OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

United Nations
Centre for Industrial Development

Original: English

Inter-Regional Symposium on Industrial
Project Evaluation

CID/IPE/B.43
Discussion Paper

Prague, Czechoslovakia
11 - 29 October, 1965

00807

ASSESSMENT OF FACTOR ENDOWMENTS IN INDUSTRIAL PROJECT EVALUATION

Prepared by: K. BABA and T. UNNO
Economic Planning Agency
Tokyo,
JAPAN

for: The Centre for Industrial Development
Department of Economic and Social Affairs
UNITED NATIONS

002731

65-42089

Contents

I. What are Factor Endowments?

1. Definitions of Resources

It is said that the study of resource problems was "ignored by econo ists and was entrusted chiefly to natural scientists, especially to physical geographers"(Zimmermann). In economics, "very small transferable units of land, labour and capital left to the control and disposition of entrepreneurs"(Pigou) are regarded as factors of production.

Since the days of Adam Smith, land (nature), labour and capital have been called the three factors of production economically. Of these, nature is a passive factor on which man's labour works, while labour and capital are active factors. The more labour and capital there are and the more excellent they become, the more expanded will that part of nature be that can be taken up and utilized. Man utilizes and works on nature for livelihood purposes (or to satisfy his desires). It is an act of taking up a useful part of nature through technical relations between man and nature, namely technical production. Production in the economic sense is not technical production but man's working on nature through a certain social relationship (production relationship). Accordingly, nature does not constitute resources in itself, but does so only when the cooperation of other factors of production is obtained. A certain part of nature utilized as resources in this way is called natural resources. Such was

a representative way of thinking toward resources entertained by old economics.

There is an opposite stand to such a way of thinking. It contends that resources does not mean individual merchandise, assets that can be transferred by transactions and so forth. They are in a composite whole instead of being individual materials or tangibles. Resources, which are living phenomena, contract or expand corresponding to the amount of labour put in. Not being fixed or static, they increase and breed when treated in a well-conditioned and rational manner, whereas they wither under war and discord. Resources are born and most of them are produced by man. The intellect of man himself, which can utilize them through education, training and learning, is one of the most important resources. Such is the contention of this school of thought.

It is wrong to limit resources only to natural resources. Human resources and cultural resources should not be overlooked. Resources can be derived from dynamic interactions of all such factors as climate, geographical features, location, geology (Coal, iron, petroleum, etc.), health, social harmony and stability, good policy, knowledge and freedom. In other words, the word resources is used concerning the functions which things can perform, and the idea reflecting and expressing man's appraisal of such functions and actions is what is meant by resources. Resources, this stand contends, are long-range and basic social assets.

According to this way of thinking, the functions or actions for attaining the end of satisfying desires, are resources, and so the contents of resources are wide and varied. As the means of attaining individual desires and social objectives are regarded as resources, resources are to be defined by such factors as (1) increase of knowledge, (2) progress of technology, (3) development of science and art, (4) desires, habits and mental attitude, and (5) objectives of society.

On the other hand, some scholars say "There are things which are quite commonly found, but only when they cease to be or when they become scarce, their need is felt and then attention is paid to them. They are important resources"(Myer). (They are, for instance, air, light, water, and land). Also some scholars regard labour, land and services as original means of production and capital as produced means of production, and call the former permanent resources and the latter non-permanent resources.(Hayek)

As to what are resources, there is no definite opinion among economists mentioned above. At any rate, the question lies in the attitude of old economics to restrict the significance of resources to its own idea. That way of thinking which regards land, labour and capital as the factors of production, and deems that nature and natural resources can be represented by "land" is not enough to even for the analysis of economic acts. Among economic relations, consumption has come to be more talked of than production, and desires are going to change from material to cultural.

Such social phenomena as consumption of leisure and recreation, which are probably the results of the said change of desires, cannot, it is feared, be fully measured or analyzed by the old economic methods. The complication of social phenomena is going to give rise to a new border science and calls for the cooperation of various sciences.

We define resources as follows "Resources are things that can be the objects on which man can work as the source for maintaining and elevating social life."

Resources are not limited to materials or tangibles, much less to natural resources. They have latent possibility and are so fluid in content as to increase or decrease according to the manner they are worked on. They vary according to desires and purpose also.

Resources are a notion of value, a social-scientific notion. Resources are an utilizable, physical or biological pattern, not limited in quantity, not fixed, and unchangeable. The opinion that resources of a nation are poor for her population stems from the misunderstanding of resources. Economic profitability does not constitute the criterion for determining the scope of resources, either. The question is what means should be chosen to attain an objective, because profitability is determined by time, place and the manner of utilization.

2. Classification of Resources

We classify resources as follows

(1) Latent Resources:

(i) Weather conditions - rainfall, light, heat, wind, and current.

(ii) Geographical conditions - geology, geographical features, location, inland water and sea water.

(iii) Human conditions - distribution and composition of population, vitality and re-producing capacity.

(2) Actual Resources:

Conditions necessary for making latent resources actual are that (a) means and methods therefore are known, and (b) the quantity and quality are large and good enough to be utilized.

(i) Natural resources - living resources and non-living resources;

(ii) Cultural resources - capital, technology, knowhow, system and organization;

(iii) Human resources - labour force and morale.

Among the resources, from the standpoint of our present study, natural resources are worthy of special attention. Therefore, we shall try to classify them more minutely.

(I) Natural Resources

The three factors of production, land, labour and capital

stem from natural, human and cultural resources. Of these, natural resources can be classified as follows according to their nature.

A. Accumulated resources (resources that are not renewed) or exhaustible resources.

(1) Resources such as the underground metallic minerals, coal, graval and kaolin that do not rot or change as long as they stay where they are.

(2) Resources that increase or decrease by natural operations such as refined minerals (oxidation), petroleum and natural gas (absorption and spouting), manure (flowing out), radium, uranium and plutonium (radiation).

B. Resources that are renewed and fluid, or sustainable resources.

(1) Resources that cannot be prevented by the hand of man from flowing such as solar heat, current and wind.

(2) Resources that are artificially affected.

(i) Rainfall (rain and snow), places of value (location), utility of durable producers' goods and consumers' goods.

(ii)Animals, plants and scenery.

(II) Primary and Secondary Resources

Another rule of classification is possible and necessary, sometimes, for the analysis of the utilization process of resources. The following one will be of some convenience.

(1) Primary Resources

The above-mentioned accumulated resources and fluid resources, such as solar heat, current and wind.

(2) Secondary Resources

Those renewable and fluid resources which belong to (2).

Resources are inter-related composites, so it is not reasonable in many cases to divide them into primary and secondary resources. Unlike live-stock products, birds, beasts, fish, agricultural products and wild plants are primary resources. But differently viewed domestic animals and wild life are the primary resources, to which agricultural products and wild life owe their existence, it may be argued. From the fact that agricultural products, animals and plants depend upon land for existence, it may be said that soil is among the primary resources, but land itself changes owing to agricultural products, animals and plants. Rainfall belongs to the primary resources in relation to agricultural products, animals and plants, but is at the same time affected by solar heat.

3. Conservation of Resources

Conservation of resources is likely to be interpreted in different ways.

1. In the narrowest sense, it means efforts for the prevention of damages caused by disasters. The objects against which conservation is to be practised in that case are as follows.

(1) Storm and flood disaster, earthquake, flood tide and coastal erosion;

(2) Fire, landslide, sinking of ground, soil erosion, reckless fishing and reckless mining;

(3) Pollution of air and water

(4) Noise, bad entry of sun light, and traffic disaster.

2. In a little broader sense, conservation means:

(1) Elevation of degree of utilization;

(2) Prevention of disaster

3. In the broadest sense, it means non-partial, comprehensive or multi-purpose utilization of resources.

(1) Cultivation and increase of material resources:

(i) Prospecting (including discovery);

(ii) Collection (including concentration and utilization);

(iii) Rearing and promotion (including protection of wild life);

(iv) Substitution;

(v) Artificial synthesis (invention).

(2) Rearing of cultural and human resources.

(3) Adjustment of conflicting uses;

(i) In individual resources;

(ii) Among various resources.

(4) Rationalization of uses and consumption of material resources.

(5) Prevention of disasters or damages (natural disasters and public nuisances).

Conservation in this broadest sense is "the sacrifice offered by the present generation for the coming generation"(L.C.Gray), and "the conservation of resources is the greatest good for the greatest number, and the greatest good for the longest term at that"(Van Hydes).

Role of Resources

The water resources of Japan facilitated electric power generation and increased production of rice. The role played by fish in the field of food cannot be ignored. There are rich resources of coal and limestone (for cement and synthetic fibre). Forest resources contributed to the economy as rehabilitation materials and as energy sources (firewood and charcoal). Clay, sand and stone (Kaolin and construction materials) did much for the recovery of the economy.

"I have often heard Japanese speak pessimistically of the future of their mother country. They say that they don't know how it will be possible for the Japanese who will shortly number 80 million to live on the resources to be found in the four islands. Far from sharing such a pessimistic idea, I believe that the 80 million people will live in this country and will perhaps be able to enjoy an even more comfortable life than in the past. -

Looking back, we know how right he was in what he pointed out.

Professor W. S. Woytinsky who visited Japan 1954 pointed out as follows.

"(1) Over-population is not a big threat. Japan is not more over-populated than some of the West European countries. (The density of population of Netherlands and Belgium is more than that of Japan, and that of Britain, West Germany and Italy is nearly equivalent;

(2) Though it is said that the land under cultivation of Japan is only 14% of the national land, the arable land of the world is no more than 9.1% of its land, The land under cultivation in Japan per capital is the smallest being 0.2 acre (that of Belgium, the Netherlands and Switzerland is 0.3 while that of Britain is 0.4), but the climate being mild, the production per unit of area is high. Moreover, the two-crop-a-year system begin widely adopted, the utilization rate of planting is 170%.

"Furthermore, the remaining land resources in Hokkaido and other districts are not yet fully developed. The frost in Hokkaido is not so severe as in the north of America and the south of Canada. Japan is almost self-sufficient in rice, and is rich in fish and vegetables, as well as in fuels, lumber, pulp, copper, zinc, cement, clay and hydro-electric power. Many natural resources are not sufficient, it is true, but it must be pointed out that when their

shortages are emphasized we are liable to overlook the most important resources, namely labor force, technical knowledge and managing ability, which are resources that have led some areas to more prosperity than other areas. The economic development of Japan since around 1875 and especially the wonderful recovery in the postwar period are enough to show that Japan is richly favored with these resources."

Looking back, we find that what he pointed out was all correct. In other words pessimistic views were wrong.

II. Prerequisites to the Materialization of Industrial Projects

Any industrial project cannot become a real one till it passes through at least the following three stages of checking-up procedure: Are there (a) social needs, (b) physical possibility, (c) economic feasibility for it? Being closely related with each other, these three conditions constitute a comprehensive condition which support actuality and rationality of a proposed project.

1. Problem Area and Resources Area

It goes without saying that any actual projects occupy certain spots or places on the earth. Therefore, we must think of the project on a concrete place. Before undertaking an actual project, the very existence of social needs to be met by products (including services) brought about by the project must be ascertained, and these may be translated into the form of problems to be solved. Area in which problems exist shall be called "problems area". If there are resources to meet the problems, on the other hand, area having such resources shall be called "resources area". From the locational point of view, an industrial project comes into being at a point on which problems area come in contact with resources area. "Contact" in this sence does not necessarily mean that the two areas are neighbouring. Let us take examples: It happens that harnessing a river (resources area) remote from industrial area (problems area) is aimed at

suppling the area with electric power; although it has been said that there may be reserved much of valuable under-ground resources in Antarctic Continent, no one would not exploit them as far. Should Antarctic Continent be a resources area, no necessity of opening up there would come about as it has not been brought into contact with problems area. Now, however, such a calm situation in the continent is about to go away, which is a result of technological progress. This exemplifies that the scope of resources is nothing but a function of advance in technology.

There occurs frequently such a case where the problem to be solved is much too serious, whereas resources to meet it are scarce. It does not always imply lowness of the necessity of development even if an area which has a great deal of potential resources is left untapped. There may be such a case, too, as development work is prevented being executed by some historical, social, and/or artificial reasons which happen to be stronger than the necessity for development. Contrary of the said cases, there may be a case where development is promoted by accidental factors. Consequently problems of development which stem from many sorts of combination of problem area and resources area result in having different nuance for different combination of them.

2. Existence of Immobile Factors and Fixed Public Assets

It can be said that technological progress is likely to

release human beings from the limitations on their economic life by enriching both quantitatively and qualitatively resources available for them. Nevertheless, there are for the present many obstacles and limitations in utilizing resources. Natural conditions including climate, topography, geology largely affect our economic activities, forming physical and regional conditions for production and consumption.

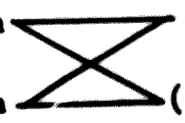
The principle of comparative costs, shows that the very specialization of products in accordance with those conditions for production given to individual nations would bring about gains from international trade, provided that it premises relative immobility of factors of production. As the conditions for production vary from region to region, and yet the actual process of production is more or less affected by them, a given state of locational conditions for a project constitutes important factor endowments affecting advantages and disadvantages of the project. What induces interregional flows of commodities and population is differences in factor endowments between regions.

In evaluating validity of any industrial project, therefore, locational conditions as well as general economic conditions getting it in need and possible should be taken into account. We will distinguish locational conditions from locational factors of industry: The former is objective surroundings whereas the latter is subjective requirements for the location of individual project. Superiority or inferiority of a locational condition

depends upon, first, the social system and the stage of development of an economy in a given social system, second, comparative differences of regions, and third, kind of industry in question. With regard to the quality of conditions of location three types of categories could be given: First is the superior (or comparatively advantageous) condition of location, second the inferior (or comparatively disadvantageous) condition, and third the neutral one which is equal to national average and therefore can be neglected when considering comparative status of locational conditions.

Under given technical and socio-economic circumstances the quality or superiority and inferiority of locational conditions is regarded as either "fixed" or "variable": The fixed conditions mainly consist of such natural conditions as climate, topography and geology and such exhaustible resources as underground mineral ores, and some social conditions built up through long historical process, whereas the variable conditions consist by and large of such sustainable resources as agricultural, forestry and livestock resources which are all able to be fastered or bred to some extent.

Summing up the above considerations, four types of combination of locational conditions can be derived as follows:



Let us illustrate these combined conditions for location with some examples found in Japan of today.

(1)- (i) Fixed superior conditions

Cool climate and sparsely populated wide area in Hokkaido are all fitted to dairy industry. Rias-type coasts good for port, provide good seaside industrial sites which are found oftenin Japan. In the southern part of Kyushu which is remote from any of large industrial centres, aboundant labour force is still available for the footloose-type industry.

(1)-(ii) Variable superior conditions

Hokkaido is in a good position to have sugar factories because of its conditions for growing sugar beet. The southern part of Kyushu is suitable for lumber mills and wooden-product factories because of its rich forest resources.

(2)- (i) Fixed inferior conditions

In Hokkaido, again, enterprises are obliged to pay nominally high wages due to cold and snowy weather. Kanaishi industrial area, having rather large scale iron and steel mills on the Rias-type coast, is hindered from its further development for lack of hinterland. The southern parts of Kyushu is poorly endowed with local capital.

(2)-(ii) Variable inferior conditions

The southern part of Kyushu is seen to be too remote in a sense of time-distance from markets of consumption. Tomakomai, a coastal city in Hokkaido having good space for building plants, is handicapped by the shoaling beach against making a port. However, these handicaps are thought to be

not fixed but variable, as they may be overcome by means of, say, constructing express highways or railways for the former case, and digging down port-site, by applying recently-developed civil engineering techniques, for the latter case.

It should be noted that even manufacturing industry, which seems at a glance free from natural land contraints, is not independent from the immobile factors or the factors attached to land:

1) Characters of land

The extent, shape and quality of land are of first importance to location of any industrial project. In some cases of building large and weighty structures, the strength of ground foundation is an essential requisite.

2) Supply of water

Almost every manufacturing activities may use water resources. Particularly such industries as paper and pulp, chemicals and iron and steel demand much water. On the contrary, manufacturers of machinery may need only a minimum amount of water since any factory where operatives are on the work cannot go on without supply of water.

3) Infrastructure or social overhead capital

Infrastructures including roads, railroads, ports, river

conservation works, sewage works and other social-service utilities themselves, though once made by men, form a set of ex ante conditions before setting an industrial project. The infrastructures or social overhead capitals may be altered by actions to change the existing state of them or public investment. Nevertheless, since an incremental or additional part created by public investment is very small as against the total stock of existing social assets, a given state of infrastructures has to be taken as a major premise to formulation of an industrial project.

III Case Studies

Case 1. Labour Force as a Locational Factor of Machinery Industry

From the viewpoint of the theory of location of industry, machinery industry is classified into footloose-type industry. Of the industries of undetermined transport orientation the footloose-type one is such that can be located either at the sources of material or the place of consumption, or the intermediate places and whose location is easily governed by factors of deviation such as labour force, available land, climate, agglomerating advantages, personal factor, impacts of policy, historical tradition, incidental events and so on.

The most footloose-type industry is characterized as follows: first, it has generally a high degree of flexibility of location; second, it is so diverse that deviation factors relating to it are many, complicated and delicate; third, it usually enjoys a comparatively high ratio of value added to output, increasing employment; forth, many of the industries of this type are favoured with high growth potentials, and together with the characteristics mentioned above being likely to exert a great effect upon overall development. Categorically speaking, the footloose industry consists of the industry relating to various vehicles (cars, lorries and rolling stocks), light voltage electric equipments (washers, air-conditioners, refrigerators, vacuum cleaners, etc.), electronics equipments (radios, television sets, tape recorders, wireless communication equipments, semi-conductor elements, etc.), precision apparatus and machines (optical

instruments, medical-care equipments, watches and clocks, measuring and scaling instruments, etc.), garment and other textile-articles, plastic molding, and many other general and industry-use machinery.

Examining the technical characteristics of machinery industry, at first we find it an assembling one. Generally speaking, it can be separated into the process of manufacturing parts and the process of assembling them. The parts are of many sorts, and the techniques adoped to produce them are also diverse. A transistor radio set, for example, is not finished till many parts such as semi-conductor elements, circuit wires, wire coverings, plastics body, leather-made case, antenna, etc. are prepared through many different technical processes. The manufacture of motor cars requires to assemble as many as ten thousands parts. In the field of assembling parts there are many manufacturers engaging in the division of labour. It is conspicuous that a clear dividing line runs between the manufacture by assembling and the making of parts. And, the former is carried by larger enterprise establishments while the latter by small and petty manufacturer groups.

Secondly, machinery industry is a labour intensive one; among manufacturing industries, most of machinery industries except car-making are characterized by their low value of capital per worker and at the same time by their low ratio of capital to output, which means high elasticity of labour input with regard to output in the process of production.

Values of capital per worker in selected industries

As of 1962 (July - Dec.)

(million yen)

Mining and mfg.	2.46
Coal	1.51
(Manufacturing, all)	(2.54)
Textiles	2.14
Paper & pulp	5.33
Chemicals	3.48
Petroleum Refinery	10.24
Tyre	1.77
Ceramics	6.01
Metal working	3.85
Machinery	1.49
General	1.34
Electric	1.51
Cars	3.30
Others	0.87
Commerce	1.11
Trading	1.09
Department stores	1.14
Public utilities	14.08
All average	3.39

Source: Ministry of International Trade and Industry;
Analysis of Japan's Business Enterprise.

Thirdly, activities of machinery industries bring about great repercussions on the other industrial activities. In terms of the coefficients of repercussion (the sum of outputs to be induced by each unit of increased demand for a given sector of industry), as shown in the Table, either of the three machinery sectors holds the top rank. In other words, for instance, the production worth 1 million yen of transport equipment tend to raise more additional output of 0.98 million yen in the other industrial sectors.

Coefficients of repercussion of selected industries

Agri., forest. & fish.	0.2353
Mining	0.2898
Food	0.2395
Textiles	0.3170
Paper & pulp	0.2525
Chemicals	0.3383
Coal & petroleum prod.	0.3851
Ceramics	0.4013
Iron & steel	0.1764
Non-ferrous metals	0.4803
General machines	0.8111
Electric equipment	0.6789
Transport equipments	0.9823
Other mfg.	0.5624
Building	0.2223

Civil engineering works

Public utilities

Transport services

Other services

(Note) 1. Calculated from the 19
compiled by the Bureau of Statis
Management Agency.

2. Coefficient of repercu
output to be induced through int
for each industries.

What position does machiner
relations? We put the question
relationship of machinery industr
composition) and the input side
of intersectoral dependence. To
into two categories of demand, t
government, capital formation an
intermediate demand sector repre
the basis of this fact, the inter
industrial activity are obtained
supplied to the endogeneous secto
the total output from the activi
we see that the input to any prod
categories of input, too, the mat
and the labour and other human fa

income." From this fact, we define the share of material inputs in the total input to a given industrial activity as the intermediate-input ratio. This ratio stands in the following relation with the ratio of value added to output:

1 - intermediate-input ratio = value-added ratio.

By using those two kinds of ratio, all industry denoted in the interindustry table can be classified into four types of industry, as follows:

		Intermediate-demand ratio	
		Below the average	Above the average
Intermediate-input ratio	Above the average	(III) Final mfg.	(II) Intermediate mfg.
	Below the average	(IV) Final primary production	(I) Intermediate primary production

According to the above classification, all industrial activities can be grouped into four types as indicated below:

(I) Intermediate primary production

Agriculture, forestry, mining, and electric power generation.

(II) Intermediate manufacturing

Iron and steel, pulp and paper, petroleum products, non-ferrous, chemicals, coal products, rubber products, textile goods, and printing and publishing.

(III) Final manufacturing

Personal belongings, shipbuilding, leather and leather products, processed food, rice cleaning and flour milling, transport equipments, machinery, timber and timber products, non-metallic minerals products, and other manufactured goods.

(IV) Final primary production

Fishery, transportation, commerce, and service-producing industry.

Roughly speaking, the industries I, II, and III all form the order of production processes: intermediate sectors represented by industrial groups I and II deliver their products to the final manufacturing sectors, which in turn sell their finished products to the final demanders; the group IV is relatively independent from the others, and functioning to supply rather directly fundamental factors of production to the final demanders.

This type of grouping of industries is of some service for clarifying characteristics of each industry, and, of course, it is of use in considering why some industries tend to cluster with each other. It is no doubt that each of the industries II and III particularly gives aggromerating advantages to one another, and for so doing they take their location neighbouring. Manufacturing and production activities directly connected with final demand are oriented to the place of consumers' market, whereas intermediate manufacturing and production need not be located near the centres of consumers market in and around which land price usually is so high as to prevent

the location of such space-consuming industries as the group I and II. A survey shows that in Japan, a few years ago, the number of the workers per hectare in the group II was less than 60 while that in the group III was more than 110. In other words, density of workers in the intermediate manufacturing factory was about double that in final manufacturing. And the former group has in general a propensity to locate near the seaside because of convenient transport of its heavy materials and products whereas the group III, with several exceptions, can be settled out of the seaside, and accordingly scattered in inland places.

Summing up the above considerations it may be concluded that for the location of machinery industry physical and geographical conditions make rather weak constraints but social and market conditions are likely to act as stronger constraints. As a matter of fact, in Japan, most of machinery manufactories are concentrated in three major industrially advanced areas - Tokyo, Osaka, Nagoya and their neighbouring areas. One of the most influential factors to location of machinery works is availability of labour force. The prevailing view on the relationships between the labour factor and the manufacture of machinery experienced a turning point around 1960 when the Japanese economy was shifting from a labour-scarce to a labour-surplus economy which had been lasting to mark the Japanese economy since the beginning of its modern development.

Up to the time of turning point, it has been said, that the most important problem is how to attain full employment and improve it,.....

secondary as well as tertiary industries are keenly required to play a great role in offering employment opportunities to the yearly increase in labour force, but, the increased labour force has been absorbed rather more into tertiary than into secondary industry, ... considering the ever-lasting situation of employment in Japan where working population is abundant and underemployment prevails, secondary industry is strongly expected to open not only a great deal of job-opportunities but also thereby bring about impacts on improvement and modernization in the field of employment, ... even if heavy industry progressed rapidly, as the so-called apparatus industry, a capital intensive one, has little capability to employ workers for investment in it, does not always imply to match employment with production at a desirable level, ... labour-absorbing capacity of machinery industry, therefore, should be noted, ... promotion of machinery industry is regarded as a key action for achieving a balanced development of heavy and chemical industries and betterment of employment situation.

The proposition proved true: a statistical evidence shows that machinery industry ranks top in terms of the number of the employed created by a given amount of fixed investment; for every one hundred million yen invested, according to the average figures for the period from 1954 to 1962, food processing industry created 102 jobs, spinning 49, paper and allied products 22, chemicals only 10, primary metallic products 22, general machinery 175, electric appliances and equipments 140, transport equipment 80, and average for all manufacture 66 (all calculated from Census of the manufactures by MITI); in terms

of the compositional ratios by industry of the increment in the number of the employed during the period between two population-census years, 1955 and 1960, primary industry lost 3.2 percent, while secondary one gained 59.8 percent and tertiary one won 43.8 percent, and moreover, within the secondary one's share manufacturing industry occupied 44.4 percent and construction industry accounted for the rest of the share, 15.4 percent; a detailed composition of the increase in the employed in the manufacturing industry during the same period was as follows:

	(Percent)		(Percent)
Food processing	3.8	Rubber	3.1
Tobacco	0.1	Leather	0.5
Textiles	4.4	Ceramics	4.7
Garments	5.6	Primary metals	8.8
Timber	2.2	Metallic products	11.1
Furnitures	1.3	Machinery	10.4
Pulp & paper	4.0	Electric equipments	14.3
Printing & publishing	2.7	Transport equipments	8.1
Chemicals	3.2	Precision equipments	2.8
Coal & petroleum products	0.2	Others	8.7
Total (manufacturing all)	100.0		

Since around 1960 labour shortage came to be felt in some sectors, due to a rapid economic expansion and violent changes in industrial structure. Japanese economy is becoming a labour-scarce one though not yet reaching that in a full sense. Particularly young labourers

and talented or skilled persons are short of filling demand whereas labour force of high and middle ages is still seeking job opportunities. It is a tradition followed in Japan that skill formation and fostering of skilled workers have been committed to the hand of private business enterprises, and there have been few social utilities for the purpose. The measures to make up for the curious gap expressed in the fact that labour force is felt short on the one side while it is abundant on the other side are being sought and executed step by step. Therefore, if the measures taken turned successful and if demand for labour increased a good deal, any idle labour force would get employed in the long run.

The role to be played by machinery industry, at any foreseeable circumstances, is still important and getting more importance, for it makes a strategic sector for industrialization and economic development especially under the conditions of a country like Japan where natural resources are scarce and population abundant and highly educated.

Case 2. Developmental Project of Synthetic Fibre Industry
- A Case Study of Vynilon Textile -

1. General Background of Necessity to Promote Synthetic Fibre Industry.

As is known, Japan is one of the countries with relatively poor natural resources in the world though some resources like

water, coal, and limestone are abundant. In addition Japan had been forced to isolate herself from the international trade market for several years immediately after the War. The level of living of the people dropped to about half of the pre-war level. The isolation policy by the Occupied Forces had decisive effect upon industrial production in Japan whose raw materials were dependent on foreign countries. Therefore in order to rehabilitate and develop the Japanese economy, it was required to utilize indigenous resources as efficiently as possible. It was quite fortunate for Japan to have abundant labor forces with relatively higher knowledge and education although raw materials and productive equipment were short due partly to the War. In some cases, technical progress in the War-time made it possible to shift raw materials depending mainly on foreign countries to indigeneously endowed natural resources.

As a typical example of efficient utilization of indigenous resources, we can point out the case of synthetic fibre industry. As is well known, the textile industry was one of the most typical industries in Japan before the War. It is not too much to say that industrialization of the Japanese economy has been promoted by the development of textile industry.

The problem was, however, that raw materials of the industry, that is, cotton had been imported from abroad. As mentioned before, Japan had been isolated for a decade including the war-time. In 1940's therefore, Japanese people had to experience

a life of austerity due to the shortage of supply of clothes. Even if Japan could enter into the international trade market soon after the War, it might have been not possible to import textile raw materials because foodstufi which was more important for the level of people's living in those days had to be imported on preferential basis.

Under these severe circumstances, promotion of synthetic fibre industry which could utilize abundantly endowed indigenous resources were proposed by the Resources Council which is a governmental advisory organ attached to Agency for Science and Technology. It was quite lucky for Japan that synthetic textile had been developed in some university's laboratory although it had not yet been industrialized. It is considered that the synthetic textile which is called as "vynilon textile" will give a good example in evaluating industrial project from the view point of factor endowments in the sense that this synthetic textile was originally developed by the Japanese technology in order to make efficient use of indigenous resources endowed abundantly in Japan.

2. The Resources Council's Recommendation

Before entering into empirical case studies on vynilon project, something should be mentioned of the Resources Council's Recommendation which gave an opportunity to industrialize vynilon textile.

As mentioned above, the Resources Council made a recommendation in 1949 on promotion of bringing up synthetic fibre industry to let people take off from a life of austerity in clothing.

The Recommendation stressed that the synthetic fibre industry was to be brought up as one of the most promising industries in Japan. Rough estimation in the Recommendation revealed that in order to clothe the 100 million population in Japan at the same level of 1938, 1300 million pounds of cotton, 200 million pounds of wool, and 600 million pounds of rayon, totalling 2,100 million pounds were required. Even if it was assumed that rayon could be supplied indigenously, almost all of required cotton and wool had to be imported from abroad. Undoubtedly such big secular imports of textile raw materials would not only become a great burden of international balance of payments, but also hamper the rehabilitation of the Japanese economy to a great extent by making imports of other essential industrial raw materials difficult even if Japan was allowed to enter the foreign trade market. Before the War, as is well known, Japan could import textile raw materials by exporting silk to the United States and other developed countries. The War, however, not only forced Japan to isolate from the international society, but made it impossible to export silk to foreign countries because synthetic fibres such as nylon textile were developed as substitution for silk by the epoch-making technical progress in advanced countries in and after the wartime.

Thus the Recommendation stressed from this point of view that the building-up of synthetic fiber industry using indigenously endowed raw materials is greatly conducive to improvements of balance of payments of Japan in future and salvation of emergent situation of people's living in those days. Because the synthetic textile which was developed by the Japanese technology are made from such abundantly endowed resources in Japan as air, water, electric power, coal, limestone, and so forth.

Vynilon textile is one of those synthetic textiles which Japan succeeded in industrializing promoted by the Recommendation.

3. Production Process of Vynilon textile and its raw materials

It may be convenient to give a brief explanation on production process of vynilon textile by which a better understanding will be obtained on the problem of assessment on factor endowments in project evaluation which will be discussed in the latter parts of this paper relating to the choice of location of vynilon textile plant.

The main raw materials of vynilon textile is carbide. Carbide is, as is well known made from limestone and carbonic materials. When limestone is chemically converted into carbide, a considerable amount of electric power is required. For this reason, carbide industry is called as electric power mass-consuming industry. Acetylene gas which is taken out from carbide is chemically changed by a catalizer into some materials whose

chemical name is "polyvynil-alchole" and whose shape is similar to natural cotton. Polyvynil alchole become vynilon when it is spinned.

Therefore we may say that important raw materials of vynilon textile are limestone, electric power, and carbonic materials like coal, cokes, and charcoal. Adding to these raw materials, water resource is also required not only in the process of production of vynilon, but for the generation of electric power.

What we have to pay attention to in this case is that most of these raw materials are immobile resources. It goes without saying that any raw materials can be transported physically unless we take into account transportation costs. However, any commodities should be supplied at reasonable prices even if these commodities are absolutely short just like in Japan immediately after the war. For example limestone which is a main raw material of carbide is too bulky to transport. In order to transmit electric power for a long distance, a considerable amount of cost is needed which will be transferred to price of final products.

In this sense, those locations have to be selected where these immobile resources can be supplied abundantly and cheaply in the case of installation of vynilon plant. This will be explained in more detail when we discuss on the concrete problem of project evaluation.

4. A Short History of Vynilon Production in Japan

Vynilon production in Japan amounted to 44,169 tons in 1964. It is quite surprising that such a remarkable development of vynilon production has been realized only for one and half decade. Though vynilon production started in 1949, technological development was finished already in the laboratory of Kyoto University before the War. Immediately after the war, the General Headquarter of Occupied Forces gave limitations on the activity level of chemical fiber industry in Japan from the fear of possible invasion into the foreign trade market. With respect to synthetic fibre industry, however, any limitations were not placed upon because of its infant stage of development. This gave a chance to industrialize synthetic textiles developed in the university's laboratory.

Vynilon textile is produced by several companies at present, and Kurashiki Rayon Company is the leading firm in vynilon production. As we take up "Toyama Factory" of this company as an example in evaluating project from the view point of factor endowments, we will give a glance at the development process of this company in vynilon production by which we will be able to know a little about a history of vynilon production. Before and during the War, main products of Kurashiki Rayon Company were rayon as symbolized in the name of the company. President of the company who were eagerly willing to utilize domestic resources had interests in the technological development of vynilon textile in

the laboratory of Kyoto University. He was determined to industrialize the technology, facing the shortage of raw materials of rayon and emergent situations of people in clothing.

In 1949, Kurashiki Rayon Company started to construct a test plant with capacity of one ton per day. Basing upon experiments and research through the test plant, construction of factory at Toyama and Okayama was started in late 1949, and after one year the operation of factories started. Capacity of the plant at Toyama factory which produced polyvynil-alchole was 5 tons per day at the initial stage and capacity of the plant at Okayama Factory which specialized in spinning polyvynil-alchole to vynilon was also 5 tons per day. Polyvynil-alchole is transported between Toyama and Okayama whose distance is several hundreds kilometers. The fact that two factories of this company are located at different place gives us an interesting material for studying locational problem of project.

By the end of 1951, the capacity of the plant at both factories increased to 8 tons per day and it became 15 tons per day at Toyama factory and 13 tons at Okayama factory.

In 1959, the capacity of the plant expanded to 55 tons per day at Toyama factory and 50 tons at Okayama and it is about 80 tons per day at both factories at present.

Here we will glance at the movement of total production of vynilon since 1950. Following table shows a remarkable development

of production of vynilon textiles, although we can not show the relative market share occupied by individual firms.

Table; Production of vynilon textile since 1950

Year	1950	51	52	53	54	55	56
Production(ton)	352	2,722	2,597	3,898	3,671	6,158	10,921
Year	1957	58	59	60	61	62	63
Production(ton)	14,730	12,853	16,567	22,638	30,004	35,431	37,376
Year	1964						
Production(ton)	44,169						

As a result of such remarkable development in production, the vynilon textile industry has taken off already from the stage of infant industry, although it has some problems to be solved.

5. Relative Advantage in Factor Endowments in Production of Vynilon textile. - A Case of Toyama Factory of Kurashiki Rayon Company.

As mentioned before, Kurashiki Rayon Company established a factory at Toyama and Okayama. It was also explained that poly-vynil-alchole which is manufactured at Toyama Factory is transported to Okayama Factory in order to spin though the distance between locations of two factories is considerably long. Why should two factories be located at different places despite the fact that the most economical way of production is to manufacture final products at the same place

where intermediate products are produced? Generally speaking, the above mentioned statement is true. Executives of Kurashiki Rayon Company did not rely their decisions on this principle. The reasons why they made their decisions to locate their two factories at different places were due to the facts that main raw materials of polyvynil-alchole were immobile and spinning technique which had been developed in the production of rayon could be fully utilized at Okayama where the company had had its main rayon spinning factory. In other words, it may be said that Toyama factory was established on the basis of relative advantage of factor endowments at Toyama and decisions to establish a factory at Okayama was made based on the principle of choice of technique.

As already explained before, Kurashiki Rayon Company had specialized in production of chemical fibres before the War, and its main factory located at Kurashiki, in Okayama prefecture. Therefore, it was relatively convenient to establish a spinning factory from the view point of easy applicability of spinning technique and skilled labors.

On the other hand, in the case of Toyama factory, situation was fundamentally different from the case of Okayama factory in the sense that immobile resources had to be used as raw materials. Therefore, executives of the company considered that it was the most efficient way of production of vynilon to locate two factories at different places with relative advantage in factor endowments including human resources.

In evaluating the project of vynilon textile production, we should not overlook relative advantages in factor endowments (especially natural resources endowments) at Toyama area.

As often mentioned before, polyvynil-alchole which is the pre-stage products of vynilon textile is made from carbide and other materials. The following table shows raw materials required in production of unit ton of vynilon textile and the process of technical progress in the production during a decade from 1949 to 1958.

Table. Required raw materials per unit ton of Vynilon textile.

Year	1949	1956	1958
Capacity per day	2 tons	20 tons	20 tons
Carbide	4.85 ton	2.4 ton	2.25 ton
Methanol	0.76	0.15	0.1
Formalin	0.72	0.5	0.4
Sulfuric acid	2.0	0.4	0.3
Caustic soda	1.0	0.2	0.15
Coal	24.0	7.0	5.0
Electric power	18,000 KWH	6,000 KWH	5,000 KWH

1) Estimated by the Resources Council

2) Coal = 6,000 calorie

As clearly understood, there was remarkable technical progress in vynilon textile industry. However, a considerable amount of carbide, electric power, and coal are still required. In addition, incomparable amount of electric power is needed to manufacture carbide from limestone. Therefore it may be said that necessary conditions for economic activity of vynilon textile industry is, possibility of abundant supply of cheap electric power and limestone at same places. In other words, vynilon textile industry can not succeed in price competition with other textile industry unless such a necessary condition is satisfied. Because main raw materials of vynilon textile are, as explained before, economically immobile resources.

Here we will focus our attention on topographical and geographical features of Toyama area. Japan as well known, stretches from North-east to South-west and its length is about two thousands kilometers. In the central part of Japan mainland, high mountains stretch also from North-east to South-west. High mountains make rivers with swift current.

Toyama area locates on North-west side of the mountains and has many rivers with much quantity of water. This made it possible to generate electric power by utilizing water current of rivers. It is, however, difficult to control hydroelectric power generation utilizing current of water, which is different from the case of power generation by water reservoirs. This gives excess supply of electric power at midnight or in spring time when snow melts

into water.

Under these circumstances, in Toyama area those industries which consume big amount of electric power had developed since pre-war time. Many of these industries had located at this area for the sake of this excess hydroelectric power whose price was relatively cheap. In addition to abundant supply of cheap electric power, rich deposits of limestone in this area made it possible to develop carbide industry. It is said that deposits of limestone in Japan are almost limitless, especially in Toyama area estimated amount of limestone deposits is said to be more than some fifty billion tons. Before the war, however, demand for carbide was limited. Only chemical fertilizer industry and iron processing industry were purchasers of this product. Therefore it was quite desirable for both producers and purchasers of carbide to construct a factory at this point.

Thus, Kurashiki Rayon Company decided to locate its main factory which manufactures polyvynil alchole at Toyama. In this case it was quite lucky for the company that Showa Denko Company which is a leading company in the carbide industry offered to use the company's idle site at Toyama where its carbide manufacturing plants located. This meant that any cost was not needed to transport carbide excepting instalation cost and operation cost of belt-conveyer.

Judging from the above stated explanations, it may be

considered that this project has been promoted under quite fortunate circumstances. However, there were many difficulties in promoting the project for both the company and government. With respect to the governments' financial assistance to the company, a brief explanation will be given in later section of this paper where we discuss on "some advices and suggestions for less-developed countries."

Among these difficulties the company faced when the project was promoted, the most difficult problem was how to finance the funds as it is often so for any project. We could not get any information about money spent on this project because it is the secret of the private company. However, we can estimate it indirectly by using materials prepared by the Resources Council.

According to the materials, economically minimum scale of vynilon plant was 10 tons per day and in order to make 10 tons vynilon textile, 10 tons of polyvynil alchole and 40 tons of carbide were needed in these days. In this case 400 million yen was needed for the constructions of plant and equipment manufacturing carbide, 1 billion yen for the plant and equipment manufacturing polyvynil-alchole, and 1 billion yen for vynilon spinning machinery, the totalling 2.4 billion yen was needed at 1951 price. In other words, about 1 percent of total investment on plant and equipment by private sector in 1949 was required in order to supply 10 tons of vynilon textile per day. Thus the materials of the Council concluded that there were no difficulties except a difficulty to

finance funds in promoting the project of vynilon textile production and requested the government to take efficient measures to make it possible to finance funds.

Above statement by the Resources Council was partly true. There were many difficulties, however, to be overcome because vynilon textile was quite a new product not only in Japan, but in the world. For example, they should develop the dyeing technique suitable for the new products and develop market for the goods.

Therefore we can conclude that the reasons why vynilon industry has been developing remarkably for a short time despite the fact that it had many difficulties to overcome in its initial stage of development were relative advantage of factor endowments and government financial assistance.

6. The Relationship of Productive Capacity of plant and Price of products.

As already mentioned briefly in former sections, the development process of productive capacity in both factories at Toyama and Okayama is as follows.

The development process of productive capacity per day.

	1949	50	51	55	56	57	59	63
Toyama factory (manufacturing polyvynil alchole)	-	5	8	15	20	35	55	80
Okayama factory (spinning vynilon)	-	5	8	15	18	35	50	80

Vynilon textile was a new product. Therefore it may be said that even such remarkable development was a result of trials and errors. So it was quite difficult to make economic calculation. In other words, this project had been promoted not from the view point of commercial profitability, but from the relative advantage of factor endowments. After some experiences for several years, it became possible to estimate the price of the products and profitability by scale of capacity of the project.

Because it was verified that production cost of vynilon textile was declining corresponding to the technical improvements, decrease of required raw materials per unit, and expansion of scale of production. In the end of 1950s, it was estimated that in a factory with capacity of 20 tons per day, the price of vynilon textile would be 400 yen per unit kilogram and 40 percent of which would be occupied by cost of raw materials.

Next table shows the international comparisons of prices of various textile.

Table. Price comparison of staple between U.S., UK, and Japan in 1958.

	Cotton	Wool	Rayon	Vynilon
Japan	253	800	184	463
U.S.	276	893	247	-
U.K.	220	712	223	-

1) Unit: Yen per kilogram.

As the above table shows, vynilon textile industry was getting out of the stage of infant industry though unit price was higher than those of cotton and rayon in 1958. It may be surprising that this industry has developed so much despite the fact that nobody could tell at the initial stage of this project when commercial profitability could be expected.

Generally speaking, a project is evaluated from the stand point of its commercial profitability as long as the project belongs to private sector. In some cases, however a project is evaluated from other stand points than commercial profitability even if it is a private industrial project. In our belief, the project of vynilon production was a rare example of industrial projects in Japan which has been promoted from the view point of efficient utilization of indigenously endowed natural and human resources.

7. Advices and Suggestions to less-developed countries derived from some experiences of vynilon textile industry.

Vynilon textile industry in Japan has developed, overcoming many difficulties by making use of relative advantage of factor endowments in Japan, and at the same time governments financial aid and other measures must not be overlooked in evaluating the remarkable development of the industry.

Experiences of vynilon textile industry will give valuable suggestions to less-developed countries because Japan immediately after the war was similar to those countries in the sense that

she needed large amount of foreign aid to develop her economy. Here, a brief explanation will be given on various measures taken by the Japanese government in order to bring up the new industry.

As explained in the second section of this paper, the Resources Council recommended in 1949 to take special measures to bring up synthetic fibre industry in which vynilon textile was included. Basing upon this recommendation, the government nominated synthetic fibre as the important commodity in March 1950 and gave a special treatment by which companies were exempted from taxation for three years at their initial stage of development. In the same year, Ministry of Finance decided to levy 25 percent of custom tax on import of synthetic textiles and at the same time decided to invest U.S. aid counterpart funds on synthetic fibre industry.

As the financial aid from the government, Kurashiki Rayon Company was given 600 million yen of loan from U.S. aid counterpart funds in 1950, 350 million yen in 1951 from Japan Development Bank which is a semi-government bank, and 970 million yen in 1952. It goes without saying that these funds were spent on the construction of two factories at Toyama and Okayama.

Along the active measures by the government, excutives and workers of the company also have made their utmost effort to establish a new industry. The remarkable development of the industry and the company is a result of close cooperation of the

government and the private company. And we may say that the case of vynilon production is one of the most typical examples where the private firm succeeded in efficient utilization of foreign aid.

Less-developed countries of today are in more favourable positions than Japan immediately after the War in respect to the generosity of aid from abroad, and have relative advantage in factor endowments. What are short in less-developed countries of today are lack of knowledge and willingness to take risk. The promotion of vynilon textile industry has been accompanied by many difficulties and risks which, however, has been overcome by private initiatives and devices supported by public leadership and assistance.

The example of vynilon textile industry gives us a valuable lesson that any difficulties and risks in promoting some project can be overcome even in less-developed countries if there are private initiatives and public leadership. Because other things are equal between these countries and Japan.

Case 3. Assessment of Regional Differences in Locational Advantages for Some Proposed Industrial Complexes.

An industrial complex may be defined as a set of activities occuring at a given location and belonging to a group (sub-system) of activities which are subject to important production, marketing, or other interrelations. Therefore, activities of an industrial complex are closely interrelated and so many-sided that they are

difficult to be analyzed or evaluated from a single point of view. But, as an example, we dare to present an assessment of the proposed projects of industrial complexes including petroleum and its derivatives (for shorthand, shall be written as petroleum-chemical complex).

Needless to say, Japan is supplying her demand for petroleum oil with imported crude oil though very small fraction of it is being met with domestically-produced oil. In Japan it is assumed naturally that any petroleum-chemical complex will be located near the seashores for the convenience of transportation and that informations on proposed sites for the projects of the complex are available for the interested. Then we will make a comparative study of the locational advantages of the proposed sites on the basis of hypothetically standardized scale of project. And moreover, for the sake of simplifying, we will take up only four cost items - rent or price of land, water charges, wages, and power rate. As a basic-indicator-product of the petroleum-chemical complex we adopt here ethylene.

At first, be a plant producing 100,000 tons/year of ethylene as our standardized scale of a project. From this assumption physical requirements per ton of ethylene are worked out: power requirement is 1,450 KWH, water 850m^3, labour 0.001 person, land 0.5749m^2.

(a) Cost of land use

Cost of rent paid for the borrowed land or imputed rent

for the owned land is calculated by the formula below:

Rend cost = Area/ton X price of land X interest rate.

where price of land is estimated from "Selected Statistics attached to the Results of Survey of the Designated Areas for Industrial Development" prepared by Economic Planning Agency, interest rate is equal to average rate of interest (7.8 percent) on loans by all banks cited in "Japanese Economic Statistics" compiled by the Bank of Japan.

(b) Water charges

These are obtained by multiplying physically required volume per ton of product by unit price for different regions. Anticipated rates regarding water works under construction are adopted.

(c) Wage rates

Wage rates, represented by monthly cash payment per capital, in the manufacturing industry, are obtained from "Year-book of Labour".

(d) Power rates

Power rates vary depending on service-areas of different power companies and are discrimated for each of industrial uses. Here the rates for chemical industry are adopted.

These four factors are assessed on the grounds mentioned above and summarized in the following table.

It should be understood with the reservation that the results figured out are subject to many assumptions and rough estimates

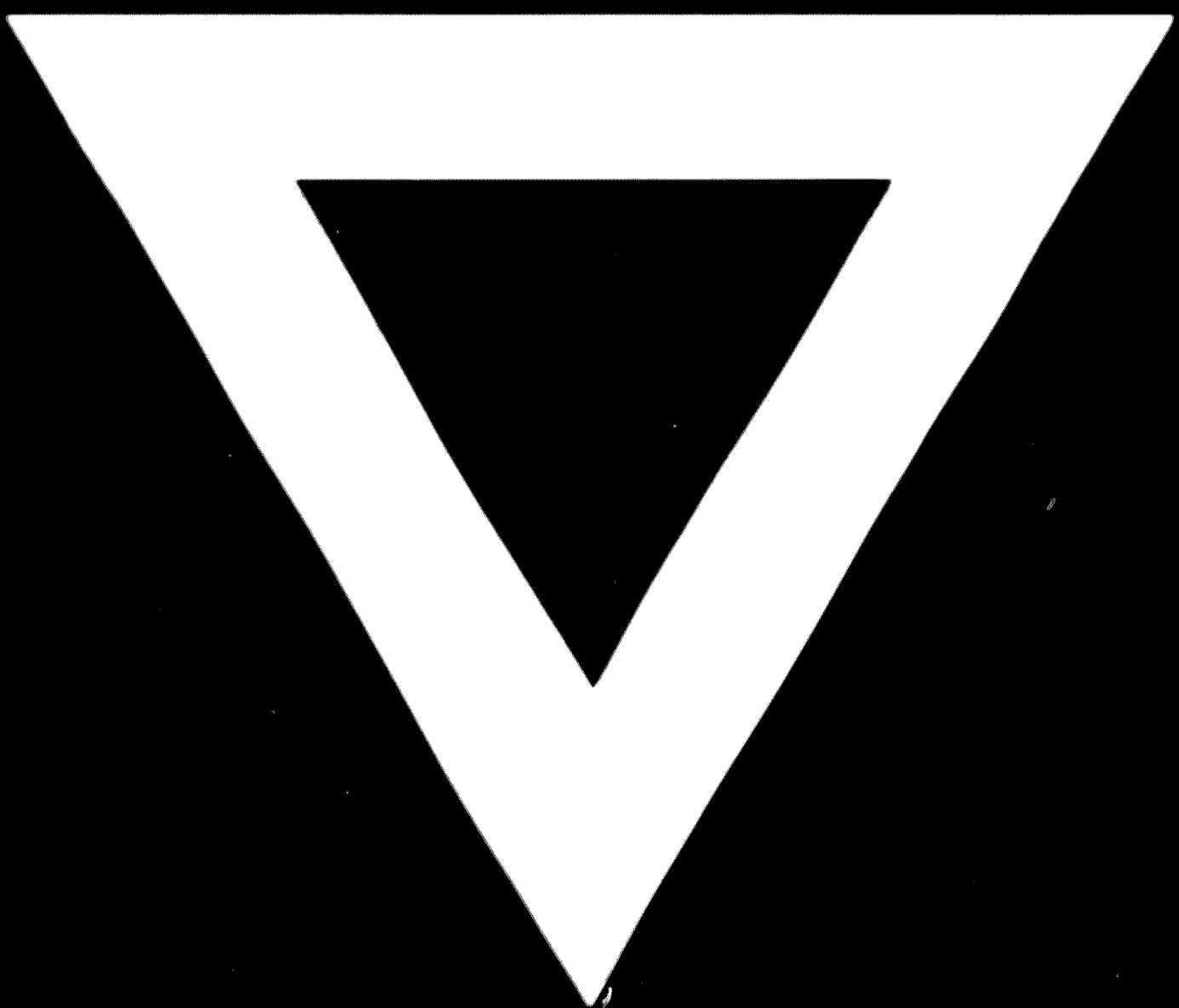
and therefore they do not necessarily suggest any realistic conclusions.

Projected Differences in the Costs of Selected Locational Factors of Production

Per Ton of Etlylene (In "Yen")

Places	Power	Water	Land	Labour	Total	Differences
Do-oh	4,553	3,400	142	362	8,457	1,457
Hachinohe	3,857	2,975	37	294	7,163	96
Sendai-Wan	3,857	2,975	41	294	7,167	100
Joban	3,857	2,975	41	294	7,067	0
Niigata	4,393	2,975	17	306	7,691	624
Toyama	4,176	3,400	207	312	8,095	1,028
Kashima	4,393	3,400	13	313	8,119	1,052
Higashi-suruga	4,393	3,400	76	333	8,202	1,135
Higashi-Mikawa	4,176	4,675	69	328	9,248	2,181
Harima	5,466	3,400	148	406	9,420	2,353
Tokushima	4,930	2,975	69	261	8,235	1,168
Okayama-Kennan	5,423	3,400	96	304	9,223	2,156
Toyo	4,930	3,400	57	339	8,726	1,659
Bingo	5,423	3,400	107	377	9,307	2,240
Shunan	5,423	3,400	83	426	9,332	2,265
Oita	4,756	2,975	57	322	8,110	1,043
Hosojima	4,756	2,975	60	355	8,146	1,079
Ariake	4,756	3,400	64	327	8,547	1,480

G-899



82.09.23