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# INTER-INDUSTRY RELATIONS, EXTERNAL ECONOMIES, AND REGIONAL ECONOMIC DEVELOPMENT[1]

by

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[1] The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO.

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# INTER-INDUSTRY RELATIONS, EXTERNAL ECONOMIES AND
# REGIONAL ECONOMIC DEVELOPMENT 1/

## SUMMARY

by

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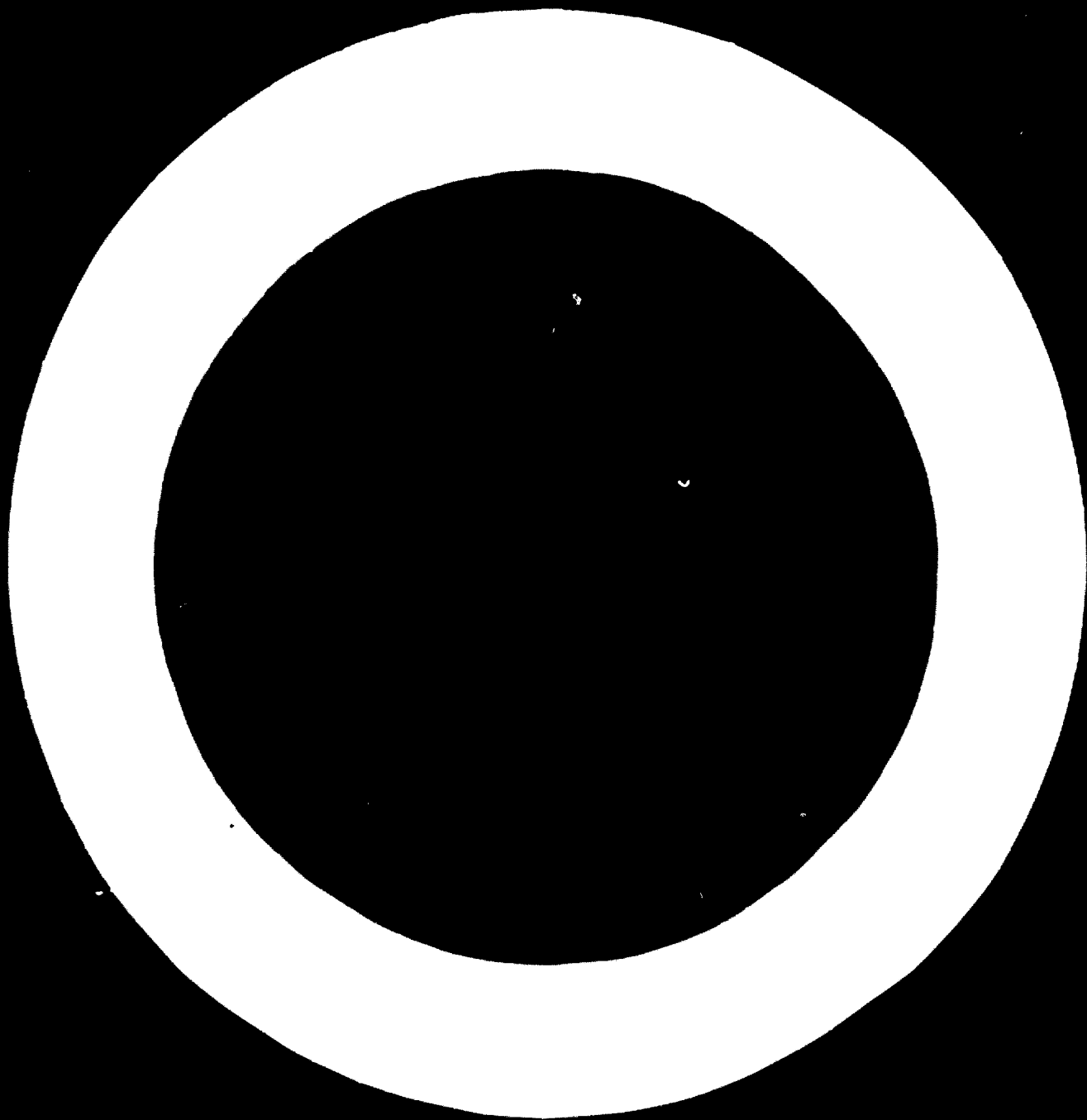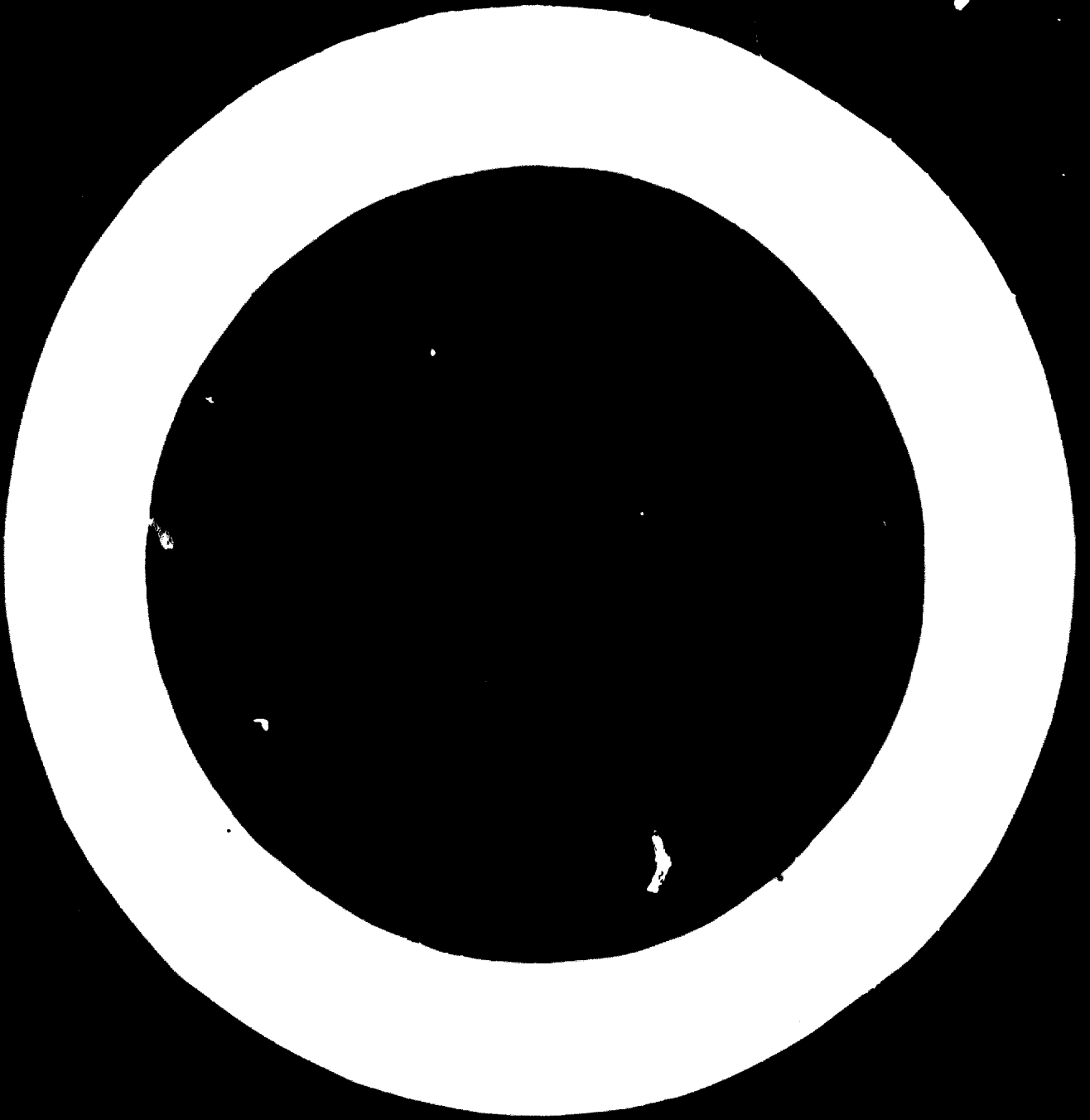
1.    Economic development is viewed as the end result of a series of induced investment decisions stemming from initial investment outlays, thus emphasizing the interdependence of economic activities and investment decisions.  The objectives of the study are: first, to identify the industries which offer the maximum potential inducement to investment, and second, to determine whether expansion of such industries leads to a pattern of regionally balanced growth.

2.    The study reviews three types of industrial linkages:  forward linkages, backward linkages, and residentiary linkages.  It concludes that residentiary linkage effects are the weakest and can hardly be relied upon as adequate stimuli to further investment.  Backward and forward linkages are then compared. The study argues that the "compulsive" nature of backward linkages does not apply to an open economy and may simply lead to increased imports of equipment and intermediates.  It is also argued that emphasis on forward linkage implies initial expansion of high value-added sectors and consequently greater residentiary linkage effects.  Thus, concluding that forward linkages are more likely than other types to maximize induced investment, the study proceeds to examine the geographic distribution of industries with high forward linkage potential in the case of Greece.

3.    On the basis of international input-output data, high forward linkage industries are identified  and subsequently found to be highly concentrated in a geographic sense.  Moreover, most of these industries appear to be concentrated in the same region, Athens.  The hypothesis is presented that such concentration results from a greater attraction of urban centres for high forward linkage industries than for other types of industries.  On the basis of data for Athens, Turin, Milan and Rome, the hypothesis is tentatively accepted.  Finally, a correlation is found between regional per capita incomes and the proportion of high forward linkage industries in the regions.

4.    The main conclusion is that expansion of high forward linkage industries will tend to lead to increasing regional income differentials in a developing country, and thus that attempts at industrial dispersal are likely, on this account at least, to be very costly in terms of the rate of output growth achieved by the nation as a whole.

# Contents

## Introduction

1.     Economic development can be viewed as the end result of a series of induced investment decisions stemming from original increments to a country's productive capacity.  Such a view of the process of economic development focuses attention on the interdependence of economic activities and investment decisions.

2.     In a regional context interdependence of economic activities and the resulting interdependence of investment decisions can be examined from two different standpoints depending on whether the focus of the analysis is the region or the nation.  If the focus is the region, and the objective the maximization of regional economic growth, the task is to identify those industries which through their impact on related industries hold the most promise of generating induced investment within the region and accelerate regional economic growth.  Past research on regional multipliers has stressed this aspect of the question by examining the multiplier effects of specific industries on regional income and on related activities $(1)\underline{1/}$

3.     However, the allocation of investment and the ensuing distribution of industry among regions that maximizes the growth of a given region or regions may diverge from the regional allocation of investment and distribution of industry that maximizes national economic growth (2).  If the focus of the analysis is the nation and the objective, maximization of national, rather than regional economic growth, then the task is to examine the spatial location of industry and allocation of investment that would maximize induced investment for the country as a whole.

4.     This study concentrates on the national sphere and has the following objectives.  First, to identify those industries which in a national context offer the maximum potential inducement to investment; secondly, to determine whether expansion in these high investment inducing activities leads to a pattern of regionally balanced growth; thirdly, to examine the policy implications for regional development and planning, of a pattern of national expansion which attempts to maximize the inducement to invest.

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1/ Letters in parentheses refer to References.

5.    The study utilizes empirical material from several developing countries, but the data on regional distribution of industrial activities come preponderantly from one country - Greece. Greece was chosen for a number of reasons: In recent years, it has generated a rather high rate of _per capita_ industrial output growth. At the same time, the geographic distribution of Greek industry is fairly typical of that prevailing in many other developing countries. Furthermore, the regional distribution of Greek industry has been the subject of considerable study and the available statistical information is of high quality and in considerable detail.

6.    Naturally, an attempt will be made throughout the study to distinguish between those conclusions and policy implications that are only relevant to Greece and those that are applicable to developing countries in general.

# I  INDUSTRIAL INTERDEPENDENCE AND LINKAGES

## The nature of the inducement mechanism

7.    Investment in the industrial sector of less developed countries is often inhibited either by the existence of a narrow domestic market which does not permit the establishment of efficient large-scale plants, or by excessive domestic factor costs.

8.    In a less developed country with a market economy, prospective profits constitute the entrepreneurs' inducement to invest. The profitability of a project is determined by the cost-price relationship at different levels of output. This relationship is, in turn, strongly influenced by the output decisions of producers in related fields. Any expansion of production in a given industry A which raises output demand or reduces production costs in a related industry B might increase the profitability or reduce the unprofitability of investment in B. If it does, then it can be said that the expansion in industry A has generated external economies which are appropriated by industry B (3). If such economies are sufficiently large to stimulate investment in B, then external economies generated by expansion in A have induced investment in B.

9.    Investment in any industry normally both appropriates external economies generated by pre-existing industries and generates some itself. The objective in this part of the analysis is to identify those industries which are likely

to be net generators of external economics. It makes sense that a less developed country should, other things being equal, promote investment in these industries so as to provide maximum inducement to additional investment.

10.    Expansion in industry A can cause an increase in demand for the output of a related industry B through either residentiary or backward linkages. Residentiary linkage is indirect and works through changes in factor income resulting from an expansion in any given industry. Increasing output in industry A causes incomes of factors of production employed in A to rise, leading to an increase in demand for the output of consumer goods in industry B. For example, expanded textile production leads to higher incomes for textile workers, who spend their incomes in the purchase of shoes and other consumer goods, thus raising demand for such consumer manufactures (4).

11.    Backward linkage is more direct than residentiary and results from the vertical interdependence of manufacturing activities. Expansion in any industry A would entail an increase in demand for the output of industry B which is used as an input by A. For example, higher production of fabricated metals would cause an increase in demand for iron, steel, aluminium or other intermediate manufacturers.

12.    The last type of industrial interdependence which might stimulate the creation of external economies will be called forward linkage. Such a linkage is also based on the vertical interdependence of industrial activities, but in this instance, unlike backward linkage, the stimulus proceeds from earlier stages of production to later ones. If production in industry A is characterised by economies of scale, expansion in A's output will cause a reduction in per unit costs of industry B which uses the output of A as an input (5). An example of forward linkage might be the reduction in per unit cost of producing aluminium consumer goods resulting from the expansion and increased efficiency in producing aluminium plates, or strip (6).

13.    Expansion in any industry will usually transmit impulses to related industries through all three linkage mechanisms. However, some industries are much more likely to stimulate investment through one linkage mechanism than through another. In the analysis to follow we will examine the relative strength of the three linkage mechanisms and the kinds of industries associated with each. We will attempt to show that one linkage mechanism is more

likely to induce additional investment than the others and that less developed countries wishing to provide the strongest inducement to industrial investment should emphasize expansion in industries that send strong impulses to related industries through this linkage mechanism.

## Residentiary linkages

14.    Let us first consider the generation of external economies and the resulting stimulation of investment through residentiary linkages. Impulses transmitted by a given industry A, in this manner, will be stronger the larger the factor income generated by expansion in this industry. Factor income per unit of expansion in gross output will be highest in those industries where the ratio of value added to gross output is highest.

15.    The rise in demand for the output of consumer goods in industry B, resulting from expansion in A, would raise the price of B's output. It would raise B's profitability and stimulate investment in B, only to the extent that economies of scale are significant in the production of B. If the increase in the price in B's output resulting from the increase in demand reflects the now higher opportunity cost of factors of production employed in B, then expansion in A has not bestowed any external economies on B (7).

16.    The demand stimulus generated by expansion in A is important only if production in B could not have been undertaken because of a limited domestic market (8). In the absence of economies of scale in industry B, the demand creating effects of expansion in A are desirable only in the general sense that any expansion of industrial output in a less developed country is desirable.

17.    Even if production in consumer goods industry B was characterized by extensive economies of scale, expansion in industry A need not increase the profitability of investment in B for another reason: Expansion in A might cause an increase in the prices of factors of production employed by B, thus increasing the latter's cost schedules and reducing its profitability. For example, expansion in the output of metal products might increase the cost of skilled labour which is an input in the production of textiles or food processing. The extent to which this occurs would depend on the elasticity of supply of factors used by A and B. In the limiting case where this elasticity is zero, that is, supply of factors is fixed, expansion in A cannot but impose external

diseconomies on B and in fact reduce the incentive to invest in it (9). On the opposite extreme, if B utilizes factors of production with no alternative uses, for example, previously unemployed or underemployed agricultural labour, the increase in demand for B resulting from A's expansion might well raise profitability in B (10).

18.   Summarizing the argument so far, the residentiary linkage effect depends on the importance of scale economies in consumer goods industries, and the elasticity of supply of factors utilized in manufacturing activities.  Whether a specific consumer goods industry will be established will also depend on the income elasticity of demand for its output and on its minimum economic scale of operations.

19.   Advocates of theories of balanced economic growth have emphasized the importance of the inducement to invest provided by the residentiary linkage mechanism described above.  Nevertheless, as the analysis has already suggested, this mechanism appears to suffer from serious drawbacks.

20.   First, empirical studies have shown that economies of scale are not as significant in consumer goods industries as they are in producer goods industries (11). This implies that the stimulus provided by expansion in a given industry A is more likely to increase profitability in producer's goods industries vertically linked with A than in consumer goods industries horizontally related to A.  Secondly, unless the increase in factor income generated through the initial expansion is quite large, its impact would be weak and diffused throughout the economy as the income recipients spread their expenditures over a large range of final goods.  The size of the original expansion sufficient to induce investment in consumer goods industries may be so large as to be unattainable, given the limited resources available for investment in less developed countries.

21.   Thirdly, should the initial expansion be large enough to impart strong demand impulses to consumer goods industries, it is quite likely that the expansion would give rise to serious diseconomies resulting from increases in the prices of factors of production used by the industries affected.  There are two reasons why such diseconomies are likely.  First, industrial production by and large is not intensive in the use of factors of production such as unskilled labour in which less developed countries might be well endowed.  Industrial technology is developed in advanced countries, and utilizes heavily factors of

production in which advanced economies are relatively well endowed such as capital goods, intermediate products, and skilled labour (12). Secondly, there is probably a presumption that the elasticity of supply of these factors in less developed countries is quite low, so that expansion in demand for such factors in one industrial sector is likely to impose considerable diseconomies in other sectors.

22.     Historical experience also tends to suggest that expansion of activities with strong residentiary effects alone has not been sufficient to provide the stimulus for the sustained economic growth of a country or region. Ohlin, for example, reports that the simultaneous expansion of consumer goods industries played but a minor role in the industrialization of nineteenth century Europe. Rather, external economies were abundant and resulted from the vertical interdependence between industries (backward and forward linkages), particularly in the producer's goods sector (13). North has also emphasized vertical interdependence as a stimulus to industrial growth of North American stemming in this instance mostly from the forward linkage stimuli generated by the primary sector (14).

## Backward linkages

23.     The inducement to invest through the backward linkage stimulus hinges on the impact that expansion in a given industry A would have on industry B's output which is used by A as an input. The larger the ratio of raw materials and intermediate inputs to total output in industry A (or what amounts to the same thing, the lower the ratio of value added to total output), the stronger the impulse that industry A would transmit. The probability that a specific industry B supplying A's inputs would be established varies directly with the portion of A's input that B's output will provide and inversely with the minimum economic scale of operation in B (15).

24.     Compared to residentiary linkage, the backward linkage mechanism is more likely to stimulate investment in additional industries as economies of scale appear to be far more prevalent in the capital and intermediate goods sectors than they are in the consumer goods industries which are stimulated through the residentiary linkage.

25. The same reservations mentioned earlier regarding the supply of factors of production to B resulting from an expansion in A apply here as well. Rising output in A might raise the cost of inputs used in both A and B and thus inhibit investment in the latter. In addition, if the increase in demand for B's input is not sufficient to induce investment in B - or at any rate until investment in B occurs - expansion in A might inhibit investment in a third industry C, which also uses B as an input by raising its price.

26. For example, let us assume that aluminium productive capacity in a less developed country is increased by the establishment of a modern plant processing bauxite ore and producing alumina (backward linkage). This will increase demand for inputs of electric power. Suppose, however, that this increase in demand is not sufficient to induce expansion in the productive capacity of electric power, but simply leads to an increase in its price. This might inhibit expansion in another industry also using electricity as a major power input. It is clear, however, from the standpoint of factor supply, in the long run and for the economy as a whole, the backward linkage mechanism is a stronger stimulus to investment than residentiary linkages insofar as it tends to increase the supply of produced inputs and thus raise the supply of produced and primary inputs taken together that is available to the economy as a whole. (16).

## Forward linkages

27. The inducement to invest through the forward linkage mechanism depends on the effect that expansion in a given industry A would have on input costs in another industry, B, using A's output as an input. If the price of A's output is reduced as a result of expansion in A, this will reduce costs and increase profitability in B. Forward linkage thus depends primarily on the existence of economies of scale in the producing industry A. Given economies of scale in A, the stimulus imparted would be stronger, the higher the portion of the industry's output that is directed to deliveries to other industries compared to deliveries designed to satisfy consumer demand - in short, the higher the ratio of intermediate to final demand. The probability that investment in a given industry B will be undertaken varies directly with the portion that the output of A would represent of total inputs in B and by the amount by which expansion in A reduces per unit input cost in B - that is, by the importance of scale economies in A (17).

28.    A comparison of the forward and backward linkage mechanisms shows that
expansion in any given industry will induce investment in a related industry
only if economics of scale prevail in input producing industries, that is, raw
materials, intermediate and capital goods.  Both mechanisms depend on econo-
mics of scale in these industries.  The forward linkage mechanism attempts to
exploit these economies directly by investment in such industries, which in
turn might stimulate investment in industries utilizing their outputs as in-
puts.  The backward linkage process works indirectly.  It attempts to stimu-
late investment in input producing industries - which are characterized by
scale economies - through expanded demand for their products generated by the
establishment of input using industries.  However, it appears from the crucial
standpoint of supplies of factors of production that the forward linkage mech-
anism should be preferred over the backward linkage process.  Expansion in any
sector is factor using and, in all likelihood, within the context of a less
developed economy, imposes certain external diseconomies to other sectors by
increasing factor scarcity.  However, if the input producing industries are
established first, making use of forward linkages, the supply of inputs is
increased directly, thus offsetting expanded factor usage by A.  On the other
hand, the backward linkage mechanism promises to increase factor inputs only
indirectly.  If the stimulus is not strong enough to induce expansion in the
input producing industries, backward linkage is likely to import net external
diseconomies on related industries much the same way that expansion through
residentiary linkage is likely to do (18).

29.    A school of thought best represented by Hirschman has argued that the
probability that the backward linkage mechanism would induce investment is
high because backward linkages are imperative, in the sense that they create
shortages of inputs which after a certain level of demand is reached must be
relieved through domestic production.  Investment decisions in less developed
countries, characterized by a relative scarcity of entrepreneurial talent, are
more easily taken in the presence of rising demand for inputs rather than in
the presence of cost reductions enabling the domestic production of goods
using locally produced inputs (19).

30.     However, as Hirschman recognizes, there is nothing imperative about backward linkages in an open economy. An increase in domestic demand for certain inputs, instead of calling forth domestic production, may simply lead to higher imports. In view of the existence of the import safety valve, the imperative aspect of induced investment through backward linkage is greatly weakened (20).

31.     Establishment of industries with a high material input ratio to total output, in the expectation of stimulating investment through backward linkages, suffers from a further important drawback. To emphasize backward linkage means initially to emphasize expansion of industries like food processing, fishing, milling, leather, or wood processing, with very high material input content but with a very small value added. Such emphasis will clearly go against one of the objectives of industrial development, namely to attempt to increase as much as possible the value added in the industrial sector and to move as rapidly as possible away from the simple processing operations associated with manufacturing activities in a stagnant, less developed economy. In the words of Hirschman, "Much is to be said for biting off as large pieces of value added at a time as the underdeveloped country can possibly digest "(21). This clearly will not be achieved by emphasizing the inducement to invest through backward linkages.

32.     In addition, the emphasis on the backward linkage mechanism and the establishment of industries with low ratios of value added to total output means that the impetus for residentiary linkages imparted by these industries will necessarily be weak, since the strength of the latter depends, among other things, on the amount of value added. On the other hand, nothing precludes that expansion of high forward linkage industries will not generate strong residentiary effects. Such residentiary effects might well be instrumental in stimulating expansion of consumer goods industries not vertically linked with the originally expanding industry, in view of the over-all increase in input supply generated by the expansion of the input producing sector.

33.     In the light of these considerations, a strong presumption exists that the strongest stimulus to additional investment can be generated through the expansion of industries with high ratios of intermediate to final demand - that is, through the forward linkage mechanism (22).

34. To summarize the argument briefly, a less developed country might well consider emphasizing investment in, and expansion of, those industries which are net generators of external economies through any of the three linkage mechanisms outlined above. There is never a guarantee that establishment or expansion of any industry A will lead to the establishment or expansion of a related activity through forward, backward, or residentiary linkage. Yet other things being equal, investment in activities which are net generators of external economies offers the less developed country the best chance for sustaining growth through a series of induced investment decisions in interdependent industries.

35. Of the three linkage effects examined, the residentiary linkage mechanism is the weakest one because (a) the lack of important economies of scale in consumer goods industries, (b) the magnitude of original expansion required to increase aggregate consumer demand, and (c) the strain it imposes on limited factor supplies.

36. Both the forward and backward linkage mechanisms hinge on the importance of economies of scale in raw material, intermediate, and producers goods industries. However, the forward linkage mechanism is to be preferred because (a) it effects an increase in input supply directly and thus reduces the possibility that external diseconomics resulting from increased factor use in the expanding industry will inhibit further investment; (b) stimulation through backward linkage involves the establishment of industries with low ratios of value added to gross output which, among other drawbacks, reduces the potential residentiary stimulus imparted by any expansion in industrial activity.

37. The forward linkage mechanism has been an important engine of growth in the industrialization of many countries. In the case of North America, forward linkages stemmed mostly from the primary sectors; in continental Europe and the Union of Soviet Socialist Republics from the development of the iron and steel industry; in England from the processing of imported textile fibres; in a less developed country like Greece from the processing of food, textiles or steel, utilizing either domestic or imported inputs. Both on theoretical and on empirical grounds, industries with high forward linkages appear to offer the strongest inducement to investment in related fields.

## II  FORWARD LINKAGE INDUSTRIES

38.  A country's input-output tables offer the best means of identifying empirically an industry's potential in triggering investment in related fields through forward linkages.  The potential for forward linkage presumably would be highest in those industries which show the highest ratio of intermediate to total demand.  Whether this potential is realized and external economics are generated would naturally depend on whether in fact production in these industries is characterized by economies of scale.

39.  To determine the industries with the highest ratios of intermediate to final demand, a sample of five countries was employed:  Israel, Italy, Japan, Norway and the Union of South Africa.  A seventeen-industry breakdown was used, employing mostly an ISIC[2]/ two-digit classification.  The seventeen industries in each of the five countries were ranked according to their ratio of deliveries to intermediate relative to total demand.  The results are shown in tables 1a and 1b.

40.  The ratios used for Italy, Japan and Norway are, with some minor qualifications, those computed in an earlier study by Chenery and Watanabe (23).  The ratios for the other two countries were computed from the input-output tables of Israel for 1958, and the Union of South Africa for 1956-1957 (24).  International comparability of intersectoral relations was determined by calculating the coefficient of concordance between the five rankings.  The coefficient of concordance was found to be .612, significant to the .01 confidence level.  This means that the probability that such concordance is due to chance is no more than 1 per cent.  There is thus conclusive evidence that the high forward linkage industries are by-and-large the same in different countries.

41.  Furthermore, these results suggest strong similarities in the production functions of the same industries in different countries in spite of differing factor endowment and industry heterogeneity in each of the countries.

42.  The fact that the coefficient of concordance was found to be statistically significant allowed us to compute a 'best ranking' paring all countries according to the proportion of each industry's deliveries to intermediate demand (25).  (These best rankings are simply calculated by inversely ranking the sums of the ranks of each industry in each of the five countries, and are also shown in table 1.)

2/ ISIC- International Standard Industrial Classification.

Table 1

**(a) Industry deliveries to intermediate demand in five countries (in per cent of total output)**

| Industries | ISIC [a] | Japan | Italy | Norway | Union of South Africa [b] | Israel [b] |
|---|---|---|---|---|---|---|
| Non-ferrous metals | 342 | 66.3 | 94.0 | 48.7 | 44.4 | 99.9 |
| Petroleum and coal products | 321,322 329 | 82.5 | 70.5 | 74.2 | 31.7 | 71.5 |
| Chemicals | 311,312 319 | 70.0 | 71.1 | 46.4 | 51.6 | 67.8 |
| Paper and products | 271-2 | 80.2 | 75.3 | 82.5 | 64.8 | 35.7 |
| Iron and steel | 341,350 | 74.8 | 68.2 | 38.9 | 46.4 | 61.7 |
| Mining | 12,14,19 | 81.8 | 59.5 | 51.6 | 11.3 | 87.1 |
| Textiles | 231,233 239,244 | 69.5 | 57.5 | 45.6 | 47.9 | 84.4 |
| Printing and publishing | 28 | 38.8 | 0 | 53.1 | 61.6 | 61.2 |
| Rubber and products | 300 | 56.2 | 39.7 | 15.8 | 55.8 | 40.3 |
| Grain mill products | 205 | 13.0 | 48.6 | 67.7 | 24.6 | 40.1 |
| Nonmetallic minerals | 33 | 30.7 | 25.1 | 18.6 | 20.7 | 99.1 |
| Machinery | 360,370 | 32.9 | 22.4 | 9.4 | 34.1 | 34.1 |
| Leather and leather products | 250,260 | 29.6 | 43.1 | 29.1 | 19.8 | 32.5 |
| Leather and products | 241-2, 291-2 | 47.1 | 31.8 | 27.7 | 20.6 | 23.1 |
| Transport equipment | 381-3 385-6,389 | 15.1 | 4.3 | 7.7 | 13.3 | 63.6 |
| Processed foods | 201-9,211-4, 220, 205 | 16.9 | 7.1 | 5.7 | 11.9 | 12.2 |
| Apparel | 232,243 | 16.5 | 3.0 | 3.8 | 3.1 | 10.0 |

**(b) Ranking of industry deliveries to intermediate demand in five countries**

| | Japan | Italy | Norway | Union of South Africa | Israel | Best ranking (N) |
|---|---|---|---|---|---|---|
| | 6 | 1 | 5 | 7 | 1 | 1 |
| | 1 | 5 | 1 | 9 | 5 | 2 |
| | 5 | 4 | 6 | 4 | 6 | 3 |
| | 3 | 3 | 8 | 1 | 12 | 4 |
| | 4 | 2 | 9 | 6 | 8 | 5 |
| | 2 | 6 | 3 | 16 | 3 | 6 |
| | 8 | 7 | 7 | 5 | 4 | 7 |
| | 13 | 17 | 4 | 2 | 9 | 8 |
| | 7 | 10 | 13 | 3 | 13 | 9 |
| | 17 | 8 | 2 | 10 | 14 | 11 |
| | 11 | 12 | 12 | 11 | 2 | 10 |
| | 10 | 13 | 14 | 8 | 10 | 12 |
| | 12 | 9 | 10 | 13 | 11 | 13 |
| | 9 | 11 | 11 | 12 | 15 | 14 |
| | 16 | 15 | 15 | 14 | 7 | 15 |
| | 14 | 14 | 16 | 15 | 16 | 16 |
| | 15 | 16 | 17 | 17 | 17 | 17 |

Sources: H.B. Chenery and T. Watanabe, "International Comparisons of the Structure of Production," Econometrica XXVI (October, 1958), pp.507-520; M. Bruno, Interdependence Structure and Structural Change in Israel (Jerusalem: Bank of Israel, 1962); B.C. Krogh, "An Input-Output Analysis of the South African Economy, 1956-7," South African Journal of Economics, XXVIII (December, 1961), pp.258-75.

[a] The breakdown by ISIC category follows closely the breakdown in Chenery-Watanabe. The major adjustment to their categories involved the exclusion of most primary and service sectors.

[b] The input-output table of Israel employed a 77 x 77 sectoral breakdown, using producers' prices for the year 1958. The input-output table of the Union of South Africa referred to inter-industry relations in 1956-1957, employed a 49 x 49 matrix, and also used producers' prices. Both tables had to be reduced in most instances to match the sectoral breakdown of the Chenery-Watanabe study.

43.    The results of the best ranking procedure are similar to earlier finds by Chenery-Watanabe.  The highest forward linkage potential is exhibited by industries like non-ferrous metals, building materials, steel, chemicals and paper; the lowest by apparel, leather and products, food processing and transport equipment.  In addition, it is of considerable significance that the industries that exhibit the highest forward linkage potential are also the industries in which, according to a recent United Nations study, economies of scale appear to be important (26).  This means that these industries not only show a potential for generation of external economies, but also that, should expansion in these industries occur, this potential will be realized because of the existence of significant scale economies.

## III  FORWARD LINKAGE AND GEOGRAPHIC BALANCE

### Spatial distribution of Greek industry

44.    Having examined both theoretically and empirically the nature of the industries likely to generate the strongest inducement to investment, we can now turn our attention to a question of central interest from a regional standpoint.  To what extent a strategy of economic development which emphasises expansion of these industries will lead to a pattern of regionally concentrated growth.

45.    We will seek an answer to this question by investigating the impact of growth through forward linkage on the regional distribution of Greek industry. We will not undertake a detailed examination of the factors that are responsible for the present geographic distribution of Greek industry.  This has been done ably by Coutsoumaris elsewhere (27).  We are considering the present distribution as given and we are concerned with its future implications, if investment in high forward linkage industries is emphasized..

46.    It will be assumed that the present distribution of Greek industry conforms to the dictates of location theory in the sense that the locational decisions of Greek firms are rational and efficient from the standpoint of private profit maximisation (28).  The assumption will also be made that the ranking of industries according to their forward linkage potential derived earlier from a sample of five countries applies to Greece.  That is, that the Greek industries of steel, non-ferrous metals, chemicals etc., have high forward linkage

potential, as much as they are presumed to have in the other countries examined. This assumption is justified by the substantial existing evidence pointing to international comparability of intersectoral relations and production functions.

47. Armed with these assumptions, we can now proceed to examine first the degree of concentration in each Greek industry in order to determine whether the foci of induced investment - the industries with high forward linkage potential - are concentrated or distributed evenly among regions.

48. Interest in the economic development of Greece's backward regions has prompted considerable research in the regional distribution of Greek industry. Both Coutsoumaris and Ward have investigated emprically the dispersion of Greek industries by calculating coefficients of localization in considerable detail (29). Unfortunately, the use of the coefficient of localization as a measurement of industrial dispersion has considerable drawbacks when applied to a country like Greece, where a large portion of total industrial employment and population is concentrated in one large metropolitan area - Athens. About 45 per cent of total Greek industrial employment is to be found in this area. "If a large portion of a country's total industry is concentrated in relatively few metropolitan areas, a specific industry also heavily concentrated in these same areas will quite likely show a low coefficient of localization (implying considerable dispersion) when the coefficient is calculated with total industry employment (as it was in the case of Greece) as a base" (30).

49. An alternative measurement of industrial dispersion, also using industry employment as a base but avoiding this implicit weighting of the individual regions by their respective shares of the base magnitude has been developed by Thompson and was used in this study. This is the coefficient of spatial variation (CSV) (31).

50.   If $X_j^r$ is the ratio of employment in industry j in region r to total industrial employment in region r, and N the total number of regions, then the coefficient of spatial variation of industry j equals $s$ where:

$$s = \sqrt{\frac{\sum_r (X_j^r - \overline{X}_j)^2}{N}} \qquad \text{and} \qquad \overline{X}_j = \frac{\sum_r X_j^r}{N}$$

51.   This is simply the standard deviation of the proportion of total industry employment that employment in a given industry accounts for in each district, divided by the mean proportion for the country. The higher the CSV, the higher the concentration.

52.   Table 2 shows the CSV's of Greek industries according to the 17 industry breakdown used earlier. The highest concentration is found in heavy industries, iron and steel, non-ferrous metals, petroleum and coal products, paper and products, rubber and chemicals.

53.   There are several reasons for this concentration. One major factor is that the scale of operations for these industries is relatively large. As Florence has shown a strong positive link exists between the optimum scale of operations for an industry and its degree of regional concentration (32). This consideration is extremely important in Greece and other less developed countries where the limited domestic market size might not allow for the establishment of many optimum size plants in any of these industries.

54.   A second important factor for concentration in these industries is that they tend to import a large portion of their inputs. In Greece, just as in many other less developed countries, there are few important points of entry so that industries heavily dependent on imported inputs will tend to minimize transport costs and, other things being equal, locate near the port of entry (33). This tendency is reinforced by the fact that in Greece, just as in many other countries, the main concentrations of demand are also located near the ports of entry, thus increasing the attraction of industry location in their vicinity.

55.     Finally, the requirements of those industries for skilled labour appear
to be higher than average.  Since skilled labour inputs have been shown to be
an important factor determining the location of industries (34), and in Greece,
just as in many other less developed areas, there is a tendency for concentra-
tion of the available pools of skilled workers, industries employing relatively
large amounts of this input would also tend to be concentrated.

## Concentration and forward linkage

56.     The index showing the geographical dispersion of Greek industries was in
turn compared to the index ranking industries according to their potential in
generating economies through forward linkage (W).  Table 2 shows the industry
rankings according to CSV and according to W.  Comparison of the two rankings
lends strong support to the hypothesis that industries with high forward
linkages tend to be concentrated.  Textiles is the only industry that is highly
dispersed but shows some potential in generating forward linkages.  This rela-
tively minor discrepancy can be readily explained by the fact that the minimum
economic scale of operations in textiles is quite small.

57.     The Spearman rank correlation coefficient for the two rankings was .78.
Such a correlation is statistically significant to the .01 confidence level,
implying only a 1 per cent chance that the relationship identified was spurious.

58.     However, the finding of a strong correlation between the two rankings
does not imply that a pattern of investment allocation which attaches importance
to the generation of forward linkages will lead to a regionally concentrated
pattern of growth.  It is quite possible that each of the high growth inducing
industries is strongly concentrated but that each is concentrated in a
different region.

59.     To test for this eventuality, the 17 industries examined were divided in
two groups:  those above the median in forward linkage generation and those
below.  Next, the location quotients of the high forward linkage grouping were
calculated for each of nine regions in which Greece was divided.  Location
quotients close to unity in most regions would have implied a fair amount of
dispersion of high forward linkage industries.

## Table 2

### Regional distribution of Greek industries

| Industry | Coefficient of spatial variation (CSV) | Ranking by CSV | Ranking by ratio of intermediate deliveries to total output (W) |
|---|---|---|---|
| Apparel | .177 | 16 | 17 |
| Transport equipment | .421 | 11 | 15 |
| Leather and products | .217 | 14 | 14 |
| Processed foods | .312 | 12 | 16 |
| Grain mill products | .644 | 8 | 11 |
| Rubber and products | .354 | 5 | 9 |
| Textiles | .213 | 15 | 7 |
| Machinery | .526 | 10 | 12 |
| Iron and steel | 1.761 | 2 | 5 |
| Non-metallic minerals | .297 | 13 | 10 |
| Lumber and wood products | .079 | 17 | 12 |
| Chemicals | .829 | 6 | 3 |
| Printing and publishing | .728 | 7 | 8 |
| Mining | .586 | 9 | 6 |
| Petroleum and coal products | 1.110 | 3 | 2 |
| Non-ferrous metals | 1.842 | 1 | 1 |
| Paper and products | 1.040 | 4 | 4 |

Source: Greece, National Statistical Service, Recensement des Etablissements Industriels et Commerciaux, 1963. The detailed data of regional distribution of industry on which these calculations are based have not been published yet. We are grateful to the National Statistical Service for permitting their use. Note: The CSVs were calculated for a breakdown of Greece in five regions: the Athens area, Central Greece, Northern Greece, Southern Greece, and the Islands.

## Table 3

## Dispersion of high forward linkage industries[a]

| Region | Location quotient |
|--------|-------------------|
| Athens | 1.346 |
| Sterea Hellas | 1.084 |
| Epirus | .349 |
| Thessaly | .574 |
| Macedonia | .704 |
| Thrace | .236 |
| Peloponesos | .815 |
| Crete | .332 |
| Islands | .599 |

Source: Greece, National Statistical Service. Recensement des Etablissements Industriels et Commerciaux, 1965.

[a] The industries included were those ranking above the median in the ratio of intermediate deliveries to total output in the ranking W of table 2. Because of the emphasis of the paper on industrial production in the strict sense, mining was dropped from the list. Thus the industries included were: non-ferrous metals, petroleum and products, chemicals, paper and products, iron and steel, textiles, rubber, printing and publishing. For details of the industries by ISIC, see table 1.

60.     The results are shown in table 3 above. In general, they lend strong support to the hypothesis that the high forward linkage industries tend to be concentrated, particularly in the Athens metropolitan area and in Sterea Hellas, the region in which Athens is located.

61.     This conclusion raised the question whether concentration of high forward linkage industries in metropolitan areas is a phenomenon unique to Greece or characterizes the location of these industries in other countries as well. A limited test was undertaken, comparing the location quotients of industries in the Athens metropolitan area with the location quotients of the same set of industries in the urban centres of Italy: Milan, Turin and Rome.

62.   Industry rankings were made by location quotient for each of the four
urban centres, and the coefficient of concordance between the rankings was
computed. The results (shown in table 4) strongly support the hypothesis that
urban centres in general tend to attract relatively large proportions of the
same industries. The coefficient of concordance between the industry rankings
was .619, significant at the .01 confidence level.

63.   A further test was then undertaken, relating the rankings of industry
location quotients in urban centres with the industry ranking according to
degree of forward linkage potential, derived earlier. A comparison of the
rankings again shows a strong tendency of industries with high forward linkage
potential to concentrate in the proximity of urban centres. The coefficient
of concordance for the rankings was .03, significant to the .01 confidence
level.

## Probable location of induced investment

64.   The discussion so far has established a strong presumption that the foci
of growth in the form of industries with high forward linkage potential tend to
be concentrated, and, in the case of Greece, in particular, to cluster in the
Athens metropolitan area and the surrounding region. The extent to which ex-
pansion in these industries leads to a pattern of concentrated growth will
also be determined by the locational tendencies of activities stimulated by
this expansion.

65.   Thus, what must be investigated is the locational tendencies of a group
of interrelated activities comprising of successive stages in the manufacturing
of an end product. The optimum location of these activities is also inter-
dependent. The location of a steel plant, for example, cannot be determined
without information on the location of pig iron production, which constitutes
one of its main inputs, or without knowledge of the location of the market
for steel products. The pig iron plant location, on the other hand, would
depend among other things on the location of the steel plant which constitutes
its market and on the location of iron ore.

66.   If the problem were to determine the location of an iron and steel complex
to be built from the ground up, the determination of the location of the pig
iron and steel plants would have to be made jointly. An industrial complex
study would have to be undertaken, supported by a cost-benefit analysis of
alternative locations for the two plants. However, our problem is somewhat

Table 1

(a) Location quotients of industries by major centres

(b) Location quotients of industries in four urban centres (ranks)

| Industries | | | | | | | | | | Best ranking (L) |
|---|---|---|---|---|---|---|---|---|---|---|

different. We have some general knowledge of the regional distribution of indus-
tries generating forward linkages. The question that must be answered is whether
the regional distribution of activities induced from expansion in the forward
linkage industries would tend in general to be similar or diverge from the regional
distribution of the latter.

67. The locational pattern of the induced activities would be determined by three
sets of factors: transport costs of inputs, transport costs of output, external
economies or diseconomies of a pecuniary or non-pecuniary nature resulting from the
spatial juxtaposition of the induced activities with the inducing ones.

68. Input costs consist of costs of materials and costs of labour. The former
include costs of raw materials and intermediate inputs, as well as costs of capital
goods employed in production.

69. If an induced activity locates in the proximity of an inducing one, it would
obviously minimize the costs of some of its material inputs, namely those procured
from the inducing high forward linkage industry. The extent to which the induced
activity B would minimize its material input costs locating near the inducing one A
would depend basically on the share of B's inputs supplied by A. The higher the
share, the larger the probability that B would locate close to A. There is some
reason to believe that the probability that the induced activity B would in fact
minimize its material inputs costs by locating in the vicinity of A is quite high.
If expansion in A (which is associated with lower cost for its output) generates
sufficient external economies to induce establishment of B, it must be that A's
output is an important input in B; and if it is, there would be a strong tendency
for B to minimize its material input costs by locating close to A.

70. No similar tendency can be identified a priori with respect to labour costs,
so recourse will be had to empirical evidence. In Greek urban areas, where indus-
tries with high forward linkage potential tend to concentrate, average wage rates
are higher than in the rest of the country. This might appear to provide an advan-
tage for induced activities with a high labour component of total cost to locate
away from urban concentrations.

71. However, closer examination shows this advantage to be non-existent. In
Greece, just as in other less developed countries, skilled labour tends to be con-
centrated in urban centres, and higher wage rates in the centres reflect a higher
skill composition of the labour force. In addition, unskilled labour differentials

appear to be insignificant (35). In the case of Athens, Ward has observed that a large pool of unskilled, low wage, immigrant labour exists in slum suburbs, which tends to reduce the advantages outlying areas might offer to the establishment of industries utilizing large amounts of unskilled labour (36).

72.     The pattern of demand in Greece is also concentrated, with Athens accounting for more than 20 per cent of total population and, more significantly, close to 60 per cent of national income and 61.4 per cent of expenditures on final goods (37). Thus industries oriented towards demand would also tend to cluster, though perhaps less so than input oriented industries.

73.     The tendency of demand oriented industries to cluster around Athens is reinforced by the structure of the transportation system. The latter demands that goods shipped from one part of Greece to the other often have to be shipped through Athens because of the absence of direct routes linking outlying areas.

74.     To measure the relevant magnitudes of the economies and diseconomies resulting from juxtaposition of induced to inducing activities is an immensely difficult if not impossible task. There are many apparent benefits for any industry locating in the proximity of a metropolitan area: banking facilities and contacts might reduce the cost of borrowing; sanitation, legal, and research facilities might be more abundant and less expensive. On the other hand, spatial juxtaposition of economic activities is liable to lead to external diseconomies in the form of water and air pollution, traffic congestion, or social problems. To the extent that the local government attempts to remedy the situation, taxes in urban centres might be higher.

75.     With respect to the relative significance of these factors in the location decisions of Greek industries, this discussion will rest with the conclusion reached in the Coutsoumaris study that, on balance, agglomeration economies generate considerable attraction of industry to the Athens metropolitan area (38).

76.     In short, from all available indications, it can be concluded that activities induced by expansion in the high forward linkage industries would tend to cluster in the Athens metropolitan area. It might appear hazardous to generalize this conclusion to other less developed countries because of the central role that one metropolitan area plays in the economic life of Greece. Yet most features of Greek regional economic development are quite common. The primacy of one metropolitan area, usually the capital or a major port which generates the bulk of total final

demand and possesses a sizeable portion of skilled labour is characteristic of many less developed countries. Mexico City, Caracas and Manila are only a few of many such examples. The transport system can in many cases be described as a giant wheel with spokes originating from the capital, but with no interconnecting links. On the materials input side, projects induced through forward linkage are likely to minimize costs by locating near the stimulating industry. Thus, if the foci of induced investment, industries with high forward linkage potential, are concentrated in urban centres, the induced activities would tend to cluster in their neighbourhood.

## Regional distribution and income

77.	The implication of our investigation so far is that, given the present geographic distribution of Greek industrial activities, an investment pattern which emphasizes expansion of industries with high potential yield of external economies through forward linkages will tend to lead to a regionally concentrated pattern of growth. The extent to which such a pattern of investment allocation would lead to rising or lowering income differentials between regions would depend on the proportion of high forward linkage industries located in low income areas. If this proportion is low, other things being equal, investment that emphasizes expansion in the high forward linkage industries in order to exploit potential external economies will lead to rising income differentials between regions.

78.	Table 5 shows the relationship between relative proportion of high linkage industries located in each of Greece's nine regions and the per capita income of the regions. There is a close association between regional per capita income and location quotient of industries with strong forward linkage potential located in the region. This finding means that low income regions have a relatively large share of industries with low forward linkage potential, while high income regions have a relatively large share of industries with high forward linkage potential. The coefficient of correlation between regional per capita income and location quotient of industries with high forward linkage potential was .75, statistically significant to the .01 confidence level.

79.	It is of interest to pose the question whether the existence of industries with high forward linkage has been a factor responsible for high incomes in certain areas or, conversely, whether such industries are attracted to high income areas. However, no a priori assumptions can be made about the direction of causality.

To the extent that industries with high forward linkage potential are demand rather than input oriented, they would exhibit a tendency to be located in high income regions. On the other hand, their establishment in one region will undoubtedly boost the prospects for this region's growth and thus become one of the factors responsible for regional income differentials.

80. No matter what the line of causation, the main conclusion stands. Since low income regions have a relatively low portion of industries with high forward linkage potential, a pattern of expansion which emphasizes the inducement of investment through forward linkage is likely to lead to rising income differentials between regions.

## CONCLUSIONS

81. This analysis has several important implications for regional development policies of less developed countries. First, when less developed countries formulate plans for investment allocation, they must consider the effect expansion in one industry will have in inducing investment in related activities. It has been argued that the strongest inducement would be forthcoming from expansion in industries with high forward linkages; that is, industries like chemicals, non-ferrous metals, iron and steel, paper - whose output is largely directed to intermediate demand. These industries are by-and-large the same in countries employing similar levels of technology.

82. This argument obviously does not mean that investment in industries with high forward linkage potential must be preferrred at all times. Investment allocation must naturally be based primarily on comparative cost and feasibility analysis. But among equally feasible projects, preference ought to be given to those generating the largest possible external economies through forward linkages.

83. Secondly, it was demonstrated that, in the case of a developing economy like Greece, industries with high forward linkage potential as well as industrial activities stimulated by their expansion tend to cluster. This phenomenon is quite likely to be encountered in other less developed countries as well. The reasons for clustering in Greece - large-scale relative to market size, dependence on imported inputs, dependence on skilled labour available in metropolitan centres, external economies resulting from spatial juxtaposition - are likely to be present elsewhere as well.

Table 5

High forward linkage and per capita income

| Region | Annual per capita income in dollars (US) | Location quotient of high linkage industries d/ |
|---|---|---|
| Athens | 312 b/ | 1.346 |
| Sterea Hellas | 273 | 1.084 |
| Epirus | 145 | .349 |
| Thessaly | 234 | .574 |
| Macedonia | 271 | .704 |
| Thrace | 236 | .236 |
| Peloponesos | 217 | .815 |
| Crete | 217 | .332 |
| Islands | 191 | .599 |

Source: Chase Manhattan Bank, "Purchasing Power Survey: Technical Note", and Greece, National Statistical Service, Recensement des Etablissements Industriels et Commerciaux, 1963. Per capita income for 1962 was calculated on the basis of national income data for 1961 and by using regional income information included in income tax collection, consumer good expenditures and other similar estimates.

d/ Industries ranking above the median in ratio of intermediate deliveries to total output. For information on the industries included, see table 3.

b/ Per capita income is for the Attiki prefecture, of which Athens is the major city. As a result, the income estimate tends to understate per capita income in the Athens metropolitan area.

84.     Concentration thus appears to be the pattern of geographical distribution
that maximizes the private profitability of industrial activities and complexes.
A government is justified to interfere with these strong tendencies to agglomerate
only if it can show first, that there is a substantial divergence between private
and social profitability and, second, that the latter will be maximized through
decentralization. The attainment of maximum social profit will call for decentral-
ization only if any of the following conditions prevail:  (a) regions with a lower
share of industrial activities actually possess locational advantages for the
establishment of many industries which are not exploited;  industries tend to locate
near urban industrial concentrations elsewhere either because of entrepreneurs
possess imperfect knowledge of market conditions or because they prefer to live and
work near urban centres in order to enjoy the amonities of urban life;  (b) large
external diseconomies result from industrial agglomeration.

85.     In the absence of these conditions, tampering with industries' tendency to
concentrate can only be decontralization for decontralization's sake, a policy
course with no justification from the standpoint of economic efficiency.

86.     Thirdly, industries with a high forward linkage potential and related
activities tend to cluster in the relatively high income regions. This implies
that expansion which emphasizes the forward linkage inducement mechanism will tend
to exaggerate regional income disparities. In the absence of clear-out divergence
of social from private profitability, an attempt to locate a relatively large
portion of any of those industries in the low income regions might tend to diminish
regional income differentials, but at a considerable cost:  The cost of a sub-
optimal geographic distribution of industry which would tend to lower the rate of
income growth for the country as a whole.

87.     Furthermore, an attempt to infuse growth in the low income regions by stressing
investment in the industries that they are more intensive - mostly industries with
low linkages - is costly as well. The cost in this case is in the form of foregone
external economics which again would have induced a higher rate of growth for the
country as a whole.

88.     Development of backward regions of less developed economies may follow any
of the following alternatives:  (a) emphasis may be placed, where possible, in the
expansion of those few high forward linkage industries which are optimally located
in backward regions;  (b) attempts should be made to channel investment induced
by expansion in the high forward linkage industries of high income areas to the

backward regions. On the basis of considerations above, it appears that industries in which economies of scale are not important, which are intensive in the use of unskilled labour and are oriented towards local demand, would most likely be optimally located in the backward areas; (c) a strong effort should be exerted where possible in the identification and development of the natural resources of less developed regions. The development of a new resource can often lead to the establishment of resource oriented industries which will infuse growth in a backward region through either forward or residentiary linkages. In Greece, for example, the exploitation of bauxite ores for aluminium production was undertaken close to the raw material source and shifted the base of the aluminium industry from the high income Athens area to a backward area of central Greece.

## References

(1) See, for example, F.T. Moore and J.W. Peterson, "Regional Analysis: An Interindustry Model of Utah", Review of Economics and Statistics, XXXV (November, 1955), p.375.

(2) C.L. Leven, "Establishing Goals for Regional Economic Development", Journal of the American Institute of Planners, XXX (May, 1964), provides some good arguments to the effect that the spatial distribution of industry that maximizes regional growth might be inconsistent with the distribution that maximizes national growth. See also H.B. Chenery, "Development Policies for Southern Italy", Quarterly Journal of Economics, LXXVI (November, 1962), pp.526-28, and I. Lefeber, "Regional Allocation of Resources in India", J. Friedmann and W. Alonsods, Regional Development and Planning (Cambridge: The M.I.T. Press, 1964), pp.642-653.

(3) T. Scitovsky, "Two Concepts of External Economies", Journal of Political Economy, LXII (April, 1954), pp.143-51.

(4) The basic elements in this linkage mechanism were identified in Rosenstein-Rodan, "The Industrialization of Eastern and Southeastern Europe", Economic Journal, LIII (June-Sept., 1943), pp.202-211, and elaborated in R. Nurkse, Problems in Capital Formation of Underdeveloped Countries (New York: 1955), and in subsequent writings by the same author. This effect has often been recognized by regional economists. See, e.g., D.C. North, "Location Theory and Economic Growth", Journal of Political Economy, LXIII (June, 1955), pp.249-51.

(5) The nature of linkages resulting from vertical interdependence was first given prominence in A. Young, "Increasing Returns and Economic Progress", Economic Journal (Dec., 1928). Subsequently, the discussion was enriched by the contributions of J.E. Meade, "External Economies and Diseconomies in a Competitive Situation", Economic Journal (March, 1952), T. Scitovsky, op. cit., M. Fleming, "External Economies and the Doctrine of Balanced Growth", Economic Journal, LXV (June, 1955), pp.251-256, and especially A.O. Hirschman, The Strategy of Economic Development (New Haven: Yale University Press, 1959), pp.78-119. The terms backward and forward linkage used here were first popularized by Hirschman. See also: H.B. Chenery, "The Interdependence of Investment Decisions", in M. Abramovitz, ed., The Allocation of Economic Resources (Stanford: Stanford University Press, 1959), pp.82-120.

(6) Expansion in industry A might cause external economies by reducing costs to other industries in other ways as well: Chief among these might be the beneficial effects that expansion in A might have in training workers, improving the attitude of workers towards industrial employment, improving the attitude of the community towards industrial enterprises, establishing research or community facilities, all of which might reduce costs in another industry. Important as these economies are, this analysis will ignore them and concentrate on the so-called pecuniary external economies discussed above for two reasons: first, the conditions under which such economies might materialise are too vague and difficult to assess systematically; second, and more important, it is almost impossible to determine a priori the nature of the industry that might generate them or the nature of the industry that might appropriate them.

(7) Chenery, "The Interdependence of Investment Decisions", p.96.

(8) Strictly speaking, in an open market where international trade is possible, demand limitations do not exist except insofar as transport costs **prohibit** exports. On the other hand, Linder has argued that the creation of an export industry in manufacturing is highly unlikely in the absence of large domestic demand. S.B. Linder, _An Essay on Trade and Transformation_ (New York: 196 )

(9) Fleming, _op. cit._, pp.246-47.

(10) Chenery, "The Interdependence of Investment Decisions", p.96.

(11) United Nations Economic and Social Council, Committee for Industrial Development, _Industrial Planning and Programming_ (New York: 1966), pp.27-29. J.S. Bain, _Barriers to New Competition_ (Cambridge, Mass.: 1956); B. Balassa, _The Theory of Economic Integration_ (Homewood, III.: 1961), pp.128-43.

(12) S. Eckaus, "The Factor Proportions Problem in Underdeveloped Areas", _American Economic Review_, XLV (June, 1955), pp.538-65.

(13) G. Ohlin, "Balanced Economic Growth in History", _American Economic Review_, XLIX (May, 1959), pp.351.

(14) North, _op. cit._ However, see C.M. Tiebout, "Exports and Regional Economic Growth", _Journal of Political Economy_, LXIV (April, 1956), pp.160-69, for an argument stressing the importance of residentiary linkages.

(15) Hirschman, _op. cit._, p. 101.

(16) Fleming, _op. cit._, pp.249-250.

(17) Hirschman, _op. cit._, p.103.

(18) Of course it can be argued that in an open economy, no supply limitations for produced inputs can exist because such inputs can be procured through international trade. However, this argument is valid only if the less developed country can procure unlimited amounts of foreign exchange. Since this condition is not likely to be fulfilled, it is quite clear that supply rigidities in the market for intermediate and capital goods inputs are likely to prevail. See: C Michalopoulos, "Imports in Economic Development: The Greek Case", in P.B. Kenen, ed., _Aspects of International Economy_ (New York: 1967).

(19) Hirschman, _op. cit._, pp.101-102.

(20) This safety valve could be closed by the imposition of trade controls. However, the danger in protection for this reason is similar to the danger associated with any other kind of protection: In the absence of complete and informed planning, such restrictions might lead to a serious resource misallocation.

(21) Hirschman, _op. cit._, p.119.

(22) Fleming is apparently of the same opinion. See _op. cit._, p.250. For an example of the forward linkage impact of the steel industry in contemporary United States, see W. Isard and R.E. Kuenne, "The Impact of Steel Upon the Greater New York-Philadelphia Industrial Region", _Review of Economics and Statistics_, XXXV (November, 1953).

(23) H.B. Chenery and T. Watanabe, "International Comparisons of the Structure of Production", Econometrica, XXVI (October, 1958), pp.507-520.

(24) These tables can be found respectively in: M. Bruno, Interdependence, Resource Use and Structural Change in Israel (Jerusalem: The Bank of Israel, 1962). D.C. Krough, "An Input-Output Analysis of the South African Economy, 1956-7", South African Journal of Economics, XXIX (December, 1961), pp.258-275.

(25) H.M. Walker and J. Lev, Statistical Inference (New York: Henry Holt, 1953), p.286.

(26) United Nations, op. cit.

(27) C.F. Coutsoumaris, The Problem of Spatial Concentration of Greek Industry (in Greek). (Athens: Center of Economic Research, Lecture Series No.4, 1962), p.26.

(28) This was one of the main conclusions of Coutsoumaris' study. Such a conclusion in no way implies that the present regional distribution of Greek industry maximizes social profitability (though Coutsoumaris apparently believes this happens to be the case - ibid., p.26). The reason of possible divergence of the locational distribution maximizes private profitability from that which maximizes social profitability is that locational decisions taken by individual firms to maximise their profits do not take into account the possible external economies or diseconomies that such a locational decision imparts on the rest of the economy.

(29) Coutsoumaris, op. cit., pp.22-23; B. Ward, Greek Regional Development (Athens: Center of Economic Research, 1962), p.128.

(30) W. Isard, Methods of Regional Analysis: An Introduction to Regional Science (New York: Wiley, 1960), p.264.

(31) W.R. Thompson, "The Coefficient of Localization: An Appraisal", Southern Economic Journal, XXIII (January, 1957).

(32) S.P. Florence, Investment Location and Plant Size (Cambridge, England: The University Press, 1948).

(33) Coutsoumaris, op. cit., p.37.

(34) S. Schiavo-campo, "Wages, Skills and Regional Location of Industry: The Case of Mexico", Paper presented at the Second Inter-American Congress of Regional Planning, Rio de Janeiro, 17-19 August, 1966.

(35) Schiave-campo, op. cit.

(36) Ward, op.cit., pp.48-52.

(37) Coutsoumaris, op.cit., p.35.

(38) Ibid.

## Appendix Table A

### Greek regional industrial employment

| Industry | Crete | Thessaly | Epirus | Thrace | Sterea Hellas | Islands | Mace-donia | Athens | Pelo-ponesos | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Apparel a/ | 1,459 | 2,154 | 647 | 797 | 2,703 | 2,213 | 8,769 | 25,926 | 3,846 | 45,514 |
| Transport equipment | 846 | 908 | 121 | 492 | 1,557 | 663 | 2,782 | 14,316 | 379 | 22,564 |
| Leather and products | 1,981 | 1,552 | 724 | 593 | 2,466 | 3,344 | 10,060 | 14,420 | 3,645 | 39,305 |
| Processed foods | 6,132 | 5,565 | 1,569 | 1,972 | 6,623 | 7,215 | 21,164 | 25,805 | 14,743 | 93,869 |
| Grain mill products | 327 | 1,217 | 602 | 639 | 1,856 | 837 | 2,970 | 873 | 1,763 | 11,084 |
| Rubber and products | 50 | 93 | 18 | 20 | 107 | 17 | 1,050 | 6,134 | 399 | 7,938 |
| Textiles | 585 | 2,107 | 296 | 243 | 3,632 | 2,436 | 3,852 | 27,110 | 4,402 | 44,914 |
| Machinery | 452 b/ | 1,441 | 186 | 273 | 1,422 | 510 | 4,437 | 13,181 | 1,332 | 23,23? |
| Iron and steel | 707 | — | — | — | 1,344 | — | — | 497 | 1,993 | 1,831 |
| Non-metallic minerals | 2,279 | 2,134 | 405 | 694 | 4,155 | 1,342 | 5,528 | 12,024 | 4,976 | 2?,091 |
| Lumber and wood products | 237 | 3,240 | 1,288 | 1,504 | 3,772 | 3,029 | 3,099 | 19,991 | 671 | ?9,180 |
| Chemicals | 280 | 79 | 35 | 16 | 1,436 | 246 | 524 | 2,670 | 626 | ?,584 |
| Printing and publishing | 435 | 408 | 126 | 98 | 194 | 230 | 1,199 | 10,004 | 733 | 16,235 |
| Mining | — | 937 | 410 | 277 | 4,284 | 2,288 | 5,552 | 2,423 | 9 | ?,41? |
| Petroleum and coal products | — | 7 | — | 9 | 573 | — | 215 | 563 | — | ,376 |
| Non-ferrous metals | 11 | — | — | — | 368 | — | — | 88 | — | 45 |
| Paper and products | — | 36 | 5 | 4 | 99 | 53 | 342 | 3,504 | 303 | ?,137 |
| Total | 15,871 | 21,828 | 6,437 | 7,631 | 35,384 | 24,601 | 83,900 | 191,700 | 41,439 | 435,23? |

Source: Greece, National Statistical Service, Recensement des Etablissements Industriels et Commerciaux, 1963.

a/ For ISIC designation, see table 1.
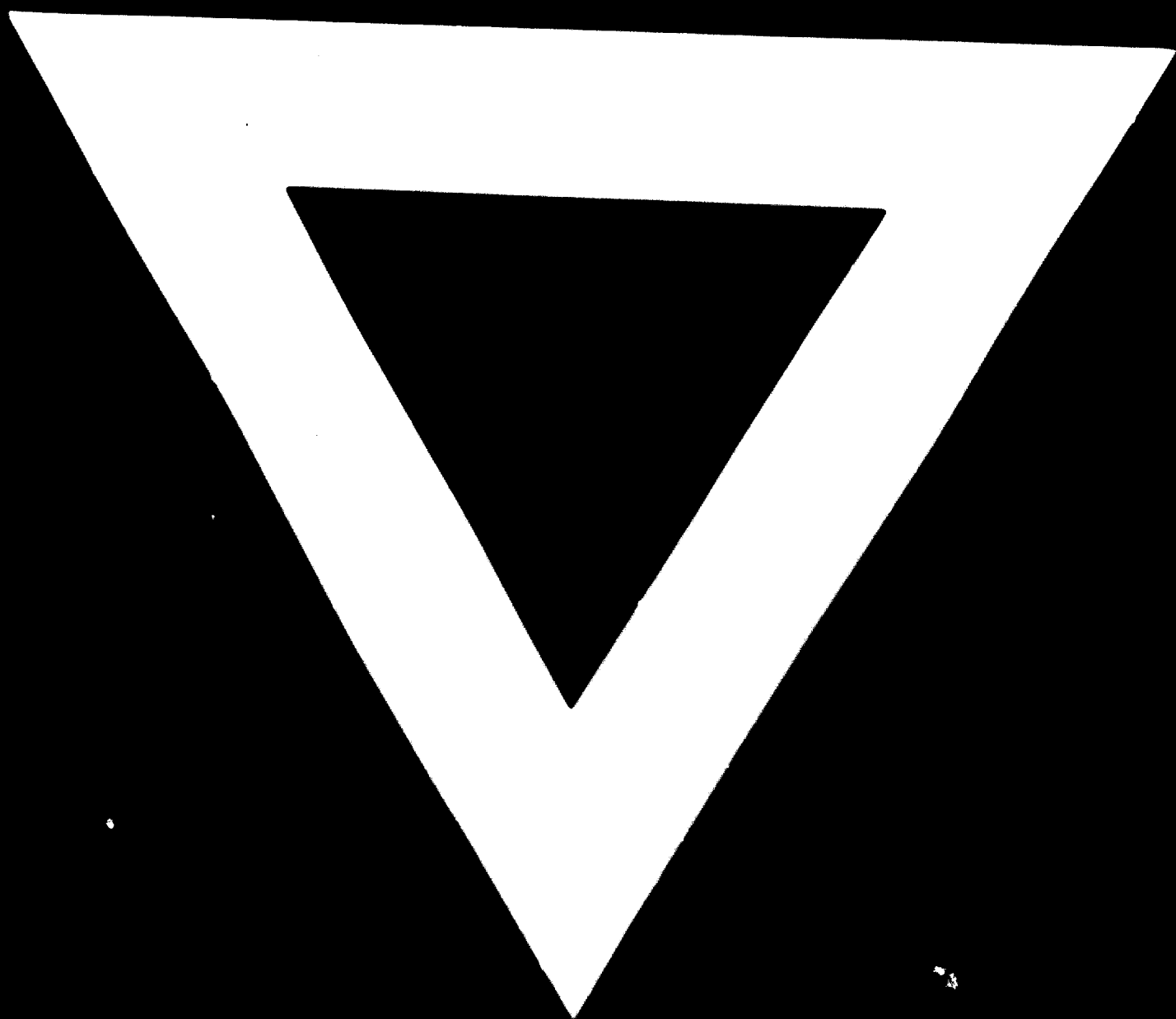
b/ — = Negligible or zero.

## Appendix Table B

### Industrial employment in
### three Italian metropolitan centres

| Industries | Italian Industrial Classification Code | Milan | Torino | Roma | Italy Total |
|---|---|---|---|---|---|
| Processed[a] foods | 3.01, 3.02 (except 3.01A) | 30,043 | 11,315 | 9,742 | 321,023 |
| Grain mill products | 3.01A | 2,854 | 1,415 | 2,919 | 111,945 |
| Textiles | 3.03-3.05 | 84,964 | 45,032 | 4,270 | 592,131 |
| Apparel | 3.06 | 51,850 | 17,098 | 11,794 | 349,977 |
| Leather and products | 3.07-3.08 | 22,635 | 8,427 | 4,175 | 226,722 |
| Lumber and wood products | 3.09-3.10 | 40,086 | 14,983 | 11,416 | 378,246 |
| Iron, steel, and non-ferrous metals | 3.11, 3.12A, 3.12B, 3.15 | 114,996 | 45,191 | 5,073 | 371,908 |
| Machinery | 3.13-3.14 | 189,843 | 78,389 | 13,482 | 578,196 |
| Transport equipment | 3.16 | 30,903 | 87,870 | 1,233 | 234,861 |
| Non-metallic minerals | 3.17 | 20,869 | 7,753 | 10,796 | 311,546 |
| Chemicals | 3.18, 3.21 | 86,375 | 14,096 | 12,953 | 254,869 |
| Petroleum and coal products | 3.19 | 3,167 | 226 | 608 | 23,984 |
| Rubber and products | 3.20 | 20,230 | 13,603 | 1,923 | 49,822 |
| Paper and products | 3.22 | 13,590 | 6,282 | 2,610 | 81,799 |
| Printing and publishing | 3.23 | 31,203 | 9,291 | 17,155 | 111,757 |
| Other industries | 3.24-3.24 | 33,211 | 11,395 | 6,927 | 117,569 |
| | | 776,824 | 372,366 | 117,376 | 4,116,355 |

Source: See Italian Data, table 4b.

[a] For ISIC designation of industries, see table 1.

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