshipped goods, crises in supply, and high transport costs. 21/ The regime was faced with the prospect of having to make new capital investments in enlargements of the rail network to keep industrial growth from being throttled. It was belatedly realized that the attempt to get lower costs in individual plants through increases in scale had actually resulted in higher costs from the national economic point of view. In the short run the economies of scale were more than offset by the costs arising from an overloaded transport system. The long-run

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18/ The Land of Socialism Today and Tomorrow, Reports and Speeches at The Eighteenth Congress of the Communist Party (Moscow: Foreign Languages Publishing House, 1939), p. 440. A fairly complete discussion of the change in policy may also be found in S. S. Balzak, V. F. Vasyutin, and Ia. G. Feigin, editors, Economic Geography of the USSR (New York: Macmillan Company, 1949), pp. 160-166.

19/ James H. Blackman, "Transportation," in Abram Bergson, editor, Soviet Economic Growth (Evanston, Ill.: Row, Peterson & Co., 1953), p. 136.

20/ Ibid., p. 133.

21/ For a discussion of the crisis in transportation, see Harry Schwartz, Russia's Soviet Economy (New York: Prentice-Hall, 1954), pp. 395-396.

solution of the problem would involve a diversion of capital investment to transport and would thus diminish the amount of resources available for investment in industrial expansion.

It should be pointed out that these difficulties arose not only because of the overemphasis on large plants as such but also because of the attempts to use highly specialized, large-scale techniques within the plants. Thus, in the iron and steel industry specialized plants were designed to produce only limited ranges of products (i.e., certain profiles of rolled shapes, certain kinds of pipe, etc.). As a result, there was considerable crosshauling between economic regions.

Prompted by the increasing burden on the rail network, Soviet economists made a number of investigations which revealed the disadvantages of overly large plants, and the planners were specifically instructed to busy themselves with the task of designing smaller plants. In place of a few large plants serving very large markets there was to be a number of considerably smaller enterprises intended to serve local and regional markets. Since we have no statistics for the subsequent decade, it is difficult to know whether this shift in the official directives actually resulted in much of a decline in average plant size. However, the data for 1950 and 1954 given in Table VI-14 suggest that there may well have been some shift to smaller plants after 1938.

2. The overemphasis on large plants was also criticized because it tended to lengthen the "period of gestation" of Soviet investment projects. The giant plants which the Russians were designing took a long time to construct, equip, and put into operation. It was suggested that this uneconomic tying up of resources could be avoided by concentrating on smaller enterprises.

3. Finally, once it was decided to condemn "gigantomania," it was admitted that the technological advantages of very large plants might be offset by the managerial difficulties involved. As a principal Soviet authority on management commented:[22/]

> The decisions of the Eighteenth Party Congress, which condemned the tendency to build giant enterprises and extremely complex combines are of great importance also in the sphere of strengthening administrative work in production. The building of medium and small enterprises, among other things, assures the liquidation of many links in enterprise administration. It facilitates administrative work, and assures an opportunity for operational and concrete management of all units of the enterprise.

22/ A. Arakelian, Industrial Management in the USSR (Washington, D.C.: Public Affairs Press, 1950), p. 123.

Still another reason for doubting that the large size of Soviet industrial plants implies economic efficiency emerges when we investigate why there are so many large enterprises. Careful studies of Soviet industrial management and Soviet industrial enterprise have emphasized that one of the important differences between Soviet and American industry is that Soviet plants are often comparatively unspecialized and embrace many technically distinct functions under one roof.[23] The plants are large not because any particular process requires large-scale production but because of the agglomeration of many separate functions in a single plant. For example, most Soviet metalworking plants have their own foundries and make their own forgings and stampings, their own bolts and fasteners, and their own containers. Similarly, the Soviet plant is less likely to get semifabricates and subassemblies from specialized suppliers; instead, it carries on the whole range of subprocesses under its own roof. The size of the plant may be further swelled by a large warehousing and procurement staff, its own transport department, and a very large repair shop. (Moreover, one of the reasons the repair shop of a Soviet plant is so large is that it produces all of its own replacement parts rather than ordering them from the original supplier of the equipment.) These and many other such functions which would be carried on by separate specialized American enterprises are performed within one Soviet industrial enterprise. In other words, in many cases the very large number of workers in Soviet enterprises by no means implies specialization and large-scale technology but rather the absence of it.

In most cases such agglomeration is not economically justifiable. The several functions could be better and more economically performed in specialized enterprises rather than in each plant. The Soviet economic literature is full of illustrative cases showing the high cost of these processes when carried on as subordinate activities, and this peculiarity of Soviet industry is explained not by its rationality but rather by the rigidities of a bureaucratically planned economy. The Soviet system has never been able to achieve adequate interbranch cooperation; the supply system is disorganized; suppliers are motivated by parochial goals to meet their own general output goals rather than to serve the needs of their customers; and the plant managers have never been able to depend on getting needed services or goods from other plants. Consequently, plant managers and their superiors in the ministries have sought safety by making their plants as nearly self-sufficient as possible. Self-sufficiency enables them to meet their output goals without having to rely on others, but it does not result in lowest possible costs of production. The very large size of many Soviet plants thus represents a

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23/ See, for instance, David Granick, Management of the Industrial Firm in the USSR (New York: Columbia University Press, 1953); and Joseph Bevliner, The Soviet Business Enterprise (mimeographed), Harvard University, Russian Research Center.

production cost of the Soviet type of economic system and should not be interpreted as the most rational way of organizing industrial production in economies not subject to the Soviet rigidities.

Corroboration of the economic irrationality of such a lack of specialization is found in recent Soviet pronouncements on economic policy. The post-Stalin leadership has been interested in rationalizing all aspects of Soviet industry, and one of the objectives stressed is to get these processes into specialized plants. There have been resolutions to separate repair; to set up specialized foundries, casting shops, and forging shops; and in general to increase the specialization and interdependence of enterprises. 24/ If this change is actually carried through, we can expect that there will be more smaller plants, fewer giant ones, and a decrease in the average size of plants.

24/ See, for instance, the Decree of the Central Committee of the Communist Party of the Soviet Union of July 11, 1955.

Table VI-1

NUMBER OF ENTERPRISES AND EMPLOYEES BY BRANCH OF INDUSTRY, SWITZERLAND 1954

Branch of Industry	Number of Enterprises	Number of Employees
Food and tobacco	780	35,992
Textiles	1,028	69,384
Clothing	1,427	55,762
Wood	1,832	37,610
Paper	207	15,006
Leather and rubber	210	6,706
Graphic arts	772	25,723
Chemicals	380	25,771
Stone and earth	438	19,323
Metalwork	1,226	64,187
Machines, apparatus, and instruments	1,774	141,118
Watches and jewelry	1,191	53,967
Musical instruments	49	2,085
Electricity, gas, and water	331	5,098
Brushes, canes, umbrellas, and similar goods	205	6,579

Source: "Basic Data on the Economy of Switzerland," Economic Reports, Part 1, No. 56-9, U.S. Department of Commerce, p. 3.

Table VI-2

INDUSTRIES AVERAGING 100 OR MORE EMPLOYEES PER PLANT, SWITZERLAND 1949

Industry	Average Number of Employees per Plant
Textile finishing	101.7
Spinning	105.9
Bed and table linen	109.0
Artificial silk	110.1
Radio and phonograph apparatus	112.5
Spinning, twisting	115.3
Sheet metal, metal powder	115.1
Airplanes	120.0
Wool finishing	120.3
Machine construction	128.6
Linoleum	129.3
Electrochemical products	132.4
Independent iron foundries	134.8
Chocolate, cocoa	142.2
Wood material, Cellulose	157.4
Glass making	162.9
Silk waste	188.1
Synthetic wool manufacturing	191.0
Net weaving	199.0
Combined equipment finishing	205.7
Manufacture of Celluloid	228.0
Copper, brass works	233.8
Cables	246.8
Railroad train cars	287.7
Aluminum manufacturing	317.5
Aluminum rolling works	320.7
Iron, steel, rolling works	412.1
Weapons, munitions	458.2
Coal tar dyes	522.1
Artificial silk manufacturing	752.0

Source: Compiled by Stanford Research Institute from Appendix E.

Table VI-3

POPULATION, NATIONAL INCOME, AND NATIONAL INCOME PER CAPITA, JAPAN 1878-1954

Intervals		Percentage Change per Decade		
Initial Decade	Terminal Decade	Population	National Income 1/	National Income per Capita 1/
1878-87	1888-97	10.8	55.6	40.9
1883-92	1893-1902	10.2	64.8	49.2
1888-97	1898-1907	11.9	50.6	34.5
1893-1902	1903-12	12.9	34.7	19.2
1898-1907	1908-17	13.2	38.1	21.8
1903-12	1913-22	12.9	45.3	28.7
1908-17	1918-27	11.1	56.0	40.3
1913-22	1923-32	12.0	67.4	49.6
1918-27	1928-37	14.5	65.0	44.0
1923-32	1933-42	13.4	52.1	34.1
1928-37	1938-47	9.9	15.3	5.0
1933-42	1950-54	14.7	10.6	-3.6

1/ 1928-32 prices.

Source: Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations," Economic Development and Cultural Change, V (October 1956) p. 91.

Table VI-4

POPULATION, NATIONAL PRODUCT, AND NATIONAL PRODUCT PER CAPITA, CONSTANT PRICES, 11 COUNTRIES
Selected Periods, 1860-1954

Country	Interval		Percentage Change		
	Initial Period	Terminal Period	Population	National Product	National Product per Capita
United Kingdom	1860-69	1949-53	8.0	21.5	12.5
Ireland and Eire	1860-69	1949-53	-3.5	12.8	16.8
France	1841-50	1949-53	1.3	15.3	13.8
Germany	1860-69	1950-54	10.1	27.4	15.1
Denmark	1870-78	1950-54	11.5	30.1	16.7
Sweden	1861-68	1950-54	6.6	36.0	27.6
Italy	1862-68	1950-54	6.9	18.0	10.4
Russia and U.S.S.R.	1870	1954	13.4	31.0	15.4
United States	1869-78	1950-54	17.4	41.2	20.3
Canada	1870-79	1950-54	18.3	41.3	19.3
Japan	1878-87	1950-54	12.7	42.3	26.3

Source: Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations," Economic Development and Cultural Change, V (October 1956), p. 13.

Table VI-5

AVERAGE ANNUAL INCREASE IN MANUFACTURING PRODUCTION, JAPAN
1895-1938
(1910-13 = 100)

Period	Textiles	Metals and Machinery	Chemicals and Ceramics	Wood Products	Food Products	Electricity and Gas	Others	All Manufacturing
1895-99	41	25	n.a.	n.a.	80	n.a.	49	-37
1900-04	50	33	n.a.	56	88	10	90	-48
1905-09	70	61	53	91	85	27	126	69
1910-14	100	100	100	100	100	100	100	100
1915-19	152	162	186	142	123	198	248	160
1920-24	185	244	252	441	170	356	190	217
1925-29	270	355	453	570	193	653	260	313
1930-34	352	410	643	601	186	1,002	n.a.	377
1935-38	416	920	1,255	1,018	190	1,517	n.a.	600

n.a. = not available.

Source: William W. Lockwood, The Economic Development of Japan, p. 115.

Table VI-6

DISTRIBUTION OF EMPLOYMENT, MOTIVE CAPACITY, AND PRODUCTION, PRIVATE FACTORIES, JAPAN[1]
1919 and 1934

Size Class (number of workers)	Percentage Distribution: Factories 1919	Factories 1934	Operatives 1919	Operatives 1934	Motive Capacity (horsepower) 1934	Gross Value of Output 1934
All private factory industries	100.0	100.0	100.0	100.0	100.0	100.0
5-9	45.8	56.5	8.5	11.8	14.2	6.9
10-99	49.1	39.7	35.9	36.9	46.2	29.8
100-499	4.3	3.1	23.5	22.0	39.6	25.1
500 or more	0.8	0.7	32.1	29.3		38.2
Textile industries	100.0	100.0	100.0	100.0	100.0	100.0
5-9	38.2	47.4	5.4	7.2	3.7	4.5
10-99	54.4	45.8	31.8	31.8	15.7	23.9
100-499	6.0	5.4	24.4	26.4	80.6	20.3
500 or more	1.4	1.4	38.4	34.7		51.2
Metallurgical industries	100.0	100.0	100.0	100.0	100.0	100.0
5-9	49.0	51.5	11.0	10.6	1.3	3.3
10-99	46.7	45.7	37.7	39.7	9.0	22.0
100-499	3.6	2.2	22.6	16.2	89.7	17.0
500 or more	0.7	0.6	28.7	33.5		57.8

1/ Establishments employing fewer than five operatives are excluded.

Source: William W. Lockwood, The Economic Development of Japan, p. 202.

Table VI-7

PERCENTAGE DISTRIBUTION OF INDUSTRIAL EMPLOYMENT, JAPAN
Selected Years, 1930-1942

Year	Total Employment	Size Class (number of workers)							
		1-4	5-9	10-29	30-49	50-199	200-499	500-999	1,000 or more
		Plants with Five or More Workers 1/							
1930	1,683,563		11.5	15.4	7.9	21.9	14.2	11.2	17.9
1932	1,733,511		12.1	16.3	8.5	21.3	13.3	11.0	17.5
1934	2,163,453		11.8	16.3	8.8	20.9	12.0	10.6	18.6
1936	2,592,687		10.2	17.6	9.4	19.7	12.1	9.9	21.1
1938	3,217,715		10.1	16.1	8.6	17.7	11.7	9.4	26.5
1939	3,786,247		11.6	18.1	8.4	16.6	10.9	8.8	25.6
		All Plants 2/							
1939	4,950,881	23.5	8.9	13.8	6.4	12.8	8.3	6.7	19.6
1940	4,986,930	22.9	9.1	13.5	6.1	12.7	8.1	7.0	20.6
1941	4,943,319	23.4	9.1	13.7	5.8	12.4	7.8	6.3	21.5
1942	5,061,888	22.5	7.7	12.8	5.5	11.5	8.0	6.2	25.8

1/ Operatives only are included.
2/ Family workers and self-employed persons as well as operatives are included in the 1-4 size class; all other size classes include operatives only.

Sources: Edwin Reubens, "Small-Scale Industry in Japan," Quarterly Journal of Economics, LXI (August 1947), p. 587. The 1930-1938 data were derived from Factory Statistics; the 1939-1942 data, from Industrial Statistics, Ministry of Commerce and Industry, Tokyo.

Table VI-8

INDICATORS OF PLANT SIZE, 19 MAJOR BRANCHES OF MANUFACTURING, JAPAN[1/]
1953

Branch of Industry	Average Number of Employees per Plant	Representative Plant Size	Total Number of Plants	Total Number of Employees	Total Value of Shipments (millions of yen)	Value of Shipments per Plant (millions of yen)	Value of Shipments per Employee (thousands) of yen)
Furniture and fixtures	13.1	small	6,771	88,497	41,944	6.2	473.9
Lumber and wood products	13.2	small	22,829	300,450	223,774	9.8	744.8
Food and kindred products	15.7	small	29,074	456,183	843,196	29.0	1,848.4
Leather and leather products	18.5	small	1,418	26,221	32,651	23.0	1,245.2
Miscellaneous industries	18.8	small	6,505	122,464	77,029	11.8	628.9
Apparel and other fabricated textile products	19.0	small	6,083	115,576	83,679	13.7	724.0
Fabricated metal products	20.1	small	10,706	214,710	195,140	18.2	908.9
Stone, clay, and glass products	21.5	small	11,050	237,123	193,179	17.5	814.7
Printing, publishing, and allied industries	27.3	bias-smaller	7,395	202,151	183,101	24.8	905.8
Textile mill products	30.1	none	32,005	962,680	1,040,630	32.5	1,080.9
Machinery	32.2	bias-smaller	11,584	373,492	293,354	25.3	785.4
Medical and scientific instruments, photographic and optical instruments, watches and clocks	32.9	bias-smaller	2,081	68,557	45,975	22.1	670.6
Paper and allied products	33.8	none	4,218	142,442	237,649	56.3	1,668.4
Petroleum and coal products	38.3	none	716	27,402	106,829	149.2	3,898.6
Electrical machinery, equipment and supplies	55.7	none	4,055	225,705	238,843	58.9	1,058.2
Chemical and related industries	65.3	largish	5,277	344,716	591,534	112.1	1,716.0
Transport equipment	66.1	largish	4,624	305,638	359,832	77.8	1,177.3
Primary metal industries	70.5	largish	5,418	381,826	838,695	154.8	2,196.5
Rubber products	89.2	none	804	71,741	81,485	101.3	1,135.8

1/ Excludes establishments with less than four workers.

Source: Compiled by Stanford Research Institute from Appendix F.

Table VI-9

BRANCHES OF INDUSTRY AVERAGING 100 OR MORE EMPLOYEES PER PLANT, SWEDEN 1956

Branch of Industry	Average Number of Employees per Plant	Horsepower per Wage Earner
Mining other than iron ore	103	31.7
Iron ore mining	154	20.3
Electrical apparatus and machinery	158	5.3
Shipyards	221	7.0
Metal works other than steel	311	30.3
Iron and steel works and iron alloy	724	24.2
China, earthenware, porcelain and china tiles	198	3.6
Cement	253	51.0
Hardboard	167	33.1
Paper and cardboard	312	30.8
Chemical pulp (Celluloid)	358	30.7
Sugar refining	150	40.6
Tobacco	218	2.3
Woolen industries	140	5.0
Twine and cardage	201	6.7
Cotton and rayon processing	218	6.3
Linen	239	3.4
Synthetic fibers (e.g., rayon)	607	11.5
Rubber products	276	9.1
Pharmaceuticals	107	8.1
Basic chemicals	137	19.1
Safety matches manufacturing	223	3.3
Explosives	321	7.1
Oil--petroleum refining, shale production	574	22.9

Source: Compiled by Stanford Research Institute from Appendix G.

Table VI-10

INDUSTRIES AVERAGING 100 OR MORE EMPLOYEES PER PLANT, AUSTRALIA 1953-1954

Industry	Average Number of Employees per Plant
Extracting and refining of alloys, etc.	111.7
Rubber goods (including tires made)	126.8
Tobacco, cigars, cigarettes, snuff	132.1
Electric light and power, government	137.8
Wool carding, spinning, weaving	138.5
Asbestos cement sheets and moldings	144.6
Government gas works	151.6
Matches	159.8
Rayon, nylon, and other snythetic fibers	161.3
Pipes, tubes, and fittings, ferrous	185.3
Breweries	199.8
Printing, government	201.0
Cement, Portland	212.2
Motor vehicles and cycles, construction and assembly	225.5
Coke works	227.6
Aircraft	233.0
Arms, ammunition (excluding explosives)	249.2
Explosives (including fireworks)	259.7
Construction, repair of vehicles, tramcars, and railway rolling stock, other than government and municipal	260.0
Nonferrous metals, rolling and extrusion	312.0
Construction, repair of vehicles, tramcars and railway rolling stock, government and municipal	316.6
Glass bottles	356.2
Papermaking	402.0
Smelting, converting, refining, rolling iron and steel	506.9
Ship and boat building and repair, marine engineering, government	536.6

Source: Compiled by Stanford Research Institute from Appendix H.

Table VI-11

DISTRIBUTION OF ENTERPRISES AND WORKERS IN LARGE-SCALE INDUSTRY, SOVIET UNION[1]
Selected Years, 1929-1936

Number of Workers per Enterprise	1929	1930	1931	1933	1934	1936
		Percent of All Enterprises				
1-50	2.5	5.9	4.5	1.1	1.3	1.2
51-100	3.9			3.0	3.3	3.6
101-500	17.7	18.3	17.4	17.1	19.0	18.7
501-1,000	13.6	13.1	14.1	13.0	12.7	13.6
1,001-3,000	22.9	25.1	27.5	24.4	24.8	25.4
3,001-5,000	11.2	11.2	10.7	11.1	11.7	11.6
Over 5,000	28.2	26.5	27.8	30.3	26.9	25.9[2]
		Percent of All Workers				
1-50	32.3	50.0	43.1	18.3	18.5	17.6
51-100	21.1			21.0	21.3	22.7
101-500	31.3	34.2	37.2	39.8	41.0	40.5
501-1,000	7.9	7.8	9.7	9.9	9.1	9.4
1,001-3,000	5.2	5.9	7.2	7.8	7.3	7.1
3,001-5,000	1.1	1.1	1.4	1.6	1.5	1.5
Over 5,000	1.1	1.1	1.4	1.6	1.3	1.2[3]

1/ Figures in this table cover mining, forestry, and electric power stations in addition to manufacturing industry. "Large-scale industry" is defined by Soviet sources as including all enterprises with more than 16 workers if mechanical power is employed, and with more than 30 workers if it is not. As will be explained subsequently, there are actually many "large-scale" enterprises excluded from the present table.

2/ Of this, 13.8 percent is made up of enterprises employing more than 10,000 workers.

3/ Of this, 0.4 percent is made up of enterprises employing more than 10,000 workers.

Sources:
1929: TsUNKhU, Sotsialisticheskoe Stroitel'stvo, 1935, p. 496.
1930 and 1931: TsUNKhU, Narodnoe Khoziaistvo SSSR, 1932, p. 430.
1933: TsUNKhU, Sotsialisticheskoe Stroitel'stvo, 1934, pp. 334-335.
1934: TsUNKhU, Trud v SSSR, 1934, pp. 118-119.
1936: TsUNKhU, Trud v SSSR, 1936, p. 73.

Table VI-12

DISTRIBUTION OF ENTERPRISES AND WORKERS
IN MANUFACTURING, SOVIET UNION
1933

Size Class (number of workers)	Percent of All Enterprises	Percent of All Workers	Capacity of Motors Serving Working Machines (kilowatts)
1-5	71.2	5.4	51,212
6-15	11.6	2.9	79,650
16-29	5.1	2.8	79,674
30-50	3.7	3.7	102,423
51-100	3.5	6.7	216,227
101-250	2.8	11.8	409,692
251-500	1.0	10.7	448,714
501-1,000	0.6	12.6	642,989
1,001-2,000	0.3	12.5	751,103
2,001-5,000	0.2	15.6	1,024,322
5,001-10,000	0.0	7.5	768,173
Over 10,000	0.0	7.8	1,109,893

Source: TsUNKhU, Sotsialisticheskoe Stroitel'stvo, pp. 42-43.

Table VI-13

DISTRIBUTION OF WORKERS IN ALL LARGE-SCALE INDUSTRY AND IN LARGE-SCALE MANUFACTURING INDUSTRY, SOVIET UNION 1934

Size Class (number of workers)	Percent of All Industry	Percent of Manufacturing Industry
1-50	1.3	1.5
51-100	3.3	3.9
101-500	19.0	22.3
501-1,000	12.7	15.2
1,001-3,000	24.8	26.9
3,001-5,000	11.7	12.8
Over 5,000	26.9	17.4

Source: TsUNKhU, Trud v SSSR, 1934, pp. 116-119.

Table VI-14

DISTRIBUTION OF WORKERS AND ENTERPRISES IN LARGE-SCALE MANUFACTURING, SOVIET UNION 1934, 1950, 1954

Size Class (number of workers)	Percent of All Workers			Percent of All Enterprises		
	1934	1950	1954	1934	1950	1954
1-50	1.5			18.3		
51-100	3.9			22.0		
101-500	22.3	30.4 1/	27.6 1/	41.4	91.1 1/	89.4 1/
501-1,000	15.2	13.1	12.1	9.0	4.4	5.0
1,001-3,000	26.9	23.6	24.0	6.8	3.3	4.0
3,001-5,000	12.8			1.4		
5,001-10,000	17.4 2/	22.0 3/	22.6 3/	1.1 2/	1.0 3/	1.3 3/
Over 10,000		10.9	13.7		0.2	0.3

1/ Up to 500.
2/ Over 5,000.
3/ 3,001-10,000.

Source: 1934: Table II.
1950 and 1954: TsSu, Narodnoe Khoziaistvo, SSSR, 1956, p. 42.

Chapter VII

THE ROLE OF SMALL-SCALE INDUSTRY IN NEWLY DEVELOPING COUNTRIES

Background

The available statistics on the scale of manufacturing industries in the United States have now been examined in considerable detail. Available statistics on plant size in Switzerland, Japan, Sweden, Australia, and the Soviet Union have also been examined, but in less detail. While additional research in this field is clearly required, it is now possible to offer some tentative generalizations and then to relate these observations to the economic circumstances of newly developing countries.

A Summary of Preceding Chapters

Chapter III was devoted primarily to a definition of such terms as representative plant size and coefficient of localization. It was also suggested in Chapter III that although the engineering efficiency of a plant may be expected to increase up to a point with increasing size, economic efficiency depends upon the size of the market and upon the costs (both absolute and relative) of the factors of production. Thus, the appropriateness of a given plant size may vary considerably from product to product. It may even vary from country to country although, as Professor Florence has shown, there is a high degree of correspondence between British and American industries in representative plant size, coefficients of localization, and rank by horsepower per employee.

In Chapter IV it was shown that small plants coexist with large plants in most of the manufacturing industries of the United States. In relatively few industries are large plants predominant or representative. Even in these few industries, moreover, plants are not large relative to the total market for the particular product, let alone to the total market for all products.

It was also shown in Chapter IV that in the United States small plants and large plants are complementary in the sense that they are dependent upon each other for supplies and for markets. If it were not for the small plants, the large plants either could not exist or would have to be more completely integrated and, hence, even larger than they are.

Although there are so many exceptions that the generalizations must be interpreted with care, it also appears that large plants, as compared with smaller plants, (1) tend to require relatively greater

inputs of capital and relatively smaller inputs of labor and (2) tend to employ a higher percentage of nonproduction workers. Moreover, large-scale industries tend to have higher coefficients of localization than smaller-scale industries.

In Chapter V the economic development of the United States was summarized, the primary purposes being to show that large plants have developed in the United States (1) only over considerable periods of time, (2) in response to expanding markets, and (3) together with a balanced industrial complex. The experience of the United States does not support the notion that an initial undertaking in any industry should be large scale or should be unrelated to the market, to resources, or to other plants or industries.

Chapter VI described the economy and the scale of manufacturing of various other industrially advanced countries. It was shown (1) that such prerequisites to industrialization as well developed transportation, banking, and education systems have been established in these countries; (2) that, as is the case in the United States, large plants and small plants coexist in most industries; (3) that some of the products which appear to require large-scale production in the United States are being produced efficiently in other countries by smaller plants; and (4) that countries with relatively small domestic markets generally depend upon export markets for the sale of most products requiring large-scale production techniques.

Among the countries examined in Chapter VI only the Soviet Union has a domestic market which approaches the American market in size, and only the Soviet Union has an industrial structure which is at all comparable to that of the United States in terms of self-sufficiency or the scale of industry. The Soviet Union has many giant plants, although Soviet statistics exaggerate their importance and Soviet planners have retreated from "gigantomania"--the overemphasis on giant plants.

These findings may now be related to the circumstances of newly developing countries, even though it is dangerous to generalize about these countries as though they all fit the same pattern.

Some Principles of Investment

Before any analysis can be attempted, however, a frame of reference must be established by indicating some of the factors other than plant size which are relevant to investment decisions in underdeveloped countries.

In general, the marginal social productivity of investments should be equated in order to maximize the income of a given society.[1] This

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1/ See Alfred E Kahn, "Investment Criteria in Development Programs," Quarterly Journal of Economics, LXV (February 1951) pp. 38-61.

is to say that the projects to be encouraged first are those which, given the cost to society, are expected to add the most to the total output of society.[2] Of course, this governing principle must be supplemented in practice by more specific rules, but it should not be overlooked as a frame of reference, particularly when other rules are incompatible.[3]

One specific rule which has been suggested is that newly developing countries should concentrate on those projects which will yield high values of annual product relative to initial investment costs.[4] On the other hand, it has also been proposed that those underindustrialized countries which borrow from other countries should promote primarily those projects which will increase exports or decrease imports.[5] These rules are somewhat incompatible since industries whose products compete with imported products may require relatively large initial expenditures of capital. Moreover, a prerequisite to the success of those industries which require relatively little capital may be the improved transportation, communication, and power facilities which involve low capital turnover. Furthermore, in the interests of preventing an increasing rate of population growth, a nation may prefer industries which add to the supply of consumers' goods only over a long period of time.

A suggestion directed to the British West Indies is to foster those industries in which wages constitute a relatively high percentage of gross and of net output and in which the horsepower and fuel consumed per employee are relatively low.[6] It has also been suggested that underindustrialized nations can benefit most from those industries which require relatively little total capital, machinery and equipment, and skilled labor, and which are characterized by small and localized plants. It has been concluded, nonetheless, that no industry is ideally suited to underindustrialized countries in all of these respects.[7]

2/ In somewhat more technical language, new investment should flow into the production of a given product until the discounted value of the expected resulting additions to national income exceeds the present social cost of the production by no more for the one product than for any other product.

3/ See Hollis B. Chenery, "The Application of Investment Criteria," Quarterly Journal of Economics, LXVII (February 1953), pp. 76-96.

4/ See Norman S. Buchanan, International Investment and Domestic Welfare (New York: Henry Holt and Company, 1945), pp. 24-72, 106-8.

5/ See J. J. Polak, "Balance of Payments Problems of Countries Reconstructing with the Help of Foreign Loans," Quarterly Journal of Economics, LVII (February 1943), pp. 209-40.

6/ See W. Arthur Lewis, "The Industrialization of the British West Indies," Caribbean Economic Review, II (1950), pp. 1-61.

7/ See Kenneth A. Bohr, "Investment Criteria for Manufacturing Industries in Underdeveloped Countries," The Review of Economics and Statistics (May 1954), pp. 157-166.

Of course, the problem of economic development is complicated if we assume that the objective of industrialization is not only to maximize national income on the basis of existing resources but also to maximize the rate of increase of the nation's productive capacity[8] or per capita income.[9] Underdeveloped countries have, and have had for centuries, an abundance of handicraft industries which require almost no expenditure for plant and equipment, which require no foreign capital or induce an increase of imports, and which employ workers who need little additional training or direction. Still, a fundamental problem of underdeveloped countries is to develop new industries and to increase the per capita supplies of scarce resources. Thus, another rule for the useful economic growth of underdeveloped countries might be that they should stimulate the production of producers' goods.

Some economists advocate the promotion of urban industries on the grounds that birth rates are lower in urban than in rural areas. Questions also arise in connection with the choice between the construction of highly integrated plants which are virtually self-sufficient and the construction of families of plants which are both independent and interdependent. And all of these issues are entwined with the broader sociological, political, religious, and economic considerations mentioned in Chapter II.

In view of the complexities of economic development, it would hardly be reasonable to assert that the size of manufacturing establishments is the only significant factor to be considered by those who are concerned with promoting the useful economic growth of underdeveloped countries. It is proper to suggest, however, that a given plant should not be encouraged solely because it is large. Indeed, in the absence of special considerations to the contrary, it is reasonable to suppose that the small plants consistent with efficiency are those which are particularly suited to the resources and the markets of underdeveloped countries. There is, moreover, a presumption that underdeveloped countries should give initial encouragement to those industries which lend themselves to small-scale operations.

Gigantomania

Man is impressed by size as such, and those who are concerned with economic development may confuse economic progress and physical

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8/ See Walter Galenson and Harvey Leibenstein, "Investment Criteria, Productivity, and Economic Development," Quarterly Journal of Economics, LXIX (August 1955), pp. 343-370; and John Moes, "Investment Criteria, Productivity and Economic Development," Quarterly Journal of Economics, LXXI (February 1956), pp. 161-64.

9/ See Stephen Enke, "Speculations on Population Growth and Economic Development," Quarterly Journal of Economics, LXXI (February 1957), pp. 19-35.

bigness, forgetting that it is the size of national per capita income rather than of industrial establishments which is important. As mentioned in Chapter VI, planners in the Soviet Union have been afflicted with gigantomaina, and there is a danger that a similar overemphasis on large plants may spread to newly developing countries.

Authorities in some underdeveloped countries may overestimate the importance of large plants and large-scale industries to their development programs, supposing that an operation cannot fail if it is large enough. In a few cases, authorities may be more eager to construct monuments to their rule than to raise the level of living of their people. They may be beguiled by prestige and become superinterested in display, in window dressing, in size for the sake of size. In the words of Stephen Enke:

> Some governments seem to have a preference for a few large and spectacular investment projects, such as giant dams, oil refineries, and steel mills, incorporating the latest U. S. practices. The portable explanation is that U. S. industry has the designs and supplies to construct such projects, and the domestic governments want the kudos of a spectacular modern undertaking.10/

In 1951, when announcing the establishment of a Commission for Industrial Development, the President of Brazil, Getulio Vargas, expressed his hope that the commission would prepare the way "for the development of large and basic industry so necessary to the economic independence of the country."11/ But is it certain that the economic independence of Brazil requires the development of large industry? For that matter, is it certain that maximum economic growth will be fostered by a program of economic independence?

Many underdeveloped countries are prepared to build steel plants regardless of the cost of the plants or the size of the market and in spite of the fact that there would be a tremendous surplus of steel if all nations produced quantities of steel commensurate with lowest unit costs. A few underdeveloped countries have already erected steel plants only to discover that the plants could not operate profitably. Worse still, in some cases, years have passed after a project has been initiated before the given plant could operate at all.

10/ Ibid, p. 33.

11/ Quoted by George Wythe, "Brazil: Trends in Industrial Development," Simon Kuznets, Willard E. Moore, and Joseph J. Spengler, editors, Economic Growth: Brazil, India, Japan (Durham, North Carolina: Duke University Press, 1955), p. 65.

Giant cement plants, chemical plants, and textile mills are being erected in underdeveloped countries without the necessary supporting industrial complex or transportation network and before there has been an adequate analysis of the market or of the resources, including vitally needed skilled labor and managerial know-how.

Incidentally, while the question of governmental sponsorship of industrialization has not been raised in this manual, and while there may be no alternative to such sponsorship in some underdeveloped countries, it is pertinent to suggest that successful development will not occur merely because it is fostered by a government. There is no obvious reason to suppose that government officials are uniquely adept at plant management. The capital provided by a government is not costless. Government officials are not oracles who can infallibly compute the marginal social productivity of alternative projects. Moreover, there is a great danger that government officials may be too reluctant, for political reasons, to admit their forecasting errors and to abandon in time those projects which have not turned out well.

Economic Waste

The difficulty with an overemphasis on large-scale undertakings is that failures (or subsidies to conceal failures) result in waste which impoverished societies can ill afford. Occasionally, such waste can be quite spectacular. For example, according to a recent dispatch to The New York Times:

> Communist China has acknowledged reluctantly, through a periodical known as Chi-hua Ching-chi (Planned Economy), that at least 1,000,000 double-wheeled, double-bladed plows are rusting in disuse because of planning blunders. Knowledge of the plow surplus has been a standing joke in China for some time and had to be explained.
>
> The central Government originally approved the manufacture of 5,000,000 plows to step up agricultural output. Their production was given priority over many other machine products and a number of factories were converted at considerable expense. As a result, a shortage in spare parts for the automobile and oil industries developed.
>
> But soon it became apparent that the plows had been designed and produced with little consideration of the realities.
>
> Few peasant farmers knew how to operate them properly. To remedy this, the Government trained 800,000 operator-instructors to teach the peasants. Of this number, only 400,000 were said to be competent to instruct.
>
> Reports from farming areas began to disclose shortcomings in the implements. Farmers in southern China complained

that their rice paddies were too small and too muddy for the plows. Farmers from all sections complained that the implements were too heavy. They said that one animal could not pull a plow and that one man could not handle a plow pulled by two animals.

In addition, they pointed out, the number of farm animals was inadequate and those available were generally too weak and too small.

Faced with these complaints, a third national planning conference last January reduced the planned output of plows to 3,500,000. Continued rejections resulted in a further cut in June to an output schedule of 2,500,000.

The ambitious production schedule still had serious effects on the national economy, according to the reports. Badly needed steel was diverted from other production to the plow program. In 1956, for example, steel production was up 50 percent over 1955, but it would have needed to be up 1,000 percent to meet the needs of the plow production schedule.

The sudden switch of production from machine products to plows, and then back to machine products when the country became flooded with unwanted plows, also caused heavy losses. Ten large factories were forced to suspend operations for several months.

Approximately 750,000 plows have been distributed, many through forced distribution to peasants who protested that they had no means of repairing them even if they were able to use them successfully.

Production now has been suspended, after more than 1,500,000 plows were produced. At least half of the total output still is under government control. 12/

12/ The New York Times, January 27, 1957. Even more recently, according to The New York Times (April 5, 1957), "The Hsinhua news agency reported that the Ministry of Metallurgical Industry 'has set appropriate limits' on investments for the Anshan Iron and Steel Company in Southern Manchuria and on other existing big steel plants.

The agency added that the ministry would devote 'greater efforts' toward building small and medium metallurgical enterprises 'throughout China within the next few years.'

Steps toward decentralization, which marked a change of Chinese Communist industrial planning, were explained by the news agency as measures 'designed to accelerate expansion of the industry' because large enterprises require more capital and longer time to build."

Prior to World War II, planners in Ceylon envisaged the establishment of a dozen or so large-scale factories for the production of cement, paper, iron and steel, hydrogenated oil, soda and sulfuric acid, plywood, ceramics, fertilizers, wood distillation, and so on. Unhappily, however, "the large-scale factories established have proved to be costly failures, and the tale has been one of greater and greater recurring losses, except of course during the actual wartime." 13/

Perhaps the most spectacular large-scale failure since World War II was the East African Ground-Nut Scheme (the Kongwa experiment) which was sponsored by the British government. According to the plan, developed in 1946, some 3.2 million acres of land in East and Central Africa were to be cleared for the growing of ground nuts. This expensive and unsuccessful experiment was abandoned in 1950. To be sure, this was an agricultural rather than a manufacturing enterprise, but the conclusion of Professor S. Herbert Frankel is applicable to both:

> Those who wish to obtain the fruits of economic enterprise must not regard it from the viewpoint of the obstinate gambler who sees the size of the prize as directly proportional to the amount he is willing to stake, oblivious to the fact that his ticket may not be the winning one. 14/

Other less spectacular failures could be mentioned, but the extraordinary economic waste of an ill-advised large-scale undertaking should be evident. To be sure, economic waste on a small scale is also undesirable; but failure on a large scale is more wasteful than failure on a small scale. Moreover, there are reasons for supposing that small-scale ventures are more suited to underdeveloped countries and therefore less likely to fail.

Plant Size and Marginal Social Productivity

International Trade

The question of the proper size of manufacturing establishments in underdeveloped areas or of the relationship between plant size and the maximization of either national income or the rate of increase of national income is complicated by considerations of national self-sufficiency.

13/ Economic Commission for Asia and the Far East, Committee on Industry and Trade, Report of the Study Group of Small-Scale Industry Experts on Their Visit to Japan, United Nations Economic and Social Council, E/CN. 11/I & T/108, 1 February, 1955, p. 204.

14/ S. Herbert Frankel, The Economic Impact on Under-Developed Societies (Oxford: Basil Blackwell, 1953), p. 152.

Officials in many underdeveloped countries feel that industrialization is impossible unless infant industries are protected from foreign competition. They are also eager to free their societies from dependence upon foreign markets and foreign sources of supply, from the inevitable vagaries of international price fluctuations, shipping bottlenecks, monopolistic practices, boycotts, blockades, and wars--both hot and cold.

To a large extent these aspirations are commendable, although in many instances it is not so much foreign competition as it is lack of resources--including entrepreneurial talent--which retards the industrialization of underdeveloped countries. It is difficult, however, given protective tariffs, quotas, and foreign exchange controls, to compare alternative projects by the yardstick of social costs and marginal social productivity.

Protection involves a cost to society--the difference in value between the resources expended to create the product at home and the resources which would have been used to produce the exports required to pay for the products imported in the absence of protection.

Unnecessary social costs are also incurred whenever a plant does not use available resources in the most efficient way. A plant which never operates at full capacity is not using capital in the most efficient way. A plant which does not equip its workers with the best equipment consistent with the general availability of capital and technical knowledge is not employing its labor supply in the most effective way. However, plant A which produces consistently at less than full capacity <u>and requires no protection</u> may involve no more unnecessary cost to society than plant B which produces at full capacity <u>and requires protection</u>. Plant C which uses antiquated production techniques <u>and requires no protection</u> may involve no more unnecessary social cost than plant D which uses the most modern production techniques <u>and requires protection</u>. It is clear, in other words, that the question of the proper size of manufacturing establishments is related to considerations of international trade.

In general, given alternative projects which require equivalent protection, there is a presumption against the one which does not use the most efficient production techniques consistent with the available resources and know-how or which requires, for efficiency, larger plants than are consistent with the requirements of the domestic market. Between two projects which are equally economic in terms of costs and market suitability, however, there is a presumption against the one which requires the greater protection. Presumably, the most desirable projects are those which employ the available factors of production in the most efficient possible manner, are suited to the market, <u>and</u> require no protection.

Conceivably, if a society is determined not to import a given product, regardless of the cost of protecting its domestic production, it is economic to construct plants which are either too small to insure minimum long-run costs or too large for the domestic market.[15] The governments of newly developing countries would do well to remember, however, that most of the large-scale industries of industrially advanced countries with relatively small domestic markets depend in large part upon foreign markets--upon exports. Moreover, the development of export markets is generally more difficult for nations which actively seek to discourage imports. It is significant that most of the large-scale industries of Switzerland, Japan, and Sweden, for example, were developed during a period when international trade was not as circumscribed by nationalistic restrictions as it is today.

It would appear, therefore, that unless an export market exists or can be developed for the products of nations having small domestic markets, there is a presumption against the suitability of large-scale industries; and this presumption is stronger the smaller the domestic market of the country in question.[16]

Domestic Markets

In the first place, a national market depends upon national income rather than population or geographic size.[17] Since, as shown in

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15/ It should be remembered, however, that the ramifications of stimulating the domestic production of a given commodity are difficult to forecast. It may turn out, for example, that the imports of other commodities become necessary. It is for this reason, among others, that interproduct production relationships should be understood by a country instituting a policy of protection. For a discussion of input-output techniques and their application to underdeveloped areas, see Council for Economic and Industry Research, Inc., How to Select Dynamic Industrial Projects (Washington, D. C.: International Cooperation Administration, 1956).

16/ Of course, it may be possible for a number of small countries collectively to promote large-scale industries if they join their markets by means of a customs union.

17/ To be sure, population is a determinant of the structure of the national market. For a given national income, the country having the greater number of people will probably have the greater effective demand for food and clothing and the smaller effective demand for other things. Indeed, one of the problems confronting an underdeveloped country seeking greater industrialization is that there is little domestic demand for manufactured goods other than food, clothing, and shelter. But the over-all market is determined by income, and the relatively low national incomes of underdeveloped countries substantially limit the maximum size of those economically profitable plants which must depend on domestic markets.

Table VII-1, the national income of most underdeveloped countries is relatively low, it is clear that the national markets of most underdeveloped countries are relatively small.

The size of the market must also be considered with respect to the product in question. To illustrate:

> In 1936 the [British West Indies] imported £355,000 of shoes, which, in the United Kingdom, would have provided employment for about 1,000 men. Since the ideal shoe factory employs at least 250 men, this means that the islands' demands could have kept four factories employed. But this would be so only if the number of styles required was very small. It is uneconomic for a shoe factory to range over more than four styles. In Puerto Rico, where the order of demand is about the same, it was found, when a factory for 300 men was built in 1947, that the local demand was for something like a hundred styles, and that the demand for any one of these was too small to support economic production. If the factory was to produce at a reasonable price, it must concentrate on a few styles, and export a large part of its output. Now, most consumer goods are, like shoes, demanded in fairly wide variety. If each or any of these varieties is to be produced cheaply, it will often be found that a large part of the output will have to be sold abroad. And that is why the Puerto Rico industrialization programme has so largely become a programme for exporting to the United States. 18/

Finally, the market for a given product is not necessarily delineated on the basis of national boundaries. The cost of transportation between two points in a given country may be considerably higher than between either point and a foreign port. Of course, a nation may reduce the inflow of foreign goods by tariffs, quotas, and foreign-exchange controls; but domestic goods may still be excluded from a large part of the potential internal market because of the high cost of transportation. The higher the transportation costs in a country the more limited is the market for any plant, and the less likely is it

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18/ Lewis, op. cit., pp. 17-18.

that a large plant will be able to operate profitably if its sales are limited to the domestic market. 19/

Thus, national income, diversity of demand, and transportation are factors which probably make the domestic markets of most underdeveloped countries too small to support many large plants or large-scale industries--a conclusion which is consistent, incidentially, with the experiences of Switzerland, Japan and Sweden.

The Allocation of Capital and Labor

The discussion to this point can be summarized as follows: assuming that the same production methods are employed in underdeveloped countries as in the United States, unless a given underdeveloped country can develop substantial export markets for those products which require large-scale manufacturing units for efficient production, that country probably must (1) import those products or (2) be resigned to a less-than-optimum employment of its resources.

Is it correct, however, to assume that the production techniques which are the most efficient in industrially advanced countries are also the most efficient in underdeveloped countries? Are the resources of underdeveloped countries being efficiently employed if the industrial techniques of the United States--including large-scale production--are transplanted into these countries? Is it not possible that procuction techniques are available or can be discovered which are better suited to the resources of underdeveloped countries and may therefore permit the efficient production of many products in plants which are smaller than those existing in the United States?

19/ For this reason, among others, a powerful case can be made for assigning high priorities to the development of transportation and communications in underdeveloped countries, although there must be some calculation of the costs involved and some comparison between these costs and the reduction in the charges paid by those who are separated by distance from the centers of production. It should be remembered that the railroads which connected the remote points of the United States were highly profitable at the time they were built and required no government subsidy other than grants of costless land. Moreover, as compared with most underdeveloped countries today, the domestic American market was already large during the great era of railroad construction--1865-1890. In 1870 the population of the United States was nearly 45 million, the net national product, at prices current in 1870, was in excess of $6 billion, and the per capita income was the highest in the world.

It was suggested in Chapter III that economic efficiency depends upon factor costs as well as engineering principles. Within limits, a given product may be created with varying amounts of natural resources, machines, power, unskilled labor, skilled labor, management, and enterprise. The precise factor combination which is optimum for any given area is, therfore, a function of local factor cost. 20/

Natural resources include such factors as climate, geography, and topography as well as water, minerals, and soil; and there are temendous differences between the natural resource endowments of the various regions of the world. In general, a country richly endowed with some particular natural resource will tend to have a comparative international advantage in the production of goods requiring relatively large quantities of that resource; and it may be economically feasible for a given nation to engage in the large-scale production and export of a commodity for which it is especially suited. 21/

Still, a common characteristic of all underdeveloped countries is their extreme relative shortage of capital. For this reason, as was indicated in Chapter II, a fundamental problem of underdeveloped countries is to increase the supply of capital on a per capita basis; specifically, some way must be found to insure that a minimum of from 10 to 15 percent of national income is devoted to net investment. 22/

20/ Even between two areas of the same country there are likely to be differences in production methods, although the greater intra-country factor mobility will probably make these differences less than between countries.

21/ At the same time, the presence of a particular resource need not inevitably dictate production of a commodity requiring that resource, and other exceedingly scarce factors of production may also be required. Thus, a country might have rich iron deposits and find the production of steel uneconomic because of the absence of power resources or the capital required to finance the construction of a steel plant. Be that as it may, it is beyond the scope of this manual to examine in detail the relationship between these various resources and the scale of manufacturing which is appropriate for the various underdeveloped areas of the world. This would involve an investigation, country by country, of resources and markets.

22/ For an excellent discussion of national capital-output ratios, see W. Arthur Lewis, The Theory of Economic Growth (Homewood, Ill.: Richard D. Irwin, Inc., 1955).

At the same time, the proper allocation of whatever capital is available is important if national income is to be increased by the maximum amount consistent with a given level of investment.

Most underdeveloped countries have a relative abundance of unskilled labor; many even have a surplus of labor in the sense that a part of the labor force is permanently unemployed or underemployed. For this reason, capital can be used most efficiently together with relatively large amounts of unskilled labor. Given the fact established in Chapters IV and V that small plants generally use relatively greater amounts of labor than do large plants, it follows that small plants are generally more suited than large plants to the availability of capital and labor in underdeveloped countries. Of course, labor is not costless nor can it be infinitely substituted for capital; and there is a point in any plant or industry beyond which the unit costs of production will rise as additional inputs of labor are substituted for inputs of capital. Nevertheless, if a small plant can compete successfully with a large plant in a given industry in the United States, there is certainly a presumption that a small plant in that industry would be particularly competitive in that industry in an underdeveloped country. In other words, in any industry in any underdeveloped country, lowest unit costs should be achieved in plants which are smaller than the representative plants of that industry in the United States.

Furthermore, given the product demand and the relative total levels of production for any two industries having equal marginal social productivity in the United States, there is a presumption that the industry requiring the greater relative amount of labor would be the one with the higher marginal social productivity in an underdeveloped country.

Of course, this conclusion does not rule out the desirability of all large plants in underdeveloped countries. There may still be some industries in which unit costs can be lower in a large plant than in a small one; and the marginal social productivity may still be higher for a large-scale industry than for a small-scale industry. On the basis of the costs of capital and labor, however, it seems appropriate that underdeveloped countries have fewer large plants in any given industry and fewer large-scale industries than industrially advanced countries. It must be remembered, moreover, that this conclusion is reinforced many fold if the size of the domestic markets of underdeveloped countries is also taken into account.

Other Resource Considerations

This conclusion is also reinforced by other resource considerations. In many underdeveloped countries the large rural labor force cannot be fully employed the year around in agriculture. At any moment there are likely to be workers who are seasonally unemployed, and there may also be those who are unemployed more or less permanently. Thus, the opportunity cost to society of engaging such workers

in rural industries may be zero. Large-scale establishments are, however, less suited than small-scale establishments to dispersal throughout the country; their coefficient of localization is high. Thus, the unemployed rural labor supply can be more effectively utilized if many small plants are developed rather than a few large ones.

In countries where a large part of the labor force is permanently unemployed, a case can be made for developing large plants which will attract workers to urban areas; but the mobility of labor may not be as great in underdeveloped as in developed countries.[23] Moreover, the cost to society of housing and otherwise providing for a growing urban force must be taken into account. If all of the costs are considered, it will frequently be found that the national income of underdeveloped societies can be increased a great deal more by a given expenditure on improving and developing many small, dispersed plants than by an equivalent expenditure on a few, large, geographically concentrated plants.

It is also probable that the supply of capital can be increased more by the development of many small plants than by the development of a few large ones. Financial markets are not highly developed in underdeveloped countries, and the financing of large industrial establishments by hundreds of thousands of individual co-owners or stockholders is virtually impossible.[24] However, individual savings might be encouraged to flow into local enterprises where direct contact can be maintained between the investors and the enterprise.

The problem of management is also relevant to this discussion. As was shown in Chapter IV, the percentage relationship of nonproduction employees to all employees is greater for large plants than for small plants, at least in the United States. Moreover, while it

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23/ See Simon Rottenberg, "The Immobility of Labour in Underdeveloped Areas," The South African Journal of Economics, 19 (December 1951), pp. 404-8.

24/ Perhaps even more fundamental deterrents to productive investment than the lack of highly developed financial markets are such factors as inflation, taxation, political corruption, and governmental instability. Inflation promotes unproductive speculation in land and inventories and makes long-term industrial planning difficult; excessive taxation on profits stifles enterprise, particularly when untaxed speculative gains are an alternative for the investor; political corruption encourages investment in political favoritism in order to obtain for government officials such things as import licenses and government contracts; and governmental instability encourages private investors to prefer the safety of foreign investments. For a detailed discussion of the general problem, see Ragnar Nurkse, Problems of Capital Formation in Underdeveloped Countries (Oxford: Basil Blackwell, 1953).

can hardly be demonstrated statistically, it is reasonable to suppose that more training and experience are required for those who manage large rather than small plants. In underdeveloped areas the scarcity of managerial talent is, if anything, even more acute than the scarcity of capital. For this reason, other things being equal, many small plants would be preferable to a few large plants.

Underdeveloped countries also have a scarcity of workers who know how to use and to repair intricate machinery. To make skilled technicians out of laborers who are unfamiliar with anything more complex than hand tools requires a large investment in training.[25/] Intricate modern machinery can be imported from industrially advanced countries, although the capital thereby employed is substantially wasted if the machinery is not efficiently used or maintained. If plant and equipment are not properly maintained, or if the cost of training repair technicians is inordinately high, plants requiring relatively large amounts of plant and equipment are inappropriate. Thus, since the assets of large plants generally comprise a larger percentage of sales than those of small plants, other things being equal, small plants are better suited than large plants to underdeveloped areas.

Beyond this, the machinery of large plants tends to be more highly specialized than that of small plants and less adaptable to the output of alternative products. Thus, the large plant is more exposed to losses resulting from fluctuations of the market. Moreover, as between one large plant and ten small plants with equal total capacities, the small plants have more flexibility; it is easier for 5 of the 10 small plants than for one-half of the large plant to shift into the production of an alternative product.

This does not mean that workers in underdeveloped countries must be resigned to primitive equipment and antiquated production techniques. It means only that the most rational alternative need not be to duplicate the production methods--particularly the large-scale production methods--of the United States. While it may be true that the entire labor force of underdeveloped countries cannot be efficiently employed in agriculture or in handicraft industries, it may also be true that the available capital cannot be efficiently employed in large manufacturing units.

The desire of underdeveloped countries to be more nearly independent of imports has been mentioned, but industrial independence involves industrial diversification; and diversification can be more effectively pursued, given the fact that one industry is an alternative to some other industry, if the available capital is employed in many small plants rather than in a few large plants.

25/ See Joseph F. Stepanck and Charles H. Prien, "The Role of Rural Industries in Underdeveloped Areas," Pacific Affairs, XXIII (March 1950), p. 66.

The element of competition should not be overlooked in this discussion. If a choice must be made between many small plants and a few large plants, other things being equal, the public will gain from the competition of the small plants. Public officials in underdeveloped countries appear to fear the abuses of private industrial monopolies, but the private competition of many small plants may be a better solution than monopolies regulated or sponsored by governments.

There is also a good deal to be said for promoting a spirit of enterprise at the grass roots level in underdeveloped countries. It is hardly possible to overestimate the importance of this spirit to the development of the United States--the power of the widely held conviction that the world will beat a path to the door of anyone who can build a better mouse trap! This spirit of enterprise is not likely to be nurtured if the industrial establishments of a country are substantially limited to large plants with which the overwhelming proportion of the population can have no entrepreneurial contact.

Finally, it should always be remembered that the most meticulous plans can go awry--that the future can never be predicted with 100 percent certainty. Regardless of how promising a project may appear on the drafting board, it is a gamble. Realizing this, the wise planner will be interested not only in maximizing gains but also in minimizing losses, particularly when losses can be ill afforded. As indicated above, an unsuccessful large venture is more wasteful than an unsuccessful small venture, not only because of the greater total capital expenditure involved but also because of the greater period of time between the conception of the large-scale undertaking and the moment when failure is recognized and acknowledged.

To summarize the discussion of this chapter as it now stands: except for export industries, large-scale production is generally unsuited to underdeveloped countries because of the relatively small size of their domestic markets; at the same time, small-scale production appears to be more suited to the factors of production in underdeveloped countries than does large-scale production. On the basis of both demand and supply considerations, therefore, it does not generally appear to be to the best interests of underdeverloped countries to promote large plants or large-scale industries.

Some Special Considerations

There are, however, three additional questions which should be considered. (1) Should not underdeveloped countries concentrate on developing producers' goods, which require large plants? (2) Can an underdeveloped country initiate the efficient production of any good other than by promoting highly integrated, and therefore large, plants? (3) Is is not possible that the per-unit-of-output costs of capital can be substantially reduced by the most modern, automatic (and presumably large) factories?

Producers' Goods

Investment in the production of producers' goods may be preferred in underdeveloped countries for at least two reasons: (1) an increasing supply of producers' goods is a prerequisite to a significantly increasing supply of consumers' goods,[26] and (2) if an increasing supply of consumers' goods is matched by an increasing population, it will not serve to increase per capita income.

The most obvious point to make in this connection is that by no means all producers' goods require large plants for efficient production. In fact, the efficient manufacture of most "light" producers' goods does not require large plants.

It is, of course, clear that industrialization cannot proceed far or efficiently without the products of "heavy" industries;[27] but it still may be rational for a nation to import these goods in exchange for raw materials or manufactured goods in which that nation has a comparative international advantage. A country can produce, for example, hardware, agricultural implements, tin cans, or machinery even though it has no domestic iron and steel industry as such.

As a general rule, it is not economic for an underdeveloped nation to promote heavy industries unless it is unusually well endowed with the requisite materials, and then only (1) if it can develop export markets or (2) if the delivered cost of the product is less when it is produced domestically on a relatively small scale than when it is imported.

26/ It is clear that the impressive increase in the national income of the Soviet Union has resulted primarily from the emphasis placed upon capital formation at the expense of consumption, although the observer of the Soviet experiment may rightly ask when the benefits of this intensive industrialization will accrue to the people. It must be remembered that the ultimate objective of production is consumption. One may also inquire whether it is necessary or desirable to suppress economic and political freedom in order to achieve a high rate of capital formation. Are Soviet resources really being used in the most efficient way for maximizing either current income or the rate of increase of productive capacity?

27/ The definition of a heavy industry is by no means precise. As Professor P. Sargent Florence has pointed out: "As between different manufacturers (and public utilities) there are different degrees of transportability and durability in their materials and products and these differences strongly affect the form of organization, including location. The contrast perhaps most often drawn is between heavy and light manufacturers, though popular discussion seldom brings out whether it is the product or material

On these bases the production of iron and steel, copper, or aluminum ingots may be economic in a few underdeveloped countries, and the construction of small-scale cement plants may be economic in many. Nevertheless, there is still a presumption that heavy industries which require large plants for efficient operations are unsuitable for most underdeveloped countries.

Integrated Plants

The question of integrated (and large) plants is somewhat more complex. The immeasurable interdependence of establishments in the United States has been mentioned in Chapter IV. Insofar as the experience of the United States has any relevance to production in underdeveloped countries today, this interdependence of establishments may be of even greater significance than plant size as such. If the large establishments in the United States were suddenly to disappear, the small- and medium-sized establishments would be severely disrupted. On the other hand, in the absence of small- and medium-sized establishments, the large establishments could not survive unless they became more highly integrated and much larger than they already are.

It must be remembered that the existing relationships between establishments in the United States have developed only over a considerable period of time and cannot be duplicated quickly in underdeveloped countries. Even apart from capital requirements, the development of an integrated and rationalized economy requires time so that the industrial relationships which are optimum for it may be worked out.

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that is heavy or light or the machines in use. For it does not follow that if materials are heavy the products or the machines are heavy. Ranking by weight of material or product all the 55 British manufacturers for which the census of 1935 gave enough data, lightest first, aluminum rolling, glassmaking and butter and margarine were 40th, 46th and 49th in lightness of materials, including fuel, i.e., relatively heavy in materials; but 14th, 20th, and 28th in tons per given price of product, i.e., relatively light in product. The ranking of industries in heaviness of machines measured by their horsepower per man was different yet. Cotton spinning had light material (7th in rank) and product (9th in rank), but the horsepower per man ranked 49th--heaviest but 6th of all the industries tabulated." --The Logic of British and American Industry (Chapel Hill: The University of North Carolina Press, 1953), p. 8.

It is this as much as any other condition which limits the immediate usefulness of large establishments in underdeveloped countries. Many small establishments can exist more or less independently, depending only upon local resources and local markets; large-scale plants require a supporting industrial complex. This is not the riddle of the chicken and the egg. It is simply that mistakes are considerably less likely if large plants begin operations only after a substantial number of small establishments have already been developed and as others are organized. 28/

Does it follow from this that underdeveloped nations should promote extremely large-scale, highly integrated, virtually self-sufficient manufacturing establishments? Perhaps it does. Before the Civil War many of the larger plants in the United States were highly integrated, and this approach was followed in the Soviet Union, at least in the early years of industrialization--before the reaction against "gigantomania."

A number of warnings are pertinent. The scale of each separate process is not necessarily increased when various stages of production are carried out in a single (and therefore large) plant. Indeed, the scale of each separate process may be reduced, since the market for the output of the early stages of production will tend to be limited by the requirements of the rest of that particular plant. The result may be less, rather than more, specialization of labor and machinery. Indeed, it is because of the pronounced advantages of specialization that the intricate system of subcontracting has evolved in the United States. Even the largest American manufacturing establishments rely upon other manufacturing establishments for supplies which are essential to their finished product, and they do so because this arrangement is more efficient than a system characterized by a greater self-sufficiency of individual plants.

Moreover, as the Russians discovered, the integration of production in large plants does not solve the problem of transportation; it does not create markets. At the same time it does increase the investment required for each individual manufacturing unit, the time needed for plant construction, and the problems of management. It also increases the dangers of monopoly.

28/ Furthermore, were it not for the large markets and the complex industrial relationships in the United States, it is extremely doubtful whether so many different types of industries could exist at all. It is for this reason that many industries in the United States may hold no immediate interest for underdeveloped societies.

Is there an alternative to large, integrated plants in an area where there has been little prior industialization? To some extent, there is. Initial investments in manufacturing can be concentrated on those small-scale operations which are consistent with the basic requirements (food, clothing, and shelter) of the people, adding larger plants as the market grows. Again, the development of an area can be planned so that a number of small though complementary plants are established more or less simultaneously.

Organized Industrial Districts. In the United States, the simultaneous establishment of small, complementary plants is being promoted through the development of organized industrial districts.[29] Such a district is an industrial area which has been organized by a single promoter who will design, construct, and maintain the plants in the area according to the specifications of the various manufacturers. He may also provide financial assistance on favorable terms.

In 1954, railroads operated 47 districts as exclusive owners or sponsors. These constituted 40 percent of the total number of districts in the United States. Approximately 30 districts were owned and operated by individual enterprises, including industrial district corporations and industrial real-estate brokers, contractors, and architects. A third group of districts was organized by local community groups, such as chambers of commerce, industrial foundations, municipal or county governments, port commissions, airport authorities, redevelopment and housing authorities, or development commissions. There were 18 districts in this group. A number of other industrial districts were planned and developed through the cooperative efforts of such combinations as railroads and chambers of commerce; railroads, land owners, and investors; and industrial real-estate brokers and land owners.

In 1954 organized industrial districts were located in 84 communities in 34 states, especially the west-north-central and west-south-central states. Although nearly one-half of all of these districts were located in these sections of the country, they were the smaller districts, averaging about 250 acres each as against approximately 500 acres for all districts.

29/ The spread of the industrial district plan and the advantages offered industry are reported in detail in Theodore K. Pasma, Organized Industrial Districts, Area Development Division, United States Department of Commerce (Washington: United States Government Printing Office, 1954).

Most of the larger districts were located in cities, such as Chicago, Los Angeles, Dallas, and Atlanta.

Altogether, the districts comprised a total of 55,000 acres, with light manufacturing being the predominant type of activity. Each was planned in accordance with such important location factors as markets, transportation, favorable tax climate, utilities, and other services.

Producers' Cooperatives. In view of the success of organized industrial districts in the United States research on their applicability to underdeveloped areas would appear to be worthwhile. It may be noted, however, that a somewhat similar development is already taking place in a number of underdeveloped countries and in Japan. This is the promotion of producers' cooperatives. To an increasing extent these cooperatives are carrying out commercial functions for entire industries--assuring a steady supply of raw materials at reasonable prices; obtaining improved tools and equipment; instructing members on the use of improved tools and equipment; making supplies and equipment available to members on easy terms; instructing members on the use of improved methods and inducing them to make what the market demands in reliable quality; assuming a marketing function by taking over from the members what they make and paying cash or part cash for it; and,if necessary, finishing, inspecting, and grading the goods for sale, building up a merchandising organization strong enough to sell all that the members make, and carrying buffer stocks for seasonal variations.

Several provincial cooperative associations have had some success in India, notably in the field of hand-loom weaving. Similar organizations have a long history of success in Europe, most prominently in the Scandinavian countries, and as cooperative productive societies in France and the Soviet Union. In the latter country they have been assigned a considerable share in the manufacture of consumers' goods.

However, according to Henry Aubrey:

> For the most part, the advantages of cooperation are in Asia better understood than applied. The obstacles and the widespread ignorance and illiteracy make the spread of cooperatives a slow and difficult task. Government assistance at all levels is usually the first, if not the only, condition of success. The shortage of capital and credit can rarely be overcome without government grants and loans. The modern beginnings of effective cooperation in India date back to the start of governmental assistance in the 1930's. In Japan the government has long encouraged cooperative organizations, but, by and large, direct government assistance was not a prominent feature of small-scale industrialization until the 1930's. The depression and the opportunities for export trade brought about by depreciation of the yen led to a chaotic state of

competition and to innumerable complaints about lack of standards and quality. Beginning in 1925, the Japanese government passed various acts for manufacturers associations whose functions were not only control and regulation, but also the provision of joint facilities in most of the fields previously mentioned. As a result, Japan had 7,553 cooperative associations by 1947, with a membership of over 800,000.[30]

Automatic Factories

A final consideration which must be mentioned is the belief of some engineers that the development of underdeveloped areas will be greatly enhanced by the use of new, productive techniques which involve tremendous capital investment per worker. In this connection, it is perhaps worthwhile to quote extensively from a recent analysis of Science and Economic Development.[31]

> A study of history provides us with a progression of [modes of organizing manufacturing activities], of which the following can be identified:
>
> Household manufacturers
> Village handicrafts
> Artisan's workshops
> Primitive factories
> Integrated "assembly lines"
> Continuous-flow process
> "Automatic factory."
>
> Each one of these approaches to production requires different inputs of capital and labor. Each one, as we move down the list, assumes increasing organization of the production process.
>
> Experience tells us it is no longer safe to depend upon any of the first three for the rapid improvement of levels of living. Productivity and quality are consistently low for products manufactured by those methods today. In addition, wherever they may be used, these methods of production are extremely vulnerable to technological change. Minimum adequate standards of living probably cannot be achieved in densely populated areas that depend heavily upon village development and the fostering of the arts and crafts.

30/ See Henry G. Aubrey, "Small Industry in Economic Development," Social Research, XVIII (September 1951), p. 290.

31/ Richard L. Meier, Science and Economic Development (New York: published jointly by the Technology Press of Massachusetts Institute of Technology and John Wylie and Sons, Inc., 1956, pp. 189-92.

The alternative forms of the primitive factory (the batch process, the machine shop, the mill, etc.) and the basic principles of the assembly line are largely innovations of the nineteenth century. They depend for their efficiency upon the application of increasing amounts of power and greater division of labor. . . These kinds of technology have passed their zenith and are now showing relatively few spurts of progress.

By far the most modern techniques for organizing industry, and also the most interesting, are the last two on the list. A continuous-flow process refers to a production system where the inputs, outputs, and intermediates are handled internally as streams. A power plant is such a continuous-flow process when powdered coal is screw-fed into a furnace, the heat produced boils the water, the steam created is piped to the turbine, and the rotational energy so generated is converted to electric power. . . When all of the regulation has been taken over by instruments, and the only important task for the worker is that of repairing and maintaining the equipment, then the transition to the automatic factory has been achieved. The most recent electric power stations are nearly perfect examples of this development, but the chemical industry has probably pushed the art of designing fully instrumented plants the furthest.

Some of the newest and most striking automatic factories have evolved from the assembly line. In them the machines not only carry out operations upon articles-in-process formerly guided by hand, but other machines will also transfer the article-in-process to the next machine in a manner that permits it to perform its task. An example can be drawn from the large metropolitan bakeries where the flour and other ingredients are mixed, kneaded, divided into portions, kneaded again, set into pans, proofed, baked, cooled, sliced, and packaged, not only without being touched by a human hand, but also without a single repetitive human task in the line. Similarly an aluminum casting can be passed from lathe to drill press to milling machine and so on for thirty or more separate machining operations and come out a piston. Such a factory design has been virtually accomplished over the past few years in both the United States and the U. S. S. R.

. . . . . .

The engineer. . . is perpetually seeking a product that will give a better performance at reasonable cost. He finds that machines will make better standardized products than artisans, and that automatic machines will permit better quality control than manually operated machines. This is

important because almost always the products of one factory must be used in conjunction with the products of the others. The specifications for each part must mesh closely with the others. In an engine, for example, not only must the tolerances of the component parts be as small as feasible, but the fuel and lubricants must be prepared with characteristics which closely fit the needs of the engine. Failure to meet quality standards at any of a hundred or more points would lead to engine failure or drastically lowered efficiency. The motivation that leads the engineer to accept automation with enthusiasm is the realization that by this means quality can be improved, occasionally to such an extent that hitherto impossible jobs become feasible. The economist's tools for the measuring of quality are very poor, and so this factor is usually left out of his calculation.

Engineers hasten to point out that, despite the large quantities of capital required per worker, the application of more automatic methods has quite consistently reduced the capital cost per unit of annual capacity. This has been strikingly true when applied to the introduction and improvement of continuous-flow processes. Therefore, from the point of view of the consumer and the man who saves part of his earnings for investment, an industrialization program that uses the most advanced methods of organization as soon as possible is to be preferred over one that develops gradually in this direction. The returns on capital are greater.

. . . . . .

Very early in the course of development, in most of the larger economies, decisions will have to be made regarding the methods for organizing electric power, cement, fertilizers, liquid fuels, heavy chemicals, sugar, paper, printing, and telecommunications networks. For each of these there is a continuous-flow process or virtually automatic solution already available (for others, such as mining, forestry, housebuilding, and roadmaking, solutions are not yet ready, and for some may never be suitable). A choice for each of these industries must be made between:

A program for stimulating scattered small-scale entrepreneurs using makeshift equipment and methods

A program of decentralized government sponsored factories with local participation and some centralized regulation

The construction of large, modern industrial units with strong initial government participation.

> The argument against the first is that it is too unpredictable and slow, and that the accumulated profits may be invested in properties that do not reinforce economic development. The second program could be designed to evade the inadequacies of the first, but it encounters the scarcity of competent managers in underdeveloped societies. Embarrasing instances of mismanagement and waste of capital are likely to wreck the program and bring about the fall of the government. The third procedure gets around these difficulties, and it has additional advantages in that it can best use foreign skills and leads to more efficient industrial establishment as judged by competition in the world market.
>
> The third procedure is no panacea since there are still many opportunities for missteps, but it can be so administered that the severest problems may be identified and dealt with in advance. The risks that remain are those necessarily associated with any kind of large enterprise that must continually struggle for its place in the sun against the vicissitudes presented by the future. Besides, it is a formula that can be used for only an estimated 20 to 40% of all capital investment required for a balanced program. For the remainder, which may use to best advantage the primitive factory or the ordinary assembly line (garments, shoes, larger units of household equipment, and bicycles are representative examples), more decentralized services to industry, promotional devices, and controls are appropriate.

This approach to economic development requires further investigation. If, however, the ultimate in mechanization is clearly superior to existing technology in reducing per unit costs of production regardless of the relative availability of the various factors of production, it is rather difficult to see why automatic factories are not already sweeping the world, at least those parts of the world where such processes are known. Nor is it clear that the problem of developing markets is automatically solved by automatic processes. Will the maximum economic size of a manufacturing establishment not be limited by the size of the market (which depends, in part, upon the transportation network) regardless of how much mechanization is applied? The problem of training the people who will construct and maintain these fantastically intricate factories must also be taken into account.

Moreover, as the author of Science and Economic Development has himself pointed out:

> The principal price one has to pay for the ultimate in mechanization is a kind of inflexibility--most such plans have larger capacities and are less able to adjust to changes in demand. If the market is miscalculated, or

the problems of maintenance and repair are neglected, the losses will be much greater than for other alternatives. 32/

This, of course, is one of the major propositions of this manual: that the wastes of ill-advised large plants are much greater than the wastes of ill-advised small plants, and extraordinary caution must therefore be exercised in promoting large plants. Before the construction of a large plant ever begins in an underdeveloped area, intensive and extensive market research is highly desirable.

Still, this approach should not be lightly dismissed. At the very least, a research team of economists and engineers should determine those industries for which highly mechanized factories appear to be appropriate, and then investigate the suitability of those industries for specific underdeveloped countries. At the same time the team might also consider economically efficient, labor-intensive innovations which would be appropriate in underdeveloped countries having more or less permanent surpluses of labor. It should be remembered, however, that a guiding objective of such research should be the maximization of marginal social productivity, and this depends upon the correct prediction of demand (markets) and supply (costs of production).

Thus, while there is need for additional research, particularly in this field, there is considerable evidence to support the conclusion that, in the absence of rather unique circumstances, the best interests of underdeveloped areas will be served by the promotion of small- and medium-sized, rather than giant, manufacturing establishments.

32/ Ibid, p. 192.

Table VII-1

NET NATIONAL PRODUCT AND PER CAPITA NET NATIONAL PRODUCT, 55 COUNTRIES
1952-1954 Average
(Current U. S. Dollars)

Country	Net National Product (billions)	Net National Product per Capita
United States	298.5	1,870
United Kingdom	39.5	780
France	31.7	740
Germany (Western)	25.0	510
India	22.3	60
Canada	19.4	1,310
Japan	16.5	190
Italy	14.7	310
Brazil	12.8	230
Argentina	8.5	460
Australia	8.4	950
Belgium	7.0	800
Sweden	6.8	950
Mexico	6.2	220
Pakistan	5.6	70
Netherlands	5.1	490
Turkey	4.9	220
Switzerland	4.9	1,010
Union of South Africa	4.0	300
Denmark	3.3	750
Philippines	3.2	150
Colombia	3.0	250
Venezuela	2.9	540
Egypt	2.9	130
Finland	2.8	670
Austria	2.6	370
Norway	2.5	740
Chile	2.3	360
New Zealand	2.0	1,000
Cuba	1.8	310
Malaya	1.8	310
Greece	1.7	220
Portugal	1.6	200
Thailand	1.6	80
Korea (South)	1.5	70

Table VII-1 (Continued)

Country	Net National Product (billions)	Net National Product per Capita
Ireland	1.2	410
Peru	1.1	120
Burma	1.0	50
Puerto Rico	1.0	430
Ceylon	0.9	110
Belgian Congo	0.8	70
Israel	0.8	470
Rhodesia and Nyasaland	0.7	100
Ecuador	0.5	150
Guatemala	0.5	160
Dominican Republic	0.4	160
Lebanon	0.4	260
Kenya	0.3	60
Luxembourg	0.3	890
Uganda	0.3	50
Jamaica	0.3	180
Honduras	0.2	150
Panama	0.2	250
Paraguay	0.2	140
Iceland	0.1	780

Source: Stanford Research Institute, Chemical Economics Handbook, I., E., 191.10a and 191.20a.