The Growth of Service Employment: A Reappraisal *

The statistics for all industrial countries indicate that the employment structure by major sectors of production is undergoing dramatic changes. Following a trend visible in the United States as early as the 'thirties, the share of service employment has been increasing sharply in all countries for over twenty years, whereas the share of industrial employment appears to have been stationary or declining, with different patterns, from the early 'seventies.[1] In almost all countries, moreover, increases in employment after 1973, even in absolute terms, are concentrated in the service sector. In 1980 the ratio of people employed in services to those in industry was well above unity in all industrial countries, ranging from 2.15 in the United States to 1.35 in Italy and 1.10 in Germany.

In Italy the process of service employment growth began rather later than in other countries, but, from 1978 on, all the absolute increases in employment have been concentrated in the services. In 1981, for the first time, services formed over 50% of total employment. In Italy too, the debate on the growth of service employment and on the relative contraction of industrial employment has therefore been stepped up, borrowing from the main lines of the relevant international literature.

Generally speaking, all the discussions on these phenomena have been based on sectoral data,[2] with the emphasis on the increase in the

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[1] An accurate description of the evolution of these phenomena can be found in EEC (1978) and in GINZBERG and VOJTA (1981).

[2] A few studies, it should be added, analyse the growth of service employment by examining employment by status, regarding as service workers those engaged in any branch, employed in jobs

TABLE 1

STRUCTURE OF EMPLOYMENT BY GROUPS OF BRANCHES: 1960-81

		Agriculture	Industry	Services	Total
United States	1960	8.3	33.6	58.1	100.0
	1970	4.5	34.4	61.1	100.0
	1980	3.6	30.6	65.8	100.0
	1981	3.5	30.1	66.4	100.0
Great Britain	1960	4.2	48.8	47.0	100.0
	1970	3.2	44.8	52.0	100.0
	1980	2.7	38.1	59.2	100.0
	1981	2.8	36.3	60.9	100.0
Japan	1960	30.2	28.5	41.3	100.0
	1970	17.4	35.7	46.9	100.0
	1980	10.4	35.3	54.3	100.0
	1981	10.0	35.3	54.7	100.0
France	1960	22.4	37.8	39.8	100.0
	1970	13.9	39.7	46.4	100.0
	1980	8.8	35.9	55.3	100.0
	1981	n.a.	n.a.	n.a.	n.a.
Germany	1960	14.0	48.7	37.3	100.0
	1970	8.6	49.3	42.1	100.0
	1980	6.0	44.8	49.2	100.0
	1981	5.9	44.3	49.8	100.0
Italy	1960	31.5	33.8	34.7	100.0
	1965	24.6	37.3	38.1	100.0
	1970	18.4	39.4	42.2	100.0
	1975	15.4	38.1	46.5	100.0
	1980	13.4	36.9	49.7	100.0
	1981	12.9	36.4	50.7	100.0

Sources: For Italy:
ISTAT, Conti Economici Nazionali, 1960-81 (new series), Rome, 1982.
For the other countries:
OECD - Labour Force Statistics 1968-1979 - Paris, 1981;
OECD - Labour Force Statistics 1959-1970 - Paris, 1972;
OECD - Labour Force Statistics - Quarterly Supplement to the Yearbook - Paris, February 1982.

service area and the relative contraction of the area producing goods, so that the debate has revolved around terms such as "service economy", "post-industrial society" and "de-industrialization". Above and beyond such an apparent similarity, however, the explanations of the develop-

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other than material processing. Taking account of the aim of our investigation, we have disregarded these studies. However, we would recall SYLOS LABINI's contributions as regards the Italian economy (1975, 1978), which analyse the relation between services taken in this sense and the structure of social classes and examine the contraposition between "workers producing wealth" and "workers producing services".

ments under way are markedly different from each other and can be subsumed under two main headings. A first group has concentrated the attention on the service sector and studied the structural change in employment in terms of *growth of the service sector* in the economies. A second type of analysis, in more recent times, has switched the emphasis to the industrial sector and studied the change in terms of *de-industrialization*.

The explanations and the interpretations so far put forward, however, seem to be controversial and partially unsatisfactory. This situation has led us to try in the present study to deal with two issues together. The first of these is a methodological one, and concerns the adequacy of the analysis underlying the major interpretations of the structural change in employment; the second one is an empirical problem, and concerns the description and the interpretation of the growth of service employment in the Italian economy. In this connection, it should be made clear that the second problem is tackled and discussed solely on the basis of the conclusions derived from the analysis of the first one. For this reason, the results presented in this article should be taken mainly as a point of departure for subsequent analyses and elaborations.

The article is divided into four sections. The first brings out certain inadequacies in current interpretations, which are due to the type of analysis on which they are based, and formulates the research hypotheses. According to these hypotheses, the growth in service employment is due to an increasing degree of integration of services in the productive system and in industry. The second section suggests a particular methodology suited to the study of the research hypotheses. The third section presents certain results relating to the process of service sector expansion in the Italian economy, which show that the hypotheses put forward can be accepted. The fourth section, to conclude, goes over the main features of the proposed analysis again and indicates more general fields of application.

I

The studies on the structural change in employment by major sector of production start from a famous study by Colin Clark. This study was based on the division of the economy into three sectors: primary, secondary and tertiary (the latter being calculated by taking the

difference between the total and the first two),[3] and hence was carried out at a high level of aggregation. A large part of subsequent studies, up to the mid 'seventies, maintained a similar level in their investigation, and studied the evolution of the same aggregates.

The whole of the studies describing the change in the composition of employment with emphasis on the service sector analysed the process of *growth of the service sector* on the basis of markedly different explanations.[4] These explanations, however, may, with a generous dose of schematization and simplification, be classified in a few major lines of thought.

A first approach is founded on the theory of stages of economic growth, based on the hypothesis of the gradual move towards models of superior consumption as per capita income increases, in conformity with Engel's law. The growth of service employment, in this view, is determined in advanced economies by a disproportionate increase, with the growth of per capita income, in the demand for services which are regarded in fact as a superior form of consumption.[5]

A second approach in these studies explains the phenomenon of the growth of the service employment by reference to the difference in the dynamics of productivity between services and industry. In this approach,[6] we find purely statistical analyses, together with more theoretical studies carried out by Keynesian economists. The lower growth of productivity in the tertiary sector is alleged to be caused either by smaller opportunities of embodying technical progress in that sector, or by the smaller exposure of the service sector to competition.

A third school of thought, lastly, includes a set of studies which explains the growth of service employment by regarding the services as a "reservoir" for manpower structurally in excess. In this case, service employment growth is not caused by an increased demand for labour in

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[3] Cf. CLARK (1940) chapters V, VI, VII and IX.

[4] In these studies, the different explanations of the process of service sector expansion are generally accompanied by analyses of the *effects* of the increase in the employment of the tertiary sector. These views, however interesting, are not examined here since they are irrelevant to the development of our arguments. Unfortunately, it is not possible to refer the reader to any systematic survey of this literature.

[5] The most important studies inspired by this approach are CLARK (1940), HOSELITZ (1960), ROSTOW (1966), BELL (1974) and, in Italy, DE MEO (1965); there is a partly critical view in FUCHS (1965), while fairly clearcut criticisms are to be found in recent studies, such as LANCIOTTI (1971), EEC (1978), GERSHUNY (1978) and STANBACK (1979).

[6] Among these studies, of different theoretical origin, see STIGLER (1956), KENDRICK (1961), FUCHS (1964) and KALDOR (1966). Criticisms and doubts of an empirical nature are contained in DHRIMES (1963), FUCHS (1965) and recently in EEC (1978).

the services (however determined), but, on the contrary, by a surplus labour supply expelled from the goods-producing sectors, associated with the concomitant need to make up for the social and economic effects of high unemployment and insufficient demand. The theoretical roots of this interpretation are of different origin, but, still simplifying matters, can be regarded as coming under the theory of the dualism of the productive systems (explained by different degrees of exposure to competition) or under the theories of the welfare state.[7]

In more recent years, some investigations into the change in the structure of employment by major sectors of production have shifted the attention from services to industry by describing the current phenomena in terms of *de-industrialization*, simply defined as the general tendency towards a reduction in industrial employment in relative and absolute terms.[8] In this case, too, the explanations put forward may be regarded as reflecting a few major approaches.

There is, first and foremost, a group of studies which analyses this phenomenon too on the basis of the theory of stages. In this perspective, de-industrialization is explained as the effect of the relative reduction in the consumption of industrial products.[9]

There is then a second group of explanations, which can be linked to the theory of technological innovation. According to this point of view, de-industrialization is the consequence of the specific characteristics of recent technological innovations which, it is argued, are such as to impede the functioning of the virtuous circle between technological progress, productivity, output, investment and employment. These innovations are alleged to lead, more intensely and rapidly than past innovations, to reductions, in industry, in the use of labour and fixed capital, and to a rise in the need for professional skills which are lacking, or even to an overaccelerated increase in the capital/output ratio.[10] The consequent reduction in industrial employment corresponds, it is argued, to a growth of employment in the tertiary sector because of the

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[7] Among the others, see LANCIOTTI (1971), FREY (1975), O'CONNOR (1973); for the explanation of unemployment in relation to dualistic growth, see GRAZIANI (1969), and for a discussion of the different welfare state theories, see PACI (1981).

[8] As noted by CAIRNCROSS (1978), this meaning of the term "de-industrialization" is perhaps the most frequently used, but it is not the most fruitful or rigorous one. Indeed the word "de-industrialization" is used to indicate a number of very different concepts. On this point, see the contributions in BLACKABY (1978).

[9] These theses are critically examined in GERSHUNY (1978).

[10] In this connection, see the recent literature on the effects of microelectronics; for example BERTING, MILLS and WINTERBERGER (1980), OECD (1981) and MOMIGLIANO (1982a).

necessity of reabsorbing the manpower expelled and/or because of the reallocation of capital in service sectors with higher returns and profitability.

A last approach in these studies explains de-industrialization as a "crowding-out" of the industrial sector by the public sector. In this theory, de-industrialization in advanced countries is the consequence of the growth of employment in the public sector owing to the growing demand for social services, or, in more general terms, of the excessive expansion of the public area, which appropriates the financial resources and skilled labour needed for the growth of the industrial sector. In some cases, in addition, the same reasoning is extended to the whole tertiary sector,[11] which is generically regarded as being unproductive.

Retrospectively considered, all the various analyses put forward give rise to considerable grounds for dissatisfaction. For econometric tests, and often mere reference to well known facts, seem in part to refute each of these explanations on an empirical level. These reasons for dissatisfaction, it has been gradually recognized, do not depend on the baselessness of the various hypotheses or relations put forward, but on the intrinsic non-homogeneity of the service sector, the result of which is that the variations in tertiary employment cannot be explained as a unitary phenomenon.[12] If defined with a purely residual criterion, the "tertiary" sector does not in reality correspond to the criteria implicit in the definition of an industry, or even less of a branch.[13] Rather, the tertiary sector corresponds to an artificial aggregation of extremely heterogeneous activities, both from the point of view of demand, technology, and output, and from that of the characteristics of its operators, the degree of competition in the markets, the relations with the labour market, and, as we shall see, the integration in the rest of the productive system.[14] For these reasons, aggregate investigations have recently been gradually abandoned and replaced by analyses based on various attempts at disaggregation.[15] If we

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[11] The first hypothesis has been formulated by BACON and ELTIS (1976). More complex hypotheses on this kind of crowding out of industry by the public sector are to be found in CARLI (1977), REVIGLIO (1977), and in part in the recent literature on the contradictions of the welfare state; see for example BOWLES and GINTIS (1981). The hypothesis of de-industrialization as the result of the excessive expansion of tertiary activities is on the contrary mainly of a neoMarxist stamp, see ELLER VAINICHER (1977, 1981), even if similar preoccupations are expressed in KALDOR (1966).

[12] Cf. FUCHS (1965, 1968), LANCIOTTI (1971), EEC (1978) and HEIMLER (1979).

[13] See EUROSTAT (1979), points 265 and 268.

[14] These facts, which are recognized by numerous authors, are discussed in detail by FREY (1975), EEC (1978) and STANBACK (1979).

[15] For a brief review of this literature, cf. MOMIGLIANO and SINISCALCO (1980).

consider these investigations it is interesting to note that numerous hypotheses which had been rejected on the basis of aggregate data can be accepted when verified on specific portions of the tertiary sector, thus confirming the substantial non-unitary nature of the phenomenon under examination.[16] On the basis of these results the desirability of explaining the growth of the service sector with a disaggregated analysis seems to be accepted by the most recent literature.

If we go beyond this problem, however, the previously cited analyses suffer, in our view, from another important defect, which probably prejudices the correct understanding of the phenomena we are discussing. If the different explanations of the growth of service employment and de-industrialization are examined, it will be noted that the different hypotheses put forward, starting from the data on employment in the industrial and service sectors, explain the various phenomena as modifications exclusively determined within the bounds of the aggregate sectors considered as separate entities, or at most linked by common determinants which act solely via mechanisms external to the sectors. The phenomena described as *growth of service employment* or *de-industrialization* are in fact regularly ascribed to "something" (for example, technical progress or productivity) which is exclusively and independently determined within the respective sector, or to the common influence of "something" which is determined outside the bounds of the various sectors (for example, modifications in the consumption patterns, or the structure of the labour market, or the social policy of the State). In both cases, therefore, the process of change is attributed to something different from and extraneous to the modifications taking place in the structure of the productive system, that is, extraneous to the modification of the relations of interdependence and integration between phases of activity which, though classified respectively as industry or services, jointly contribute to the production of specific commodities[17] called for by final demand. If a modification of this type exists, investigations which ignore its effects are incomplete, because they neglect an important determinant of the phenomena being investigated.

In the present work, starting from several indications which lead us to suppose that this type of structural change in the productive system is quantitatively important, we have formulated the following hypotheses:

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[16] For the verification with disaggregated data of various hypotheses, which were rejected in the aggregate, see LANCIOTTI (1971) and HEIMLER (1979).

[17] The term "commodity" is used to indicate goods *or* services.

1) the relative and absolute growth of tertiary employment is due in great part to an increase in the integration of services in the productive system;

2) the greater degree of integration is to be specifically ascribed to the growth of services for industry, and, more generally, for the production of goods.

These hypotheses are markedly different from those presented so far. According to our hypotheses, the relative and absolute growth in service employment largely derives from a growing use of activities classified in the branches of the tertiary sector, but integrated into the productive system and into industry in particular; the phenomenon under review is thus an effect of the structural change in the productive system, and in particular in that part of the system which produces industrial goods. The sectoral data, registered by branch, distinguish between the units which produce goods and those which produce services. The growth in the importance of the latter component, however, does not imply that the part of the economic system producing goods is declining, relatively speaking, and even less does it imply the passage to a post-industrial society in the sense in which Bell (1974) uses this term. In the analysis which we shall present in the following sections, the examination of employment by branch takes place within the analysis of the structure of the productive system and its changes; according to this analysis, the growth in services will be related to the production of goods and, being a function thereof, it can even show an increase in the importance of that part of the productive system.

A few recent studies have advanced substantially similar considerations; we refer to the contributions by the EEC (1978), Stanback (1979) and Ginzberg and Vojta (1981) which disaggregate the tertiary sector into "consumer" and "producer services",[18] laying stress on the latter component. In these studies, "producer services" are defined as those services *mainly* intended for intermediate demand, and "consumer services" as those *mainly* intended for final consumption. The results for all countries bring out the considerable and growing importance of producer services, which is used as evidence to show the marked integration between the production of goods and the production of

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[18] The distinction between "producer" and "consumer services" was introduced in a seminal work by GREENFIELD (1966). Until the end of the 'seventies, however, this distinction was widely disregarded.

services, and hence to contradict the explanations of the growth of service sector and de-industrialization based on the theory of stages.[19]

If, however, we evaluate the methodology with which these studies have been carried out, we will see that they have been based on rather crude indicators, both as regards the measurement of producer services and as regards the interpretation of the results. In fact, as we will see, producer services can be measured more exactly without having recourse to the criterion of the main destination. Even the best measurement of these services, however, does not make it possible to analyse their specific destination within the productive system,[20] such as their integration into the industrial system or the productive system of any commodity.

On the basis of an indicator of producer services, therefore, many of the conclusions of the literature here cited cannot be proved. In the research which we present, on the contrary, we have developed a general methodology which enables us to evaluate the hypotheses put forward, taking account of the structure of the productive system and the transformations thereof.

II

The methodology presented in the following section has mainly empirical purposes and is based on input-output tables from which numerous indicators are derived.

The first of these is very simple and is a measurement of total employment in the producer services. In the analysis cited above, the area of the producer services is defined on the basis of the kind of services involved or, in the best of cases, on the basis of the criterion of the main destination, which is deduced from the ratio of the intermediate to total demand. In this case too, however, the producer services sectors, once identified, are studied in their entirety,[21] and aggregated as such; hence a considerable lack of precision in their aggregate measurement. The indicator we propose, which we shall term "services

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[19] In this sense, very polemical conclusions are to be found in the introduction by E. Ginzberg to the volume by STANBACK (1979).

[20] The expression "structure of the productive system" is henceforth used in the sense introduced by LEONTIEF (1953), Chapter 2, and is common to all the input-output literature.

[21] This is the methodology used by STANBACK (1979) and EEC (1978).

for the productive system", on the contrary, measures the exact extension of the tertiary employment integrated into the system and is defined as

$$\sum_{i=m}^{n} \frac{u_i}{x_i} l_i ,$$

where u_i is the amount of the domestic production of branch i devoted to intermediate uses, x_i is the total production of branch i, l_i is the total employment in branch i, and the elements from *m* to *n* correspond to all the service branches.

The indicator proposed, expressing the integration of every branch in terms of employees, i.e. in homogeneous terms, permits their aggregation, thus enabling us to overcome the lack of precision flowing from the criterion of the main destination. As we shall see, it supplies elements for the evaluation of the first of the hypotheses proposed by us, and, more generally, on any change in the structure of the productive system.

This indicator, however, does not allow us to say anything more on the specific integration of the tertiary sector into the different productive processes. In order to assess the magnitudes in which we are interested, such as the tertiary integrated with industry, it is necessary to analyse in detail the structure of the productive system with a view to observing analytically the total inputs incorporated in the different commodities. To this end, however, the traditional analysis of the productive system disaggregated into industries appears to be insufficient.

As is well known, the logical operation at the basis of the disaggregation of the economy into industries consists in circumscribing a part of the productive system with boundaries, constructed on the basis of homogeneities of demand, output, or technology, in order to be able to study that part in relative isolation from the rest.[22] As Becattini (1979) recalls, "relative isolation" means that the relations between the entities within the portion circumscribed are considered with greater attention and detail than the relations between internal and external entities. For every industry, the latter are described by the two elements which define value added (sales and the total intermediate purchases)

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[22] On the foundations of this problem, see GEORGESCU ROEGEN (1971), Chapter IX and BECATTINI (1962).

aggregated in a synthetic account. Such an aggregated treatment of the relations between industry and system, *given general interdependence between industries*,[23] does not allow to derive information on the entire productive processes which lead from the primary inputs to the final commodities and determine important characteristics thereof.

For the detailed analysis of these processes and of the phenomena which can be ascribed to them, it is then necessary to break down the whole productive system into subsystems which produce the various final commodities (at the level of disaggregation desired), starting from primary inputs. The logical operation of this disaggregation consists in the subdivision of each industry into as many parts as there are final commodities so as to identify the contribution of each industry to each process, thus reconstructing the whole economic system. According to this disaggregation, the single aggregates are not bounded by fixed and conventional limits, but are naturally delimited *qua* complete systems of production, without further exchanges with the rest of the productive system.

Once the final commodities have been identified by an appropriate classification, the structure and the variation over time of the different productive subsystems describe the productive system and its changes in a way suited to the observation of the phenomena which interest us.

A methodology for disaggregating the productive system in this way can be found in the literature on the production of commodities by means of commodities. Concepts of "subsystem" and "vertically integrated sector" are discussed on the theoretical level by Sraffa (1960)[24] and Pasinetti (1973, 1981). An extremely limited number of attempts to study on empirical lines various phenomena making use of analogous concepts are to be found in Leontief (1951, P. IV), Gupta and Steedman (1971), Gossling (1972), Peterson (1979), Momigliano and Siniscalco (1980) and Rampa (1981). In the following sections, we present a development of this methodology, devised with the object of making an empirical study of the productive system, analysing its variables by branch[25] and subsystem. In particular, we will present an

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[23] This problem, which is examined in the Introduction and in part II of LEONTIEF (1941), is taken up in sections 9.1 and 10.8 of DORFMAN, SAMUELSON, and SOLOW (1958), who oppose the hypothesis of general interdependence to the "Austrian" concept of the economic system, and discuss the consequences thereof for the analysis.

[24] The algebraic derivation of Sraffa's subsystems is proposed by HARCOURT and MASSARO (1964) and especially by ZAGHINI (1967), who proves their important properties.

[25] The "branch" is the version of the industry selected in the ESA accounts system; hence, passing from general discussion to specific methodology, we shall always refer to "branches" and no longer generically to "industries" or "sectors".

operator which converts any magnitude whatever from branches to subsystems. The characteristics of this operator, as we shall see, will make it possible to identify some interesting properties of these units being investigated.

We shall now begin by defining the *subsystem i as a unit of investigation*[26] *identified by all the activities used directly or indirectly to satisfy the final demand for commodity i.*[27]

In the methodology and in the following calculations, the subsystem will be described at an intermediate level of detail. In addition, as the calculations are based on input-output tables, considering the nature of that instrument, any subsystem will be described *given fixed capital*: hence the more limited theoretical scope than that of the versions put forward by Sraffa and Pasinetti.

To introduce the methodology, we will use the following notation:[28]

$x \equiv [x_i(t)]$	$i = 1, 2 \ldots n.$	the vector of total domestic production in the year t, expressed at current prices;
$f \equiv [f_i(t)]$	»	the vector of the final demand for goods and services produced domestically in the year t, expressed at current prices;
$l \equiv [l_i(t)]$	»	the vector of employed persons present in the economic system in the year t. The vector can be interpreted as the flow of labour called for by the system, expressed in man/years;

[26] In MOMIGLIANO and SINISCALCO (1980, 1982), the particular version of the subsystem presented was termed "blocco", a word of a completely conventional nature introduced in order to underline the specific level of detail selected (see Appendix 2) and the limitations determined by the treatment of fixed capital. In this article, however, it has seemed advisable to maintain the term "subsystem" despite the fact that the version proposed presents certain particularities, differences and limitations compared with Sraffa's version.

[27] In our methodology, the input-output table is used to represent the economic system in a given year. All the exercises proposed by us, therefore, relate dated inputs to dated quantities of demand, and the use of the table, in association with its own final demand and its own output, as we shall see, has numerous advantages. If, however, we were to use the same table to represent a technology or a general equilibrium system, the term "used" ought to be replaced by the term "necessary" in the definition of the subsystem.

[28] The symbol $\equiv$ is used to denote a definitional equality, and in particular an equality of two different notations for the same thing.

$g \equiv [g_i\ (t)]$ $\quad i = 1, 2... n.$ the vector of a generic magnitude, real or monetary, expressed in homogeneous terms, existing in the economic system in the year t;

$A \equiv [a_{ij}\ (t)]$ $\quad i, j = 1, 2,... n.$ the matrix of the direct technical coefficients of domestic production, calculated from flows at current prices; this matrix is square with $a_{ij} \geqslant 0$.

For all these elements, the superscript ^ indicates that the vector beneath it has been transformed into a diagonal matrix, with all the elements of the vector on the main diagonal.

Making use of this notation, together with the traditional elements of input-output analysis, the economic system can be described by the following equation:

$$(1) \quad \underset{nxn}{(I-A)}\ \underset{nx1}{x} = \underset{nx1}{f}\ ,$$

the solution of which is:

$$(2) \quad \underset{nx1}{x} = \underset{nxn}{(I-A)^{-1}}\ \underset{nx1}{f}\ ,$$

in which the matrix $(I-A)^{-1}$ is Leontief's inverse, which shows the direct and indirect requirements of domestic production.

On the basis of equation (2), we can construct an operator B defined as

$$(3) \quad \underset{nxn}{B} = \underset{nxn}{(\hat{x})^{-1}}\ \underset{nxn}{(I-A)^{-1}}\ \underset{nxn}{\hat{f}}$$

This operator, as we shall see, makes it possible to reclassify any magnitude from branches into subsystems: however, it presents *per se* interesting characteristics. If we carry out the multiplication $(I-A)^{-1}\hat{f}$ and premultiply the resulting matrix by $(\hat{x})^{-1}$, it will at once be noted that each row of operator B shows in its elements the part of the production of each branch which is directly and indirectly activated by the final demand for the various commodities, that is, *the proportion of the activity of each branch which comes under the various subsystems.* Each column, on the contrary, indicates in its elements the *proportion of the activities of the various branches which come under a subsystem.* Operator B, if read by row and column, therefore, contains all the

information needed to break down each branch into the parts which ensure the integration of each subsystem, in line with Sraffa's proposals. In the operator, while the elements in every row add up to unity, those in each column, being proportions of different values, cannot be added up. If, however, we premultiply matrix B by any diagonalized vector $\hat{g}$, we obtain a matrix G whose elements are all expressed in homogeneous terms. It is thus possible to aggregate at will the matrix G and to calculate the relative importance of the various branches in any subsystem, by constructing, to that end, an appropriate matrix C.

In the subsequent section, the analysis of the employment structure and of changes in it will be carried out on the basis of employment matrices $L = \hat{l} B$, on the basis of operators B, which represent the shares of employment by row, and of matrices C, which represent them by column.

To illustrate the above remarks by means of some examples, Table 2 shows for 1975 operator B, the employment matrix L and matrix C calculated from L. In operator B we can read off by row the percentage of any magnitude (and hence of employment) of every branch belonging to the various subsystems. The element 5,2 for example indicates that 18.38% of the branch "other market services" belongs to the "industry" subsystem, and the element 5,5 indicates that 60.91% of branch 5 is used directly and indirectly to satisfy its own final demand.

In matrix L, on the contrary, we can read off in absolute terms the same information referred to total employment, analysing in each row the contribution of one branch to the various subsystems and in each column the contribution of all branches to one subsystem. Since in L all magnitudes are expressed in homogeneous terms, they can be aggregated at pleasure. Thus the sum per row is equal to the employment in branches and the sum per column to employment in subsystems. If in each column we add up elements 4 and 5, we obtain the total of market services which belong to each subsystem.

Lastly, matrix C, calculated starting from L, shows the importance of each branch in the various subsystems (and hence by column represents their structure) analysed in terms of employment.[29] While the elements of matrix C cannot be added up by row, they can be aggregated as we please by column.

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[29] If matrix C were calculated for another magnitude, let us say value added, it would obviously be different.

TABLE 2

BRANCHES AND SUBSYSTEMS, 1975

BRANCHES \ SUBSYSTEMS	2.1 OPERATOR B						
	1	2	3	4	5	6	
	Agriculture	Industry	Bldg. and construction	Trade	Other market services	Non-market services	Total by row
1 Agriculture	0.4801	0.4073	0.0028	0.0033	0.0800	0.0266	1.0
2 Industry	0.0072	0.8099	0.0795	0.0218	0.0473	0.0343	1.0
3 Bldg. and construction	0.0011	0.0257	0.8633	0.0160	0.0504	0.0435	1.0
4 Trade	0.0109	0.1021	0.0226	0.8137	0.0335	0.0172	1.0
5 Other market services	0.0085	0.1838	0.0496	0.0505	0.6091	0.0990	1.0
6 Non-market services	0.0	0.0	0.0	0.0	0.0	1.0	1.0
Total by column	—	—	—	—	—	—	
	2.2 MATRIX OF TOTAL EMPLOYMENT L (thousands of employed)						
	1	2	3	4	5	6	(employment in branches)
1 Agriculture	1463	1241	8	10	244	81	3047
2 Industry	42	4708	462	127	275	199	5813
3 Bldg. and construction	2	45	1510	28	88	76	1749
4 Trade	26	244	54	1944	80	41	2389
5 Other market services	31	674	180	185	2233	363	3666
6 Non-market services	0	0	0	0	0	3162	3162
Total by column (employment in subsystems)	1564	6912	2214	2294	2920	3922	19826
	2.3 MATRIX OF THE SHARES BY COLUMN C						
	1	2	3	4	5	6	
1 Agriculture	0.935	0.180	0.004	0.004	0.084	0.021	—
2 Industry	0.027	0.681	0.209	0.056	0.094	0.051	—
3 Bldg. and construction	0.001	0.006	0.682	0.012	0.030	0.019	—
4 Trade	0.017	0.035	0.024	0.847	0.027	0.010	—
5 Other market services	0.020	0.098	0.081	0.081	0.765	0.093	—
6 Non-market services	0.0	0.0	0.0	0.0	0.0	0.806	—
Total by column	1.0	1.0	1.0	1.0	1.0	1.0	

Sources: see Appendix 1.

To conclude we may mention an important characteristic of operator B. Despite the fact that it is calculated from matrix A and from $(I-A)^{-1}$ which depend on relative prices, operator B, as is shown in Appendix 2, is independent of relative prices. As a corollary of this, when B is multiplied by a physical magnitude (e.g. employment), the resulting matrix too is independent of relative prices.

To qualify this point, it should however be noted that B is not a pure indicator of techniques; as can be easily observed from equation (3), it depends on techniques *and* on final demand, and the effects of these two components on B are apparently inseparable. While not providing a description of technical change alone, however operator B is totally adequate if we wish to ascribe parts of any variable of the system to components of final demand. In this sense, the comparison in time of the tertiary employment integrated into industry is entirely legitimate.

III

Making use of the methodology presented, we can now examine certain aspects of the process of service employment growth in the Italian economy.[30] The analysis lays no claim to being complete: its sole purpose is to provide an initial case for an evaluation of the research hypotheses.

The data presented are limited to the years 1965, 1970 and 1975, because these are the only years for which the input-output tables are constructed from direct polling; the table for 1975, in any case, is the most recent table available for the Italian economy. To evaluate the results presented, we must bear in mind certain characteristics of the input-output tables used: the flows are classified by branch, and not by sector; the transactions are registered at prices *ex-factory*; the tables record exchanges and not actual use.

Having made these points, we shall begin by discussing the first of the indicators presented: the "services for the productive system" (henceforth indicated as SFS). As explained in the previous section, this aggregate indicates synthetically the exact degree of integration of the

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[30] In order to avoid excessive repetition, in this section the terms "services" and "tertiary sector" are used as synonyms; however, the ESA nomenclature has been retained in the tables.

services into the productive system as a whole, and therefore enables us to discuss the first of the two research hypotheses proposed in section I.

The fact that the table registers only exchanges excludes from SFS all non-market services, which, even if needed for the production of some goods and services, are entirely recorded as final demand. This inevitably involves an underestimate of the integration of the service sector into the productive system. If only to avoid this underestimate, SFS is compared solely with market services, maintaining non-market services completely separate.[31] The fact that the table records transactions at *ex-factory* prices, on the contrary, allows us to disaggregate services into three parts: SFS, final trade,[32] and services for final demand. After these preliminary remarks, we can assess the main findings emerging from Table 3. From that table, it will be noted that:

(i) SFS forms a considerable portion of the market service sector. From 1965 to 1975, its importance increases to a growing extent (from 31.9% to 36.3%) compared with a gradual contraction of services for final demand (from 36.3% to 32%) and with a substantial stability of the importance of final trade;

(ii) the growth of SFS (+32.6%) is much greater than that of final trade (+14.9%)[33] and of services for final demand (+4.4%); SFS is thus the most dynamic component of market services;

(iii) given its importance and dynamism, SFS accounts for a large part of the increase in market services; in the period

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[31] The problem flowing from the impossibility of measuring the integration of non-market services into the rest of the productive system has already been examined in MOMIGLIANO and SINISCALCO (1980), where the different economic nature of these services (largely produced by the State) was discussed at length.

[32] As is well known, the table at *ex-factory* prices considers trade and transport serving it separately from exchanges of goods, and records them in two separate rows, the output of which is intended for final demand for what consists of final distribution, and is intended for intermediate demand for what consists of trade between firms and transport serving it. The latter part is therefore recorded in SFS, while final distribution is dealt with independently. The possibility of separating final trade both from SFS and from services for final demand seems particularly desirable considering the particular nature of final distribution, which is used for the working of the system (and therein is analogous to SFS), but it is not integrated into it, since entirely situated downstream from the productive processes.

[33] It may be interesting to note that, in the 1970-75 period, contrary to the period 1965-70, the increase in total trade, just above 111,000 employed, is to a large extent concentrated in intermediate trade, which increases by over 80,000, while final trade increases by just under 30,000.

1965-75, the increase in SFS accounts for 62.2% of the growth in market services; in the period 1970-75, it accounts for over 100% thereof; in this second subperiod, services for final demand fall even in absolute terms.

Over and above their specific interest, these data allow us to confirm the first of the two hypotheses put forward: the increase in employment in market services is largely imputable to a structural change corresponding to an increased integration of the services in the overall productive system.

The increase in SFS, however, must be considered solely as a first indicator of the change under way. Having identified the importance of this phenomenon, it is interesting to study the ultimate destination of

TABLE 3

EMPLOYMENT IN SERVICES: SFS AND OTHER COMPONENTS 1965-75
(number of employees)

3.1 Levels	1965	1970	1975
Total services	7,445,800	8,240,300	9,217,000
Market services	5,187,010 (100)	5,879,595 (100)	6,054,600 (100)
Services for the productive system (SFS)	1,657,027 (31.94)	1,920,771 (32.67)	2,196,595 (36.28)
Final trade	1,647,807 (31.76)	1,862,084 (31.67)	1,893,044 (31.27)
Services for final demand	1,882,176 (36.30)	2,096,740 (35.66)	1,964,961 (32.45)
3.2 Growth: absolute and percentage values	**1965-1975**	**1965-1970**	**1970-1975**
Total services	+1,771,200 (+23.79)	+794,500 (+10.68)	+976,700 (+11.85)
Market services	+ 867,590 (+16.72)	+692,585 (+13.35)	+175,005 (+ 2.97)
Services for the productive system (SFS)	+ 539,574 (+32.56)	+263,750 (+15.91)	+275,824 (+14.36)
Final trade	+ 245,237 (+14.88)	+214,277 (+13.00)	+ 30,960 (+ 1.66)
Services for final demand	+ 82,785 (+ 4.39)	+214,564 (+11.40)	−131,779 (− 6.28)

Sources: Elaborations from ISTAT data (see Appendix 1).

intermediate services, and the growth of service employment share in the various kinds of production. For that purpose, however, SFS, like any other indicator of producer services, is inadequate: as was discussed in the previous section, each branch must be then decomposed in such a way to break down the economic system in subsystems. On the basis of operator B, matrix L, and matrix C, illustrated in section II, we will examine then the relation between service employment and various subsystems. Analysing the matrices by branch (rows) we will study the *integration of services into the different subsystems*, i.e. the absolute and percentage part of each service branch which belongs to the different subsystems. Analysing the matrices by subsystem (i.e. by column), we will study *the share of service employment in each subsystem*, i.e. the absolute and relative magnitude of service employment within each subsystem. The results will be presented at an increasingly disaggregated level, with data taken from matrices of different dimensions.[34]

We shall begin the examination of the results with certain tables derived from 6x6 matrices, corresponding to those given in Table 2 for 1975. Table 4 shows, in the branches, the *total* market services corresponding to the sum of rows 4 (trade) and 5 (other market services) of Table 2. In the columns on the contrary, they show the six subsystems disaggregated.[35] On the basis of these data, we start examining the integration of services into the different subsystems.

From tables 4.1 and 4.2 the following indications emerge:

(i) from 1965 to 1975 market services increase their integration into industry (the relative magnitude of these services rises from 12.0% to 15.1% of total market services) and into non-market services (from 4% to 6%). The integration of market services with agriculture, with building and construction, trade and market services, on the contrary, contracts;

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[34] The calculations, however, have all been carried out at the maximum level of disaggregation, and the results have then been reaggregated in the manner desired, with a view to avoiding the distortions flowing from the aggregation of the input-output tables. On this point see KOSSOV (1972).

[35] The decision to aggregate trade and other services in the branches, but to leave them disaggregated in the subsystems is determined by the fact that the flows are recorded at *ex-factory* prices. When we analyse the contribution of the services branch in the various subsystems (analysis by row), there is no reason to separate trade (which is obviously intermediate trade in all subsystems except in the trade one) from the other services. When, on the contrary, we analyse the individual subsystems, it seems desirable to separate trade from "other market services"; for the final trade demand is completely independent of the demand for the other services, and is on the contrary complementary to the final demand for goods. The analysis of the services subsystem must therefore be separated from the analysis of the final trade subsystem.

TABLE 4

ANALYSIS OF MARKET SERVICES BY BRANCH AND SUBSYSTEM

4.1 - Integration of Market Services into Subsystems (row operator B, percentage values)

BRANCH \ SUBSYSTEMS	1 Agriculture	2 Industry	3 Bldg. and construction	4 Trade	5 Other market services	6 Non-market services
Total* market services						
1965	1.26	12.04	4.28	36.02	41.91	4.48
1970	0.95	13.28	4.51	35.86	41.42	3.97
1975	0.95	15.15	3.86	35.16	38.20	6.67

4.2 - Market Service Employment in Subsystems (row matrix L, absolute values)

BRANCH \ SUBSYSTEMS	1 Agriculture	2 Industry	3 Bldg. and construction	4 Trade	5 Other market services	6 Non market services
Total* market services						
1965	65,678	624,778	222,043	1,868,138	2,173,850	232,526
1970	56,160	781,064	265,023	2,108,242	2,435,908	233,198
1975	57,800	917,402	233,711	2,312,908	2,312,948	403,790

4.3 - Share of Service Employment in Subsystems (row matrix C, percentage values)

BRANCH \ SUBSYSTEMS	1 Agriculture	2 Industry	3 Build. and construction	4 Trade	5 Other market services	6 Non-market services
Total* market services						
1965	2.27	9.73	8.41	93.26	82.06	8.71
1970	2.74	11.49	9.95	93.00	82.03	8.31
1975	3.69	13.27	10.55	92.82	79.23	10.29

Sources: Data taken from matrices B, L and C 6x6, elaborated from ISTAT data (see Appendix 1).
* The row "Total market services" corresponds to the sum of rows 4 and 5 of Table 2.

(ii) from 1965 to 1975, services for industry (henceforth referred to as SFI) rise by about 293,000 employees, with an increase (+46.8%) distinctly higher than that of total market services (+16.7%) and of SFS (+32.6%);

(iii) from 1965 to 1975, the absolute increase in SFI accounts for 33.7% of the increase in total services and 54.2% of the increase in SFS. In the period 1970-75, the absolute magnitude of SFI growth is such as to account for 77.9% of the increase in market services;

(iv) lastly, the market services employment integrated into non-market services subsystem, in the period 1965-75, also marks a very sharp increase (+73.6%, +171,000 employees), accounting for a further 19.7% of the increase in market services; it should be added that this phenomenon is concentrated almost exclusively in the second quinquennium of the period.

These synthetic results therefore seem to confirm the second of our hypotheses as well: the integration of services into industry increases substantially and accounts for the bulk of the increase in market services and in SFS. SFI thus becomes the most important component in the increase in employment in market services.

We shall now examine the service employment in the different subsystems. From Tables 4.2 and 4.3, it emerges that:

(i) from 1965 to 1975 all subsystems which produce goods and the non-market services subsystem increase their own share of service employment; the industry subsystem in particular increases its own service employment from 9.7% to 13.3%;

(ii) these increases are matched in absolute terms by a marked rise of employment in SFI (+46.8%) and in services for non-market services (+73.6%), as well as, to a more modest degree, an increase in services for building (+5.3%), services for trade (+23.8%) and for market services (+6.4%). Between 1970 and 1975, however, the service employment in the latter subsystem falls by 123,000 employees;

(iii) the absolute increase in employment in SFI accounts to a large extent for the increase in employment in the industry subsystem: 60.1% in the period 1965-75, and more than 100% in the period 1970-75.

From the entire matrices L, which we have not published for lack of space, the conclusion emerges that, from 1970 to 1975, the subsystem producing market services for final demand loses in all 50,000 employees. This means that, in terms of employment, the part of the system producing final services has suffered a shrinkage in relative and absolute terms.

While the increase in tertiary employment for non-market services seems to be a phenomenon confined to a single quinquennium (1970-75), which happened to be particularly critical for the public sector in

Italy,[36] the growth in service employment in the subsystems producing goods appears to be a more general phenomenon, and in any case to lend itself better to more soundly based interpretations. Thus, leaving aside the more detailed analysis of the non-market services subsystem, we propose an interpretation of the growth of SFI and of the expansion of the tertiary employment in the subsystems producing goods. This interpretation, already put forward in Momigliano and Siniscalco (1980), to a certain extent approximates the one suggested in the literature on producer services.

According to the proposed interpretation, the growth of tertiary employment in the subsystems producing goods can be explained as an increase in intermediate services functional to the working of the productive system and contributing to its efficiency. The growth in these services may be caused, in advanced capitalistic economies, by the greater complexity of the management problems (taxation, finance, administration, communications, research, market study, information systems, etc.) by a smaller degree of vertical integration of firms and plants, and, at the same time, by the large industrial firms hiving off existing services in their business structure, with a view to improving efficiency and increasing specialization. These processes provide access on the part of other users to these services, and create a new demand on the part of small and medium firms which, because of economies of scale, could not produce the same services within their own organization.

The case for this interpretation, which is certainly not the only one which can be put forward, can be further strengthened moving to a more detailed examination of service employment in the various subsystems.

Table 5 allows to examine the integration of the various service branches into the "industry" subsystem. This table, which is derived from the 44x6 matrice enables us to consider, for every branch of the tertiary sector, the number of service employees belonging to the industry subsystem, the share in the respective branch (analysis by row) and in the industry subsystem as a whole (analysis by column). From this table it is clear that:

(i) in 1975, the services most closely integrated into the industry subsystem are: credit, research, auxiliary transport services, followed by communications, transport and business services provided to enterprises;

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[36] On this point see REVIGLIO (1977).

TABLE 5

ANALYSIS OF DIFFERENT MARKET SERVICES WITHIN THE INDUSTRY SUBSYSTEM

Branch code	Branches	1965			1975		
		number of employees	percentage share in branch examined	percentage share in industry subsystem	number of employees	percentage share in branch examined	percentage share in industry subsystem
55	Recovery and repair services	113,595	23.24	1.77	119,357	23.11	1.73
57	Wholesale and retail trade	153,826	7.63	2.40	243,330	10.18	3.52
59	Lodging and catering services	29,340	6.51	0.45	30,780	5.55	0.44
61	Inland transport services	129,687	21.13	2.02	169,572	24.12	2.45
63	Maritime and air transport services	2,204	3.89	0.03	2,968	4.63	0.04
65	Auxiliary transport services	15,478	13.64	0.24	43,358	30.88	0.63
67	Communication services	46,055	25.33	0.72	57,290	25.34	0.83
69	Services of credit and insurance institutions	56,280	31.21	0.88	85,191	32.09	1.23
71	Business services provided to enterprises	46,149	18.08	0.72	102,391	23.52	1.48
73	Services of renting of immovable goods	0	—	—	0	—	—
75	Market services of education and research	20,149	16.92	0.31	39,468	31.12	0.57
77	Market services of health	2,081	0.67	0.03	1,132	0.68	0.01
79	Recreational and cultural services, personal services, other market services, n.e.c.	9,934	2.49	0.15	22,565	4.85	0.33
	Total	624,778		9.72	917,402		13.27
	Mean		14.43	0.81		18.01	1.17

Sources: Matrices L, B and C 44x6, elaborated on ISTAT data (see Appendix 1).

TOTAL MARKET SERVICES WITHIN THE

Subsystems / Branch: total market services	Coal, lignite (brown coal) and briquettes	Products of coking	Crude petroleum, natural gas and petroleum products	Electric power, gas, steam and water	Production and processing of radioactive materials and ores	Ferrous and non-ferrous ores and metals	Non-metallic mineral products	Chemical products	Metal products except machinery and transport equipment	Agricultural and industrial machinery	Office and data-processing machines; precision and optical instruments
Code	03	05	07	09	11	13	15	17	19	21	23
1965 no. of employed (absolute value)	11	557	9,830	7,825	0	21,203	8,567	53,209	36,291	54,055	11,308
1965 relative percentage share in subsystem	6.79	30.56	35.18	14.27	–	25.98	10.03	21.64	14.63	13.59	11.87
1975 no. of employed (absolute value)	0	1,195	13,249	4,620	0	26,300	16,293	82,759	44,075	118,184	19,685
1975 relative percentage share in subsystem	–	38.65	37.40	13.64	–	27.24	13.01	26.09	15.30	17.83	18.09

Sources: Matrices L and C 6 x 44 elaborated on ISTAT data (see Appendix 1).

TABLE 6

DIFFERENT INDUSTRY SUBSYSTEMS, 1965-75

Electrical goods	Motor vehicles	Other transport equipment	Meats, meat preparations and preserves, other products from slaughtered animals	Milk and dairy products	Other food products	Alcoholic and non-alcoholic beverages	Tobacco products	Textiles and clothing	Leathers, leather and skin goods, footwear	Timber, wooden products and furniture	Paper and printing products	Rubber and plastic products	Other manufacturing products	Mean
25	27	29	31	33	35	37	39	41	43	45	47	49	51	
31,505	58,210	16,415	32,877	18,975	83,550	15,586	3,020	101,528	16,738	11,021	16,898	9,553	5,955	
12.37	17.84	11.91	4.92	4.40	8.10	17.95	4.36	7.98	5.45	3.76	13.04	11.16	6.44	13.10
68,188	75,845	25,450	46,204	21,925	99,511	15,019	2,627	116,449	34,294	27,545	22,209	21,053	14,271	
15.23	18.13	14.48	8.43	7.31	11.36	18.69	7.64	9.04	9.55	6.92	17.80	16.89	13.17	16.09

(ii) all service branches, except for hotels and recovery and repair services, from 1965 to 1975 increase their integration into the industry subsystem: the arithmetic mean of the integration coefficients passes from 14.43 to 18.01%; the largest increase is for research, auxiliary transport services, and business services to firms;

(iii) all services, except for hotels, recovery and repair services and health services increase their share of employment in the industry subsystem; the mean of these shares rises from 0.81% to 1.17%. The largest percentage increase is for auxiliary transport services, business services provided to enterprises, research and credit.

Equally interesting indications can be gleaned from Table 6 which enables us to assess the share of service employment as a whole in the different industrial subsystems. This table, which is derived from the 6x44 matrices, shows the magnitude of market services employment in absolute and percentage term in each subsystem. From this table it can be shown that:

(i) between 1965 and 1975, service employment increases in absolute terms in all industry subsystems, with the exception of coal, electric power and tobacco products, with percentage increases often above 100;

(ii) service employment increases its relative share in all subsystems, excluding only coal and electric power. The arithmetic mean of these shares rises from 13.10 to 16.09%.

From a first study of all the disaggregated data presented so far, some indications appear to emerge. The services most closely integrated into industry correspond to a large extent to branches which are normally identified as business services and branches serving the increasing decentralization of production. The subsystems with the highest share of service employment[37] mainly correspond to branches with a low labour intensity, a high use of raw materials and/or to branches generally defined

[37] It will be noted that the industrial subsystems with an above-average share of tertiary employment are (in 1975): products of coking, oil products, ferrous and non-ferrous ores and minerals, chemical products, beverages, motor vehicles, office machinery, agricultural and industrial machinery, paper and printing products, rubber and plastic products.

as "modern", or "advanced"; on the contrary the subsystems with the lowest share of service employment mainly correspond to branches usually defined as "traditional" or "mature".[38] A comparison in time of the rank of industrial subsystems ranked by the share of tertiary employment brings out a substantial stability over time,[39] but, as can be seen, the subsystems with the smallest tertiary share increase this share with an above-average growth.

The study of the 44x44 matrices (which, for reasons of space, we do not reproduce, but which are available) adds further evidence to that already submitted. As an example, Table 7 shows the share of the different services in two industrial subsystems selected as particularly different cases as regards the structural characteristics of the corresponding branch. In the first subsystem, chemical products, the share of services passes from 21.6% to 26.1% and the increase is largely determined by the growth of services to business enterprises, research and other services. In the second subsystem, leathers, leather and skin goods, footwear, on the contrary, the share of services — a much lower one — almost doubles with an increase in all branches of the tertiary sector.

More generally, despite the fact that the whole structure of the subsystems changes substantially, which makes difficult to effect a clear interpretation of the changes underway, the whole table at the highest level of disaggregation confirms the view that in all industry subsystems the increase in tertiary employment takes place in the branches of research, services to enterprises and "other services", and, in addition, although not in all subsystems, in transport, auxiliary transport services and in wholesale and intermediate trade.

All these results seem therefore consistent with the interpretation according to which the increase in services integrated into industry is attributable on the one hand to the greater complexity of managerial functions, and on the other to a smaller degree of vertical integration in firms.

Before concluding, it may be interesting to consider a last finding. Defining the productivity (y) of the subsystem i as the ratio of final demand for domestic production of commodity i to employment in subsystem i, and defining the tertiary share (x) of that subsystem as the ratio of tertiary employment to total employment in subsystem i, we

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[38] The subsystems with the lowest coefficient of tertiary employment include timber, wooden products and furniture, tobacco products, meat, milk and dairy products, textiles and clothing, leather, leather and skin goods, footwear.

[39] This confirms the thesis that the degree of integration of the services into the various subsystems depends on the structural characteristics of the productive processes.

TABLE 7

SHARE OF EMPLOYMENT IN THE DIFFERENT SERVICES IN TWO INDUSTRIAL SUBSYSTEMS, 1965-75

Branches \ Subsystems		17		43	
		Chemical products		Leathers, leather and skin goods, footwear	
		1965	1975	1965	1975
55	Recovery and repair services	2.80	2.65	0.75	1.27
57	Wholesale and retail trade	2.96	2.88	2.40	4.01
59	Lodging and catering services	1.73	1.65	0.16	0.32
61	Inland transport services	4.03	4.14	1.04	1.75
63	Maritime and air transport services	0.11	0.13	0.01	0.02
65	Auxiliary transport services	0.79	0.79	0.07	0.27
67	Communication services	2.59	2.35	0.23	0.29
69	Services of credit and insurance institutions	1.83	1.89	0.38	0.61
71	Business services provided to enterprises	2.05	3.99	0.32	0.78
73	Services of renting of immovable goods	—	—	—	—
75	Market services of education and research	2.01	4.57	0.05	0.15
77	Market services of health	0.00	0.01	0.00	0.00
79	Recreational and cultural services, personal services, other market services, n.e.c.	0.68	1.04	0.04	0.08
	Total services in subsystem	21.64	26.09	5.45	9.55
	Total employment in subsystem	100	100	100	100

Sources: Matrices L and C size 44x44 elaborated on ISTAT data (see Appendix 1).

have found a considerable and significant positive correlation between the two magnitudes (R = 0.50).[40] This correlation obviously does not prove the existence of a causal relation and even less its direction, yet it can be regarded as a further element in line with the interpretation advanced by us.

Above and beyond the problems of interpretation and of their verification (which certainly calls for further investigation), the disaggregated analysis in any case brings out one fact: the phenomena of integration of the tertiary sector in industry and the growth of the tertiary share in the industry subsystem, which have already emerged at the level of aggregated analysis, are in reality phenomena which are also systematically met with at the level of the vast majority of the individual branches and individual subsystems. They correspond therefore to a generalized trend in our productive system.

IV

We are now in a position to draw a few conclusions and to reconsider certain characteristics of the analysis presented. Our research took as its starting point the observation of a phenomenon common to all industrial countries: the relative and absolute increase of service employment in a framework of general change in the structure of employment by branches and groups of branches. Analysing the main explanations of this phenomenon, we have concentrated on certain unsatisfactory characteristics common to the different explanations: the excessive level of aggregation and, above all, the fact that the change in question is analysed *as if* industry and the tertiary sector were separate and independent entities, linked at most by some common external influences. This separation, which no economist would support explicitly, is implicitly assumed in the main analyses of the growth of service employment and de-industrialization, and is at the root of a serious failure to understand the change under way. Impelled by these reasons, we have proposed a different approach and supposed that the structural change of employment — and in particular the growth of service employment — are largely due to the change in the structure of the

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[40] The equation $y = \alpha_0 + \alpha_1 (x)$, estimated as a cross-section of all industry subsystems for the year 1975, gives the following result:

$$y = - 0.008 + 0.1531\, x, \quad (R^2 = 0.25) \quad (F = 6.88).$$

productive system. In particular we have supposed that the growth of service employment is determined by a growth of services called for by industry and by the production of goods.

Having observed the impossibility of testing this hypothesis correctly on the basis of traditional information on the sectors, we have put forward a particular methodology for the study of the structure of the productive system and have carried out certain exercises on the basis of the data available for the Italian economy. The results of these exercises have enabled us to confirm our hypothesis and to bring out some other interesting phenomena.

Since these findings are available only for the Italian economy, we do not, however, propose our hypothesis as a general explanation of the process of service employment growth in all industrial countries. In line with the point made in the introduction, the aim of this article is mainly methodological: taking as an example the problem examined, we mean to discuss the general validity of the analysis proposed, and draw attention to the relations between disaggregated variables within the productive system.

In Section II, making use of a conceptual apparatus similar to Sraffa's subsystems, we have introduced a methodology which enables us to calculate empirically two important nexuses, showing them in one and the same table:

— a nexus which links the activity of each branch of the system to the final demand for all the commodities (taken one by one);

— a nexus which links the final demand for each commodity to the activity of all the branches of the system (taken one by one).

For a given year, that is, for a given structure of the system, the two nexuses show, at the same time, the extent to which employment (or any other variable) in a branch can be ascribed to the final demand for the various commodities, and to what extent the final demand for a given commodity is related to employment in the different branches.

From this, certain important indications can be drawn. It can in particular be noted that the part of a branch which is used to satisfy the final demand for its own product is often small.[41] It follows that the attempts to account for variations in employment in a branch on the basis of variations in final demand for its own product (as in the case of

[41] See Appendix 2.

the theory of stages) are bound to fail, even if the structure of the system does not change, because they are based on an incorrect nexus. In addition it can be noted that the share of most of the branches in their own subsystems is equally limited. It follows that the attempts to explain the characteristics or the performance of a product[42] by examining exclusively the branch which produces it (according to the ESA classification) are at best incomplete because, once again, based on an incorrect nexus.

In the case of comparisons in time, the two nexuses which we can read off in the matrices calculated for various years allow us to derive even more interesting information. The variations in employment in the different branches in fact can be analysed taking account of all the sectoral and intersectoral effects of the change in techniques.

In the case analysed by us, we have seen that the relative and absolute growth of service employment is largely explained by the growing integration of services into the industrial system; more in general on the basis of the nexuses we have put forward, we can evaluate the effects on the entire system of processes only apparently internal to the branches. Phenomena such as, for example, the changes in the productivity of the different branches are often, even if not necessarily, determined by processes of "restructuring", and above all by technico-organizational change, which have intersectoral effects to be measured only by examining the subsystems.

For all these reasons, the various analyses which regard the structural changes in employment and account for the various phenomena on the basis of factors acting exclusively within the branches or exclusively outside them run the risk of being utterly incomplete. Whatever explicative hypothesis it is intended to put forward, it is advisable to assess it by analysing the whole productive system broken down into branches and subsystems.

As we have already indicated, the type of analysis which we propose is applicable not only to employment, but makes it possible to examine a large number of variables, the sole limit being imposed by the data available which must be consistent with the tables used. Among the various possibilities, we would pick out the study of real variables, such as other measurements of the labour inputs (however disaggregated),

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[42] This observation is valid for individual products (as in the case of some theories of international trade) or for the final product of a big group of branches as a whole (such as industry) whose performance is often explained on the basis of variables referring to the group of branches alone.

real inputs such as power, indicators of research and development, patents etc. and the study of monetary variables such as value added, profits, etc.

Once the reclassification of the different variables has been effected, it is possible to carry out various analyses of the productive system analysed by branch and subsystem. Of these, we can for example cite:[43]

— the study of the productivity of the various subsystems, defined as the ratio of the final demand for a commodity to the inputs of the subsystem producing it;

— the study of the relations between final demand, supply and distribution of value added and profits between branches within the subsystems;

— the study of magnitudes such as the trade balance of the various subsystems;

— the study of certain characteristics and performances of the products as determined by all the inputs incorporated in them.

The results of which we dispose for the Italian economy show that the importance of this methodology is not only theoretical. Some empirical applications seem to modify, or at least to qualify, many elements of conventional wisdom developed in recent years. The examination of these data is not possible in the present paper; simply as an example, we may confine ourselves to the statement that:

— total employment in most of the subsystems, at any level of aggregation, is very different from employment in the respective branches, often subverting the employment relevance conventionally attributed to some types of production;

— the subsystems which correspond to branches which have not increased employment in the period in question are frequently those in which employment has grown markedly, and *vice versa*;

— the distribution of value added by branch within the subsystems has often varied sharply, with considerable effects on the gross profits of enterprises which belong to industrial branches;

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[43] Some indications on this kind of studies can be found in MOMIGLIANO (1981, 1982a, 1982b) and SINISCALCO (1982).

— the productive system and in particular the industrial system, when analysed by branch and subsystem, show substantial modifications in a period in which the data obtained by conventional methodologies (including standard uses of input-output tables) support the hypothesis of its "crystallization".[44]

From all the above, the importance of this type of analysis ought to emerge with great clarity. In addition to the descriptive aspects, it appears important to note that this type of investigation offers the possibility of elaborating new approaches to economic and industrial policy, based on more appropriate indicators than is possible from a use, often misleading, of sectoral information alone.

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APPENDIX 1: the statistical sources.

The calculations underlying the findings of this article have been carried out using the input output tables published in ISTAT (1974, 1981) and an employment series consistent with them. The tables used are the 44 branches version of the "Tavola intersettoriale dell'economia italiana a prezzi *départ usine*" for 1965 and 1970 and of the "Tavola intersettoriale dell'economia italiana a prezzi *ex-fabrica*, al netto dell'IVA deducibile" for 1975. The calculations have been based on the domestic output flows, and the imputed banking services have been redistributed among the different branches using the elaborations contained in CNR (1982). The 44 branches employment data for 1975 are published in ISTAT (1981); the data for 1965 and 1970 are published in many official documents (e.g. ISTAT 1979) at a slightly higher level of aggregation; the corresponding 44 branches series has been circulating for some time at an informal level and is available from the authors.

All the data we used present two kinds of problems. The first concerns their general reliability, which is crucial for the evaluation of the results, but cannot be discussed in this article for reasons of space. The second is related to the concept of branch and is of general interest. Let us assume that the data are perfectly in

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[44] See CARLI (1977), who bases this view on the data contained in CROCE (1977).

line with the theoretical concept of branch as defined in EUROSTAT (1981). In this case, generally speaking, phenomena of hiving-off without technological changes (i.e. phenomena of pure decentralization of production) do not influence the flows recorded in the table. It follows that, in these cases, operator B and the structure of the subsystems do not vary. In particular cases, however, the mere hiving-off of certain services may be reflected in the flows of the table, and hence in operator B, to the extent to which these services are "auxiliary activities" (see EUROSTAT 1981, note 1 to point 267). Even in this case, however, total employment in the different subsystems does not change, as can be intuitively grasped if it is remembered that the subsystem "consolidates" all employment used directly or indirectly in the different branches to meet the final demand for a given commodity. In the particular case of pure decentralization of auxiliary services then, other things being equal, we observe a change in the structure of the subsystems, while the total employment of each subsystem remains unchanged. The observed growth of the share of service employment within the different subsystems can therefore be caused both by new services and by the hiving-off of the existing auxiliary activities.

APPENDIX 2: methodology.

In the present Appendix we deal with different points related to the methodology presented in section II. First we will demonstrate that operator B is independent of relative prices; second we will show some possible uses of it, and finally we will examine certain characteristics of the actual operators calculated for the Italian economy.

1) As was affirmed in Section II, the operator B which has been constructed is independent of relative prices. The expression "independent of relative prices" should not bring to mind the concept of causation *à la* Samuelson; it means that the numerical result of B_t is the same whether B_t is calculated from matrices at current prices, at prices of a base year, or expressed in physical terms. This independence — asserted in Momigliano and Siniscalco (1980), and proved by Rampa (1981) — may be demonstrated as follows. If we denote as p the vector of relative prices for commodities 1, 2 .... n at time t, and by the superscript $\hat{}$ magnitudes expressed in physical terms (or coefficients calculated from them), it is possible to write:

$$B = (\hat{x})^{-1} (I-A)^{-1} \hat{f} =$$

$$= [(\hat{x})^{-1} (\hat{p})^{-1}] [\hat{p} (I-\bar{A})^{-1} (\hat{p})^{-1}] [\hat{p} \hat{\bar{f}}] =$$

$$= (\hat{x})^{-1} (I-\bar{A})^{-1} \bar{f}.$$

This shows that the operators B which we compare in time are in fact identical with those which we could calculate and compare if we had matrices in physical terms.

We would emphasize that B is independent of relative prices even if it is calculated starting from the matrix of technical coefficients A and from $(I-A)^{-1}$, which depend on relative prices. This apparent paradox is possible thanks to the subsequent multiplication of $(I-A)^{-1}$ by matrices $\hat{x}$ and $\hat{f}$ which in their turn depend on relative prices, so that the influence of these prices is elided.

2) In Section II we anticipated that operator B can be used to reclassify variables from branches to subsystems at different levels of detail. By disposing of a vector g and of a matrix X of direct flows of any variable (the obvious example is domestic production, but we can imagine flows of import, value added, uses of fixed capital, employment, etc.) it is possible to write:

$$\text{i)}\quad \gamma = gB$$

$$\text{ii)}\quad G = \hat{g}B$$

$$\text{iii)}\quad S_j = X\hat{b}_j$$

were b_j is one column of operator B.

In equation i), vector γ expresses the variable g by subsystem. Every element γ_j expresses the variable g vertically integrated in commodity j. Every subsystem is therefore represented by a scalar, as a vertically integrated sector.

In equation ii), matrix G is analogous to matrix L of section II. In this matrix, each column g_j indicates in its elements the total contribution of the different branches to the subsystem j. Each subsystem, then, is represented by a vector.

Lastly, in equation iii), matrix S_j represents a complete subsystem in the most detailed form. Each column i of matrix X represents the direct inputs of variable x into branch i; in the multiplication $X\hat{b}_j$ all the elements of each column i (i=1,2...n) are multiplied by the proportion in which branch i contributes to subsystem j. Matrix S_j therefore shows in detail all inputs and outputs, of all branches, which are used by subsystem j and only by it.

While vector γ describes the subsystems in the most synthetic way, aggregating all the contributions of the different branches to each subsystem, matrix S_j provides a description of the subsystem at the maximum level of detail. Between these two extremes, matrix G expresses by row and column the information relative to the branches and the subsystems, and makes it possible to see, in one and the same table, the two nexuses between disaggregated variables discussed in section IV. By these characteristics it describes branches and subsystems at a particularly appropriate level of detail for the study of certain aspects of the productive system, as discussed in Siniscalco (1982).

3) We conclude the appendix by giving some information about the actual operators B and matrices C calculated for the Italian economy. In section IV we said that the share of the branch i which is used to satisfy the final demand for commodity i is often small; we also said that, in terms of employment, the share of branch i in subsystem i is equally small. These two coefficients, shown by the elements on the main diagonal of matrices B and C, are very interesting for the analysis of the economic system. The following table shows the mean, standard deviation and the range of variation of the elements on the main diagonal of B and C of two different years.

TABLE A.1

ELEMENTS ON THE MAIN DIAGONAL OF 44x44 MATRICES B AND C FOR THE ITALIAN ECONOMY

	Mean	Standard deviation	Range of variation
Matrix B 1965	0.596	0.291	0.947
Matrix B 1975	0.579	0.298	0.845
Matrix C 1965	0.610	0.257	0.916
Matrix C 1975	0.603	0.250	0.813

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