TECHNICAL INNOVATION AND CLASSIFICATIONS OF INDUSTRIES

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PREFACE

Lech Zacher, from the Polish Academy of Science, prepared this paper for the IIASA Task Force Meeting on "Innovation and Industrial Strategy" in June 1980. Its main purpose is to develop the concept of leading industries and to give some insight into the process of structural development. The criteria which he used are mainly dealing with technological progress. It seems to me that socio-economic indicators should play a decisive role here. Thus, his paper provokes our further thoughts on the linkage between technological progress and industrial development.

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INTRODUCTION

In this paper, we shall try to explain a series of concepts like leading branches, carriers of technological progress, modern and traditional branches etc., and next to define their scope and use in the classification of production structures--in which they occur--from the angle of correlation between production structures and technological progress. These comments are not concerned at all with less developed countries; and the divisions and classifications discussed are relative, at least in time (and often also in space).

NEW AND OLD BRANCHES

These are relative concepts which are rather imprecise. We say that an industry (or branch) is old if it began to develop a long time ago, for example during the first industrial revolution. The textile industry, based on traditional raw materials may serve as an example, along with agriculture, coal mining, ore-mining, metallurgy, etc. On the other hand, a new branch or division will be one which has developed recently, let us say within the last dozen or so years (usually this term is used to refer to industries that have developed since the Second World War). The electronics, rocket, space, computer, and atomic power industries may serve as examples. Thus the criterion for the classification of a branch into the category new or old is the age of the industry. This is a general, super-national classification. We can also speak of new or old industries within a certain country or region, when the concepts new and old take on a different, and still more relative meaning.

It may happen, for example, that in some particular country a mining and smelting industry develops as a result of the discovery of ore deposits. Looking at the matter from the historical angle, these are undoubtedly old industries, but in this country they are new, as previously they did not exist. It may, of course, happen that the concepts "absolutely new--old" will overlap with the concepts "new--old on a national scale". But when the concepts "absolutely new--old" are used, the two concepts are mutually exclusive (no industry new on a world scale can be old on a national scale, and vice versa). In using the concepts new--old to refer to the national--or regional--scale, we have two possibilities:

-- some new industry (national) may be old (absolutely) or new (absolutely) and vice versa; and
-- an old national industry may be absolutely old and vice versa.

New branches are formed as a result of technological progress (especially fundamental innovations, inventions) and the deepening of the social division of labor. These branches cover the manufacture of new products to replace old ones and also the manufacture of new products which create new wants. The formation and development of new branches is accompanied by a falling rate of growth or stagnation in old branches. New branches are marked by higher productivity, for they are equipped with newer (and more modern) manufacturing equipment. Traditional industries (e.g., textiles) are relatively straightforward, while new industries are complicated (e.g., the eletronic equipment industry); the latter are marked by a high degree of processing in production (measured for example by the number of processing phases).

MODERN AND TRADITIONAL BRANCHES

Usually the criterion for classification is in this case the degree of modernity of the technology and techniques employed (generally, and not in a given country (see Ames and Rosenberg 1963). Modern branches are those which employ modern technology, techniques, materials. These branches are usually new, although there are also old branches applying new technology--e.g., the textile industry, where synthetic raw materials are used; automated coal mining or oil drilling; the ship-building industry--and they must thus be termed modern (or, rather, quasi-modern). To be more precise, we may say that from the point of view of the end product, these are traditional industries (the product has been known for a very long time) but from the point of view ot the technology employed they are modern. Thus, it is possible to have a traditional industrial structure, within the framework of which modern technology is employed. There are also new branches employing old technology.

The majority of traditional branches are old (e.g., the textile industry using natural raw materials). Thus, in comparison with the previous classification:

-- new industries may be modern and vice versa; and
-- old industries may be traditional and vice versa, or also, old industries may be modern (quasi-modern).

If we accept, for example, that the chemicals industry is relatively old, we must say that some of its branches are traditional (e.g., fertilizer production), while others are modern (plastics) (see Baumol 1967).

EXPANDING, STAGNATING, DECLINING BRANCHES

The distinguishing of branches with a different growth rate is natural, if we are examining an economy as a system. For we know that among the components of a system, there are both components with growth and progress potential and components on the decline. In this respect, we may distinguish growing, expanding branches (see Beksiak 1968). Some people define the latter as those branches where employment is growing at a faster rate than global employment at a given time (see Brzezinski 1970). This is, however, a local-regional criterion, which may be used only within a given country (we should add that usually there is a positive correlation between the growth rate in production and the growth in the rate of employment in a given industry). This version of the concept under discussion is however to a certain degree distorted, for it gives preference to labor-intensive branches with a low requirement in capital equipment (and thus rather traditional branches, and services).

A better criterion is the concentration of research staff. From this point of view, the fastest-expanding (or more precisely, staff-intensive) industries over the last few years have been the aircraft, electronics, precision instruments and chemicals industries. This criterion gives preference to industries where much research is carried out, the research-oriented industries; these concepts cut across or overlap with the concepts of research-intensive, modern industries, and also usually with the concepts of new product industries, and with the concepts of carriers of technological progress, or branches creating technological progress. This criterion is fairly narrow, but precise, for the growth in research staff reflects certain general tendencies and is characteristic of certain specific industries in all economically developed countries.

The third criterion (differing from the previous ones) is the production growth rate in branches or divisions. This criterion is based on the general principles of development of the economic structure, and especially on the striking

similarity in the relative growth rates of different branches of manufacturing industry. The machine and chemicals industries may serve as examples. These industries are marked by widespread introduction of new processes and products. Usually, new and modern industries are those with a high growth rate in respect of production growth (on a world scale), but not these alone, if we look at particular countries. For it may happen that in some countries, especially less developed and/or with a specific and narrow specialization--often raw materials, agriculture--that old industries have a very high growth rate, like for example, the mining industries in the majority of socialist countries. At the same time, production technology may be rather old-fashioned (they are then traditional industries) and their growth is based on extensive factors; or, the technology applied may be modern (then they are simultaneously quasi-modern industries) and this is usually linked with intensive growth patterns. On the other hand, branches which are highly-developed in countries which lead the world in technology (e.g., electronics) may develop slowly in other countries (e.g., in Poland) because of, for example, incorrect investment, scientific or licence policies in a previous period, lack of staff, difficulties in crossing the take-off in this industry etc. In every country there is a group of expanding industries with a higher than average rate of production growth (expanding industries). These are mainly new product industries. Branches producing new (previously unknown) products play a vital role in the developemnt of industry. By creating new needs and demand for their products, they stimulate economic growth, expecially as their links with other industries give impetus to these as well. Although research into the relative significance of new products in industrial production is not being carried out, it is possible to say that their influence is very great, at least up to the point of market saturation.

The relative importance of the expanding industries and their growth rate reflects fairly closely the rate of introduction of new products (and indirectly the innovation rate). There is a positive correlation between innovations and the expansion of industries manufacturing new products. Certain conditions are necessary for "new product" innovations: a wide range of available inventions and innovations and also a suitable industrial and market structure. The absorption of new products in developed countries is greater than formerly, and greater than in under-developed countries (because of higher income, better information and advertisement). Foreign trade pressures may provide the stimulus for development in the expanding industries, with a growth in export and/or import substitution as the aim. These industries speed up the renewal of capital and also the application of innovations in the old industries.

On the whole, the expanding area of the economy, from the point of view of the production growth rate, is the whole of industry, and especially manufacturing industry, which has a

growth rate higher than the growth rate of the GNP (see Chen and Zacher 1978). In manufacturing, the manufacture of the means of production and of consumer durables are developing fastest. In most developed countries, the branches with the highest rate of growth are the machine, metallurgy and chemicals industries. We should add that in countries with a high overall growth rate, even industries which are expanding least sometimes have a high growth rate, and vice versa: a low overall growth rate slows down the rate of growth of the expanding industries. Government policy and military requirements may affect the industrial growth rate (development priorities, regional planning, export incentives, etc.); armaments and space research have brought a revival in the manufacture of means of transport, especially aircraft, the precision insturments industry, the electrotechnical industry, electronics, and in metallurgy.

Stagnating branches include those with a low (below average) and not rising growth rate, and whose share in the gross industrial product is not rising. The food industry, textiles, clothing, shoes, may serve as examples.

Finally, declining branches (in respect of the growth rate) are marked by a low rate of growth, and a decrease in their significance and share of the gross industrial product. Declining branches release labor (at the same time making possible the development of other branches, but also sometimes causing structural unemployment). Broadly, we may regard agriculture (especially in comparison with industry) as just such a declining sector of the national economy because of its low profitability and low growth rate, and every major agricultural region as a relatively backward region. In all highly industrialized countries, the share of agriculture in the GNP has seriously diminished over the last twenty years, and in most of these countries employment in agriculture has fallen over the same period by at least 20% (see Collection by Soviet Authors 1965). However, the growth rate of productivity was sometimes even higher than in industry. Declining branches receive government subsidies and other forms of protection. In the 1950s coal mining and textiles could also be numbered among declining branches of industry.

New product industries may (to a large extent) be identified with new industries and they are mainly demand-creating industries. New products are currently introduced as a result of market research, and often as a result of want-creating innovation. Therefore, new product industries are usually research-based, research-intensive, research-oriented industries. These are often branches working primarily for the direct satisfaction of consumer wants. At the present time, product diversification is growing in geometric progression, causing a growth in the variability rate for product programs, and as a result, new technological innovations become essential.

The classification criterion in this case is not the age of the industry, nor the technology, nor the growth rate of production, but the product itself--or, strictly, its novelty. We should add that new product industries are usually new industries, modern (product innovations usually require process-innovations) with a high growth rate--and therefore expanding. They are demand-creating branches, and at the same time the basis for their existence is a high per capita income and a highly diversified demand structure in society.

In the case of research oriented industries the classification criterion is the dependence of the origin, development, and existence of the industry (branch) on the carrying out of--or at least the broad-based implementation of the results of--scientific-technological research. If the degree of connection with the development of science and technology is measured by the intensity of research, the measured relationship of expenditure on R & D to added value, then--generally--it is several times greater in manufacturing than in trade, transport, agriculture or mining. Within manufacturing industry, it is highest in the aircraft, chemicals, electronics, machine, vehicle, and instruments industries. Analysis of the share of research personnel employed in the given industries points to similar conclusions. The majority of these industries result from the present dynamic progress in science and technology, and at the same time provide a further incentive for this progress.

However, from the viewpoint of technological progress, it is possible to distinguish the following:

-- branches producing basic component elements of technological progress (manufacture of the means of production, new materials, techniques) which can be termed carriers, generators of new technology;
-- branches profiting from technological progress (progress-intensive); and
-- branches indifferent to technological progress, progress-intensive to a very low degree.

Referring to the first viewpoint, particular branches creating basic component elements of technological progress may be marked by varying rates of growth or intensity of technological progress. They are marked by the fact that the technological occurring within them is objective within their products, which in turn decide on the technological progress in other branches and sectors of the national economy.

These branches have an exceptionally strong influence on other branches, giving impetus to them. They are the carriers of modern technology, decisive in the technological structure (its degree of modernity) of the national economy. However, this definition limits the scope ot these branches to manufacturing the means of production. To a certain extent, inventive

industry can be included here. As examples of these branches we may give (of course, those which are really carriers of new technology and not of traditional, duplicated technology) some branches of the machine and chemicals industries, or electronics. It is said that consumption of the achievements of the latter branch has not only revolutionized methods of production but also forced the modernization of the organization of these processes in the field of production, investment, scientific research work, the education system, etc. The development of electronics has been decisive in the development of telecommunications, automation, measuring apparatus, transport, etc. The electronics industry is currently a typical carrier of new technology; its influence is shown not so much in an increase in the scope of cooperation with other industries, as in the introduction of the latest developments in electronic technology in many branches of industry. There is today a general awareness of the great importance of this industry (see Hirschman 1960). This industry is also significant from another angle: electronic apparatus is the basis of automation, which is linked with the dismissal of labor in certain branches, without dimimution of the volume of production. (This is especially important in highly-developed countries.) The labor made available as a result of the application of forms of technological progress may be employed in other sectors of production. If we have the relevant data, we can calculate the percentage increase in the growth rate, or also the absolute increase in national revenue. It should be noted that this may be a measure of the gains brought about by structural changes in industry.

Of course, the above branches will, according to the definition, be branches in the sphere of material production. These branches will be decisive in the level of modernity attained by the final product of other branches--e.g., electronics, atomic power, automated elements, all demarcate the level of modernity of the electro-machine, chemicals and other industries. Changes in technology in these branches influence other branches and also the development of the corresponding academic disciplines. There, when we speak of structural changes, we are not thinking of transformations (so far dominant for example in Poland) where the effect is limited to a given branch, or a branch which is the consumer of its end product (e.g., production of modern ships, modernization of coal mining, etc.). Above all, we are concerned with modifications in branches where the end product revolutionizes the technology of manufacture, the technology and organization of production in all or some branches of the national economy, and not only those in the production sphere; thus, we are concerned with changes in branches which may be termed carriers of technological progress, influencing the system of production and consumption in many ways. For an economy at the stage of that of Poland, for example, these will be--in the future--highly advanced computers, and today it is possible to develop automation, "ordinary" electronics, introducing transistors, machine tools for plastic manufacture

instead of traditional lathes, the use of synthetic materials instead of steel, of which there is a shortage, and synthetic textiles instead of natural fibres, etc.

Let us refer now to the branches which profit from technological progress. These are branches which easily and willingly absorb technological progress. They may also be branches which produce consumer items (especially consumer durables) and also other sectors of the economy (e.g., services). These branches, however, may at the same time make heavy investment in scientific research, but the resultant product of this research does not necessarily have to take the form of a visible manufactured item, but may be for example a new method or technology. This type of technological progress (not the result of capital investment nor in the form of a visible manufactured item) is very important (see Kleer 1968), (it is often claimed that "half" of technological progress can in no way be attributed to investment); this means that the criterion for classification under discussion is not too accurate. For we find that branches creating material elements (in the form of machines, equipment of new materials) are at the same time branches which benefit from technological progress.

If we give up the classification of elements of technological change into material and non-material, the above classification loses its justification. It seems, however, that it is possible to speak about branches which to a greater or lesser extent benefit from technological progress (occurring in scientific research, or in other branches). It is also possible to distinguish branches which benefit from the achievements of science and technology (adapting the results of applied or even pure research to their own ends) and also those which--as well as this--benefit also from technological progress occurring in other branches as a result of some connection which they have with the former. In the first instance, there is no influence exerted by one sector on another, but in the second, we have a case where one side exerts influence in technological progress and the other side absorbs it.

If we are speaking of the opportunities for technological progress in various branches or sectors, we should say that generally the greatest opportunities for expanding R & D activities come in industries where the growth is highest (requiring the building of extra production capacities). The heavy electric machine industry, the motor industry, electronics, chemicals, may serve as examples. Next, we should mention the branches in which production is not growing but where there are opportunities for reducing costs. Finally, branches of industry that are so large that all innovations are applied widely, even if expansion is only small (e.g., the building industry) (see Kleer 1970).

W.J. Baumol distinguishes two sectors in the economy: the technologically progressive and the non-progressive, where

productivity growth is only sporadic. The second sector covers mainly services (administration, education, catering, entertainment, some types of labor-intensive products, e.g., porcelain and glass products). In these areas of activity there is a lack of innovation, capital accumulation or large-scale economies; in this slowly-developing sector, the end-point is really the work itself (material costs are small) (see Kleer and Zacher 1979). Baumol writes that productivity growth in a given branch reflects the activeness of its technological structure, which defines very precisely whether labor productivity will rise fast or slowly. Some say that slow in certain types of production or services is not only the result of the technological structure of their own manufacture but also of the current technology of consumption: this refers especially to services. Baumol, however, claims that the nature of services does not permit a steady and cumulative growth in productivity through capital accumulation, innovation and large-scale economies.

LEADING SECTORS

Let us first cite S. Kuznets' definition. He writes that first sector A leads if it is developing independently of sectors B,C, and D etc. on a national scale, but under the influence of factors which can be considered autonomous in a given national economy. These may be technological changes resulting from certain new inventions; or changes in the raw material base resulting from new discoveries; or changes in foreign demand which are external in relation to a given economy; or changes in the social structure (political revolution, agrarian reform, etc.) which may be considered exogenic in relation to specific economic processes. It is worth noting that the autonomous nature of this phenomenon--in relation to a given national economy--is based on the incentive and not the effect. The effect may reflect many other economic factors apart from the incentive mentioned--factors which form a component part of the economy and society.

This brings us to the second characteristic of a lending sector: the range of its effects, or more exactly, the size of its contribution to the economic growth of a country. Sector B may "respond" to an autonomous incentive, but while its contribution to the economic growth of the country is not fundamental, then it will not lead in growth, irrespective of the height of its own growth rate. A thousand-fold increase in the production of paper serviettes over a period of 10 years would still not make this a leading industry (see Kuznets 1966). The lower limit defining a considerable share in the economy may only be found by empirical research. Kuznets differentiates--global and per capita--the direct contribution of sector A to the growth of the economy, the consequences of its importance in the economy and its percentage growth rate, from its indirect contribution through its bilateral links with sectors B,C,D, etc., and also from its contribution--again indirect--through its influence on the social structure and population characteristics

(urbanization, the form of organization of the economic unit, education etc.) variously influencing the economic growth of the country. The size, and especially the distribution in time of these direct and indirect effects, may vary. The direct and indirect contribution of a branch in a given period may be very small, despite the fact that its own growth rate is high, and its technology modern, while in a later period its contribution to the growth of the economy may be far greater, despite a reduction in its growth rate and the fact that its technology has ceased to be modern.

The establishing of these branch characteristics mentioned by Kuznets--the autonomous character of an impulse and the distribution in time and size of their direct and indirect contributions to economic growth--requires intensive research: not only on leading sectors, but also those branches which they influence require quantitative research covering the whole economy. The fact of whether a branch is leading, or other elements speeding up the growth rate, may be established, according to Kuznets, only through exact analysis of the circumstances which preceded and also occurred during the period of this acceleration, country by country, using statistical, theoretical, and other analytical methods on historical facts.

J. Kleer defines leading sectors more precisely, attributing the following characteristics to them:

- -- these branches have the highest rate of growth among manufacturing industries in the economy and their share of industrial production is growing;
- -- they have an above average level of productivity;
- -- they influence technological changes in other branches of the national economy; and
- -- they lead to the creation of a new demand structure (production and consumption) (see Kuznets 1966).

The first point could be expanded--following Kuznets' model--by the requirement that the given branch should have a considerable share in the economy (the growth rate alone, without reference to the importance of a given branch in industry or in the national economy, may lead sometimes to mistaken conclusions, especially in countries beginning to develop a given branch). This requirement has also been emphasized by W.E.G. Salter.

Let us look at some empirical examples. Recently, it has often been thought that the automobile industry is one of the leading industries in highly-developed countries. It has been predestined for this role by frequent changes in car bodies, technological improvements, new design solutions, constant favorable export opportunities. This is a leading branch, although it is not an industry producing new goods in the exact

meaning of the word, as the motor car has been a consumer item for 20 or 30 years; however, constant technological changes, and especially exterior changes, make it a quasi-new product. Maybe in a relatively short space of time a technological revolution will take place in the motor industry, connected for example with a general application of Wankel engines or the mass production of effective electric cars. Public demand reacts very sharply to novelty in the motor industry (in the rich countries). Together with the development of the motor industry, the branches of the economy directly connected with the motor car also have an exceptionally high growth rate (e.g., rubber, synthetic materials).

I would like to mention some other examples of the concept of leading branches. In the initial phase of industrialization, most socialist countries gave priority to so called section I (this was both a political and economic imperative) including metallurgy, fuels, heavy machinery, transport. These were the sections of heavy industry which up to the 1930s were leading industries in the world. In the 1940s and 1950s, the machine industry ceased to be a leading industry and its role was taken over by the electro-machine industry, precision instruments, light machinery, electronics.

This above example shows that first of all there are leading branches on a world scale, and then in particular countries (and these may be completely different from the first group); and secondly, that one may speak of leading branches not only at the level of the whole economy, but also within the framework of particular sections of industry. Particular leading branches correspond to given levels of industrial (economic) development. Differentiated levels of development, objective conditions and economic strategy in various countries means that it is not possible to define some optimal, universal set of leading branches, although it is probable that there are some objective sequences in the occurrence of leading branches during the successive phases of development, resulting from the internal logic of industrial development.

The role of leading branches is thus played by various branches of industry in different countries and at different period. Thus for example, before the first World War the great growth of the railways acted as a stimulus to the Russian economy and that of the U.S.A. In the inter-war period, the motor industry was the leading industry in the U.S.A. and the machine industry in the Soviet Union in 1928-1940 (see Kuznets 1971). These same authors write that currently the leading branches of industry in the highly developed countries are the electric power industry, chemicals (especially polymer chemicals) and the branches of industry which determine the technological structure of the economy.

Old, traditional branches may also be leading branches. For example, in Soviet Kazachstan the main leading branches

used to be linked with raw materials. Mining was a leading industry there as a result of certain natural conditions and the acceptance of a certain concept of the development of industry. After 1953, grain production became another leading branch in the Kazachstan Republic (see Lattes and Dordvies 1969). It is thus possible to say that in the particular case of under-developed countries (or regions) a leading branch may have different characteristics from those discussed above. In this case, we say that a branch is leading if it produces an economic surplus and if its development is changing the structure of the economy. This last characteristic is general and (relating to all levels of development) deserves special emphasis. In our opinion, it is a basic definitive characteristic of a leading branch. If the development of a given branch changes the structure of industry (the economy) then we say that the branch is leading structurally. In this connection, the basic task for structural development policy should be to define the structurally leading branches.

The concept of leading branches is one of the central categories of W. Rostow's well-known theory on the phases of economic development. Rostow, in introducing the concept of leading branches, begins with the following facts:

-- the growth rate of different branches of the economy varies greatly in a given period of time; and
-- in certain periods, economic growth is a direct or indirect result of unusually swift growth in certain particular key sectors (see Perroux 1964).

Rostow mentions the cotton industry in England in 1780-1840, iron in 1840-1850, the steel industry 1870-1880, and then chemicals, the electrical and machine industries, as examples of branches leading growth. The English sequence in leading branches may be considered as classical, but other countries of course do not have to reproduce the classical English pattern, especially as leading branches are linked with the exploitation of natural resources, with the demand structure of the world market and with the application of research in the national economy. With the exception of raw materials and food production processes, in the last two centuries growth has been based on exploiting great technological innovations, which formed the foundation for leading industrial branches (this happened in the textile, metallurgical, machine, chemicals and other industries). The overall growth rate depends--with all else being equal--on the time scale of the application of these main technological opportunities. Rowtow accepts that in particular periods different branches play a strategic role in defining the overall growth rate of the economy, and divides branches into three types:

-- primary growth sectors;
-- supplementary growth sectors; and
-- derived growth sectors.

The branches mentioned under point one are those where the opportunities for innovation or the application of new resources are higher than the average in the economy. The branches referred to in point two are those where a high growth rate is the result of "response" to progress in the first group (or the result of demand from the first group): an example may be the growth of the railways as a primary growth sector, leading to a massive expansion in iron and steel or mining as supplementary growth sectors. Branches of the third type are those where progress depends on growth of income, population, or other rather slowly developing parameters, (the food industry or housing may serve as examples).

Despite the arbitrary nature of these categories, which Rostow was aware of in advance, he believes that empirical definition of these types of branch is possible for particular regions and in particular periods. Rostow's categories afford some difficulties, as a branch may for example belong simultaneously to the first and second types. In attempting more precise conclusions, Rostow writes that leading branches (strategic) are those in which an additional unit of investment produces the maximum increase in product (ignoring other direct or indirect effects produced by these branches). The correct choice of leading primary branches and the concentration of resources on these branches may lead to the growth of significant branches of the second type (supplementary) and in turn the growth of income causes a general expansion in the economy, including the slowly developing (but essential for balanced growth) derived sectors.

Supplementary branches on a world scale may be leading branches within a given region or economy. Rostow points out also the necessity of the existence of favorable social, political conditions, or other conditions essential for the growth of leading branches (see The Problems of Economic Growth under Capitalism 1965).

The concept of branches which add impetum to growth is similar to that of leading branches. J. Beksiak distinguishes three groups of manufacturing branches which play a particular role in the process of economic growth. In the first group he places branches producing consumer goods, which have a swifter rate of growth than other branches, but where the rate of growth does not influence the functioning of the manufacturing apparatus but directly changes the structure of the final product. In the second group he places branches manufacturing producer goods, the swift growth of which is necessary for the achievement of the desired growth rate for the whole national economy. He terms these latter branches those "giving impetus" to the process of growth. Primarily, branches manufacturing producer items are included here, where the share and role is growing according to the types of technology employed in the economy, and forming a "laboratory" for creating new technological solutions and a "school" fro staff with new qualifications. J. Beksiak places foreign trade in the

third group, treating it also as a kind of producing branch, except that the production deals with the transformation of domestic goods into foreign ones. This branch possesses some characteristics of both the previous groups. By the import of end products, it is possible to change directly the structure of consumption, and in this sense this branch belongs to the first group. Furthermore, in importing producer items, and of these usually goods which are the main carriers of world technological progress (the latest products of technology, licenses etc.) this branch also at the same time belongs to the second group, for it is a branch giving impetus to economic growth. Because of the wide opportunities available to foreign trade to change the economic structure--through change in its structure and share in the whole economy--this is especially significant for the growth of the national economy (see Pullen 1966).

Production processes are accompanied by improvement of the tools, methods and organization of production and also a growth in labor qualifications. Particular branches supply each other with various products, provide services; innovations in some lead to innovations in others. The most important role here is played by certain branches whose influence is very wide, and whose character predisposes them to attain the rank of a creative center for new technological solutions and the education of new personnel. The electronics and atomic industries are the most typical of branches which give impetus to the economy--understood in this sense.

Let us add further, at the end of this review of various classifications of branches of industry, that we sometimes hear of leading systems or sectors (both in the socialist and capitalist systems). Leading sectors give impetus to non-leading sectors. In an industrial society, agriculture is a non-leading sector. We are using a slightly different viewpoint when we say that the leading sector in third world countries is the state sector (NB--mainly because of its modernity and ability to concentrate).

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