

GEOGRAPHY OF INDUSTRY AND TRANSPORT

Sergio Conti

Dipartimento Interateneo Territorio, University of Turin, Italy

Keywords: Enterprise, agglomeration, external economies, division of labor, industrial districts, local development, networks, logistics

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Summary

Beside the definition of the objectives and the main concepts of industrial geography (production process, functional and spatial relations, division of labor, economies of agglomeration), contemporary industrial space is explained as characterized by the densification of production structures in selected areas of the world. In this way, industrial space appears discontinuous and polarized, involving limited and circumscribed regions that often correspond to the manufacturing concentrations of past centuries. In effect, recent changes and processes (i.e. internationalization and decentralization of production, regional policies, technological innovation, development of communications), while producing a profound reorganization of both companies and industrial space, highlight a relatively stable model of distribution of manufacturing production over time.

The main theoretical schemes that have characterized the debate in industrial geography are briefly introduced: a) classical location theory, which expressed the application of neoclassical economic theory to the problems of location, b) the geography of enterprise, associated both with behavioral approaches and organization theory, c) the

regulation theory of neo-Marxist inspiration, d) the neo-Marshallian theory of external economies, and e) the strategic approach. In this way, the concept of the local system is highlighted as the foundation of economic and industrial organization through which a relational dynamics can be emphasized.

Finally, the problem of relations between areas, following the process of globalization of trade and communication, is introduced with reference to the development of transport and communication systems and their recent profound reorganization.

1. Introduction: A Relational Science

The objectives of industrial geography are the description and interpretation of the location dynamics of manufacturing activities on various scales, from the local to the worldwide (or global). In this light, industrial geography is an essential component of economic geography, whose objective is the explanation and description of the territorial differentiation of economic phenomena and processes.

If, in the broad sense, the term industry covers many phases and types of economic activity (including mining, construction, and certain services), in the strict sense industry is a synonym of the secondary sector (i.e. the set of manufacturing activities that transform raw materials from agriculture, mining, forestry, and livestock into consumer products).

It is well known that, in general terms, manufacturing includes three distinct stages:

- (a) procurement of one, or more frequently many, raw or semi-processed materials,
- (b) production or, in other words, the transformation of these materials into the final product,
- (c) distribution to the market, represented by consumers or by the market of companies themselves if the production process generates a semi-finished product that becomes in turn a “raw material” to be transformed by other industries.

This suggests that industry operates in the economic system *not* in isolation, but by establishing an indispensable range of *functional relations* that become increasingly complex as industrial development moves forward.

From the geographical point of view, these relations are essential factors in location and territorial organization and they become more complex and numerous as the size and technological level of the company grow. It is, in fact, territorially that the more or less close-knit network of exchanges needed for the various production factors and those for distribution and sales of products is found. The various stages of the production process are not necessarily performed in the same place: the location of raw materials, for example, is often distant from the plants that process them, just as the latter do not necessarily operate in the market in which the product will be sold. In the same way, certain production structures that demand a comparatively simple structure of relations establish limited relations with the environment outside the production plant and the network of relations is generally deployed inside the local framework. In those sectors where, instead, large-scale firms are present, there will be both relations with the

immediately surrounding area and more wide-ranging ones, reaching out to cover markets and production units scattered throughout the world.

It is thus possible to explain how the organization of industrial space depends on a relatively complex series of conditions. In contrast with agricultural space, where crops are distributed relatively continuously across the land, industrial space is a *discontinuous* space. In other words, it is a space of relations between a multitude of variously located elements.

2. General Concepts and Processes

During the twentieth century, and especially after World War II, industrial development, starting from the first concentrations in central-northern Europe and the United States, spread to other regions and countries. However, from many points of view, the regions that were the first to be industrialized maintained for several decades, and generally still maintain, particularly solid production structures.

The process of industrial location functions with a certain degree of *inertia*. The concentration of manufacturing leads, in fact, to the profound transformation of the area concerned: numerous infrastructures concentrate there (transport, services, housing) that as a whole can constitute a factor of attraction for other companies that locate there later. The conditions are thus created that favor the establishment of relations that the company must build with the external environment and that, reducing operating costs, induce a further concentration of companies and new investment in infrastructures. The intensification of relations between a number of companies in the same area produces collective advantages, or *economies of agglomeration*. These are part of an industrial agglomeration, with the individual companies benefiting from favorable conditions that they could not find if they operated in isolation. Through agglomeration, companies can therefore achieve savings in costs, or external economies of scale, that can be traced back to the following categories:

- (a) The establishment of exchange relations between companies that participate in the same production cycle. This makes it possible to create a *division of labor* between the various production units, creating relations for the supply of semi-finished products and parts;
- (b) A more highly differentiated labor market in terms of age, sex, qualifications, and specializations;
- (c) A larger outlet market for products;
- (d) The possibility of joint use by a number of companies of a single system of infrastructures and services (road and rail networks, consultancy services, scientific and technological research, etc.);
- (e) The particular industrial “atmosphere” present in a given area. The rivalry between companies stimulates the innovation process, while a culture of industrialization spreads among the population, facilitating vocational learning;
- (f) The reputation acquired by the product from a particular area, stimulating in consumers demand for that particular type of goods.

As a whole, these factors explain one of the fundamental characteristics of industrial space that has been formed over the decades: the *densification* of production structures

in selected areas of the earth's surface. Although the industrial economy is now virtually worldwide, in the sense that much of the earth's surface is involved as a supplier of raw materials or as a consumer of the products of modern industry, industrial space is *discontinuous and concentrated*, in reality occupying only 10% of the land area.

It is easy to see on the earth's surface how the major industrial regions are concentrated in a limited number of countries and, within these, in fairly limited and circumscribed areas. These areas often correspond to the old coalfields that led industrialization in past centuries (the central European ones of the Ruhr and the Sambre-Meuse, of Dunbas and Kuznetsk in Russia, in Pennsylvania and the northeast in general in the United States) and in the major metropolitan cities and ports (Paris, London, New York, Los Angeles, Tokyo, Osaka, etc.). This highlights a relatively stable model of the distribution of industry over time. Even recently, the world's six most industrialized countries (the United States, Germany, Russia, France, Japan, and the United Kingdom), with only 17% of the world's population, supplied over 60% of manufactured products.

The search for advantages deriving from the close-knit inter-industrial relations between companies and the environment in which they produce cannot, however, offer a complete explanation of the complexity and profound differences that exist between the different forms of industrial development in the contemporary world. Industry is a highly dynamic sector, continually changing internally and at the same time spreading in space, involving new regions and countries. For this reason, it is necessary to consider a set of factors, closely related to each other, that modify industrial structures and make the picture drawn so far more complex, but also more realistic: a) diseconomies of agglomeration, b) regional policies, c) technological development, and d) the rise of the great multinational company.

2.1. Territorial Decentralization and Diffusive Processes

In certain regions and in given historical periods (in particular, the last decades of the twentieth century) the advantages deriving from concentration could be translated into diseconomies. These give rise, in turn, to processes of de-agglomeration, in that some companies are driven to seek out locations outside the congested industrial centers.

These processes can initially assume the form of *relocation* (or *territorial decentralization*). This occurs when companies, faced with an increase in costs in the traditional urban areas, move the site of their operations to suburban areas or to regions further away. When the decentralization is towards the peripheral areas of the major cities, this is termed *suburbanization*. In this case it is a phenomenon typical of all the industrial economies: this affected the United States from the period between the two world wars and later all of the large European industrial agglomerations, leading to a centrifugal process of expansion of the urban areas.

Territorial decentralization can also assume the form of long-range relocation, when the production unit is moved towards decidedly external areas. Thus, the construction of decentralized production plants in some underdeveloped countries with low labor costs and more permissive tax and environmental legislation (such as Southeast Asia) responds to a clear territorial strategy of the major industrial companies.

2.2. Regional Imbalances and Re-equilibrium Policies

The growing industrial concentration that has affected some regions in recent decades has produced effects that do not concern only the limited areas involved. The *cumulative process* of expansion of the distances between regions and countries can be conceptualized in the *core-periphery* mechanism, which on the various spatial scales determines the trend of growth for some regions and stagnation (or decline) for others.

Alongside factors of an economic nature (growth of income and well-being, concentration of industries, infrastructure, and migratory movements), the central areas exercise functions of growing control and domination over the periphery. This cumulative effect is echoed in the creation in the central areas of new values, culture, social behavior, etc. that, together with the accumulation of fixed capital (plants, research centers, infrastructure, etc.), favor the development of high entrepreneurial and innovation levels, producing *imbalances* in levels of development.

In this framework, for some types of region (the areas in decline, underdeveloped regions) public bodies can pursue a policy aimed at encouraging industrial decentralization and the “artificial” formation of agglomeration processes. This form of control and direction of industrial investment are summarized in the concept of *regional policy*, which can assume two main forms:

- (a) *Indirect* intervention, through which the state or other public bodies attempt to encourage the location of private companies. The most common forms are the provision of infrastructures that in the mid and long term can make these regions attractive for industrial development, and also the offer of tax benefits and funding of various kinds to companies that decide to locate in an area identified as an objective by regional policy.
- (b) *Direct* intervention, through the location of publicly owned industrial companies. These new industrial realities, acting as development “poles,” should trigger an agglomeration process with self-propelling development capacities and dissemination effects on the surrounding area. Above all, in the early decades after World War II, these regional development strategies were practiced systematically in many European countries (France, Italy, and Scotland especially) and above all in various underdeveloped countries (such as Brazil, Venezuela, Algeria, Iraq, and India).

2.3. Technological Innovation and Industrial Space

As is well known, even the industrial revolution was made possible by a series of innovations, first and foremost the steam engine which, used in manufacturing, led to an extremely rapid increase in productivity and, in geographical terms, the concentration of industry in areas rich in energy sources.

Since then, the history of industrial development has been characterized by the progressive substitution of labor by capital, in the form of new machines and automated systems, to carry out not only material operations (mechanization), but also production process control (automation). The introduction of new techniques has not been a linear

and continuous process, however, nor has it occurred in the same way in different countries and regions.

Starting in the 1960s, especially in the developed countries, there was a new technological revolution that has had as profound effects as those of the first industrial revolution. The introduction of electronic computers, telecommunications, and various automated systems made considerable changes to the production process, leading to new relations both within individual companies and between companies. Technological development, by making communication and the transmission of information easier and modifying the organization of work, set in motion a profound and ongoing reorganization of industrial space. The processes of the territorial decentralization of industry—from the regional to the worldwide scale—would not, in fact, be possible without an efficient system of trade in products, but especially in information, between the various plants spread over an extensive area, and without the introduction of new machines that allow the division of the plants into small production units.

By allowing the geographical separation of the various phases of the production cycle, technological innovation and the spread of communication systems have created a new structure in the functional relations between production units, less linked to the traditional constraint of distance. This encourages the rise of a growing *division of labor* between different regions and countries that also entails growing *interdependence* between the economies of the world's industrial system.

While the spread of the more obsolete and “banal” industrial functions has created new industrial areas in peripheral areas and countries, a new type of agglomeration has formed in the “central” areas based on technologically advanced production processes. For innovative companies, the traditional factors (generic markets, transport, sources of raw materials and energy) are of limited importance, while local conditions play a key role. These local conditions are usually found in the central areas of the system, such as the presence of universities and research centers, highly skilled labor, venture capital available for investment in new businesses of which the financial results are uncertain.

2.4. Multinational Companies and the Internationalization of Production

The most highly visible transformations of industrial space have continued to depend on the behavior of major corporations capable of implementing a strategy that goes beyond limited regional and national boundaries. In reality, the expansion of the capitalist system, starting from the historical centers of development (Europe, the United States and, more recently, Japan) has progressively expanded worldwide and is structurally linked to the investment strategies of these companies, 350 of which, towards the end of the 1990s, controlled about one-third of the entire production of the industrialized world.

The system of multinational companies thus asserted itself as a production system of worldwide significance in which three different forms of internationalization of capital overlapped: the same company reaches out at the same time to new markets to exploit wage differences and to control the sources of raw materials. The consequence is that it

manages to be present, directly or through subsidiaries, in all markets in which it can make profits.

The development of information technologies and the greater efficiency of telecommunications (especially via satellite) have allowed the organization of a highly flexible production system, despite being split into plants thousands of kilometers apart. Secondly, many of these companies have developed a financial function internally, and are thus able to make major investments autonomously and shift money from one country to another. These operations have become, in turn, a further source of profits.

Global companies represent the last chronological stage of the evolution of the industrial system and they stand out from the usual image of the multinational company. The foreign activities of this new form of company are no longer limited to a few branches working in the same production sector, but extend through *networks* to all continents, covering a vast spectrum of industrial sectors, with a turnover that can exceed the gross national product of entire national economies.

Because of the speed of economic and technological changes, and increased international competition, these companies have tended to expand their sectors of activity considerably (with the purpose of penetrating more domestic and international markets). In addition, faced with growing uncertainty and the cost of technological research, they have tended to pursue cooperation agreements with other companies and public bodies for the development of specific research projects. The traditional strategy, aimed at *internalizing* most functions within the company (from production to research and marketing), has gradually been replaced by a new form of company behavior, based on the search for alliances and the stipulation of cooperation agreements with other actors—often even competitors—in various parts of the globe.

On the whole, the dominant rationale of many company networks is to give priority to cooperation agreements between the three great areas of the industrialized world (the United States, Europe, Japan Triad) that possess both a high technological capacity and large capacity to absorb products. In fact, if over 95% of all *foreign investment* currently originates in the industrialized countries, about two-thirds is destined for operations in the same developed economies. The traditionally industrial countries continue to attract a major share of foreign investment because they have rich and expanding markets, as well as a series of favorable location conditions (skilled work force, technological economies of agglomeration). In the 1990s, for example, over 70% of the foreign investment flows of U.S. companies in the manufacturing industry was directed towards the industrialized countries. This share rose to about 90% for machinery and fine chemicals, while it fell to less than 50% for metalworking, foodstuffs, and standardized electrical appliances. In the meantime, direct investment in developing countries has grown at a faster speed than investment in the developed economies. However, investment in this area has continued to be fairly concentrated, with a limited number of developing countries (Argentina, Brazil, Hong Kong, Malaysia, Mexico, Singapore, South Korea, Taiwan) receiving almost 75% of investment in underdeveloped countries between 1960 and 1998. In these countries, the relatively high share of investment is in the production of essential goods and standardized processes, where the advantages of wage differences are accompanied by the possibility of re-exporting the profits and by

advantageous taxation and financial conditions. In contrast, the vast majority of underdeveloped countries, especially those with low and very low incomes, attract negligible influxes of foreign technology and capital.

3. The Theoretical and Methodological Tradition

3.1. The Neoclassical Legacy

As a relatively autonomous discipline in terms of method and content, the origins of industrial geography lie in the discipline of economics (and neoclassical economics, in particular) at the juncture of the nineteenth and twentieth centuries, when the European economy had already been through the profound transformations following the development and spread of manufacturing. The object of observation at the time was the manufacturing industry of the paleotechnical era, driven by steam engines, whose raw materials and products were subject to slow and expensive transport. This explains how the objective of the early pioneering studies of a group of economists attentive to the spatial dimension of manufacturing (such as Weber, Hoover, and Predöhl) was to explain the locations that allowed the minimization of transport costs. These, in turn, were assumed to be proportional to the distance that separated raw materials (and semi-finished products), product markets and, consequently, the place of production.

These theoretical schemes, which can be referred to as a whole as the “classical theory of industrial location,” constituted in practice the application of neoclassical economic theory to the problems of location, and from this point of view represented an undoubted addition to the traditional economic way of thinking. Nevertheless, in line with the premises of neoclassical economics, they are based on highly abstract assumptions, such as that of a system of perfect competition, an *isotropic* space (i.e. having the same characteristics in all its parts), and the rationality of the behavior of economic agents. For this reason they respond to an identical decision-making model and identical objectives of maximization. It follows that the neoclassical explanation of industrial location initially focuses on “economic” variables (transportation costs, labor costs, etc), with history, political economy, and social processes being ignored or interpreted as “complications” of the basic economic forces. Second, neoclassical location theory analyzes economic factors in an abstract, deductive manner to derive generalizations as to where industry should locate. The theory so derived provides a “normative” yardstick to compare with actual behavior. Third, neoclassical models assume “universal” economic laws based on universal notions of rationality that govern behavior. In other words, it is the iron laws of economics that govern behavior, rather than the idiosyncrasies of individual agents.

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Biographical Sketch

Sergio Conti. Graduate in Economics in 1971, fellowship holder since 1973, contract lecturer since 1974, lecturer since 1981, associate professor since 1987. Since 1998, professor in economic geography at the University of Turin, Faculty of Economics. Ph.D., London School of Economics and Political Science, 1979. From 1992 to 2000, chair of the Commission on the Organization of Industrial Spaces of the International Geographical Union. From 1997, chair of the Italian Committee for the International Geographical Union.